Hampton Roads Region – **Portsmouth and Chesapeake Joint Land Use Study (JLUS)**

Topic: Roadway Flooding

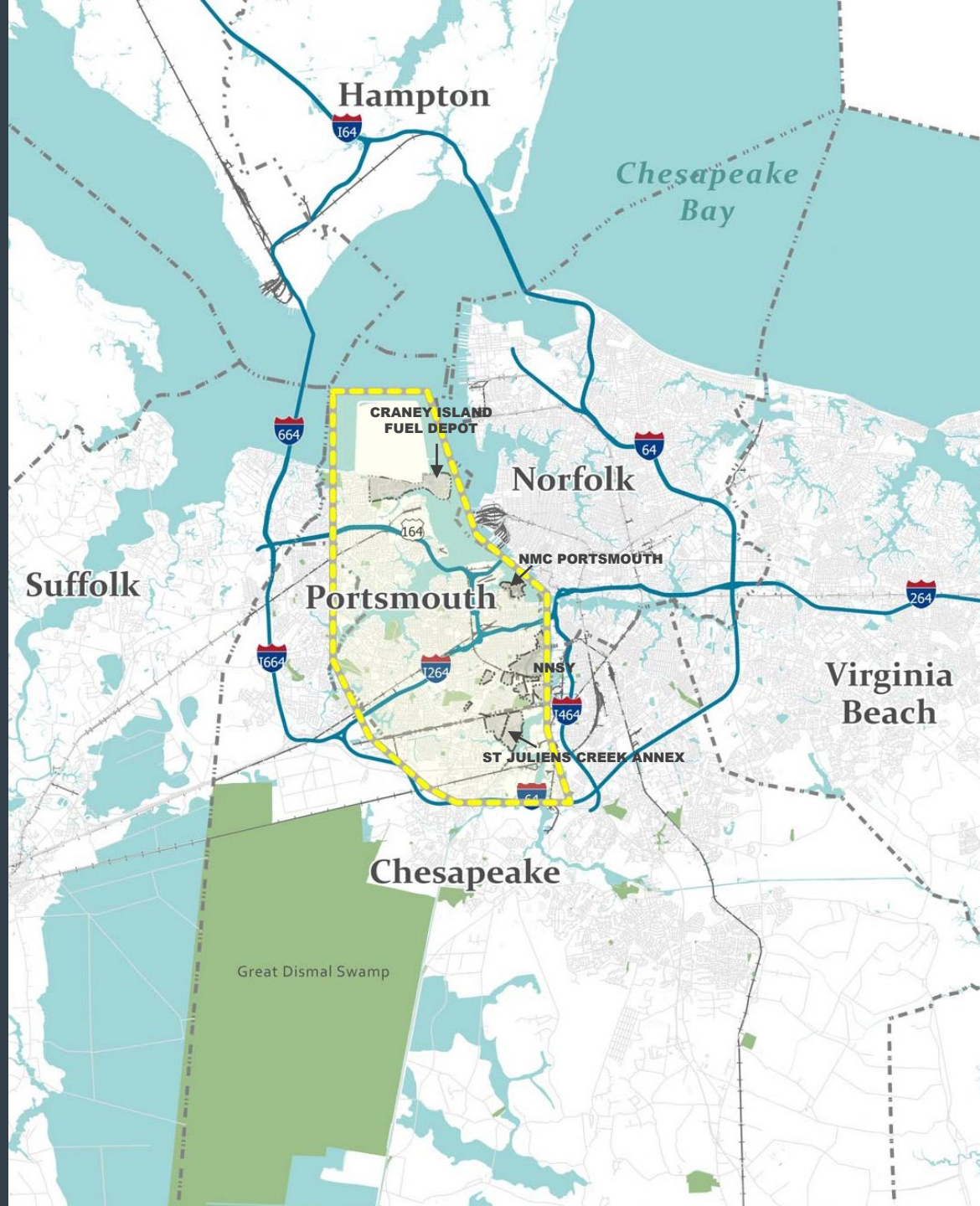
Introduction

A Joint Land Use Study (JLUS) is being prepared to address key issues that affect, or have the potential to affect, the cities of Portsmouth and/or Chesapeake, as well as the Navy's ability to conduct operations. The plan focuses on preventing future land use conflicts, addressing existing conflicts, and encouraging investment in the community that will support economic development and complement military activities.

This study is a cooperative effort among the Cities of Chesapeake and Portsmouth, the Commonwealth of Virginia, and several Navy installations in South Hampton Roads:

- Norfolk Naval Shipyard (NNSY);
- St. Juliens Creek Annex;
- Naval Medical Center (NMC) Portsmouth; and
- Craney Island Fuel Depot

The Hampton Roads Planning District Commission is the project sponsor.



Introduction

Earlier in the process, policy makers, community leaders, and citizens identified issues and priorities of common concern, including roadway flooding, limited transit and access alternatives, overflow parking, and land use conflicts. **These slides focus on roadway flooding.***

Roadway Flooding

Future rainfall and tidal flooding will impact multiple roadways used to access the installations and sea level rise will compound flooding issues over time.

Transit / Access

Transit options for installation employees are limited and bus hours of operations, routes, and transfer processes are likely deterrents to use. Gaps in the pedestrian and trail networks can also discourage the use of other transportation modes.

Parking

Limited availability of parking within a reasonable walking distance leads some Shipyard employees to search for preferable alternatives. This leads to overflow parking in the neighborhoods around the Shipyard

Land Use

Opportunities for more convenience, restaurants, or shopping near the installations exist. However, underlying environmental restrictions or local land use and zoning policies need to be considered.

***The operational impacts of roadway flooding is covered under a separate slide deck entitled Travel Demand Slides.**

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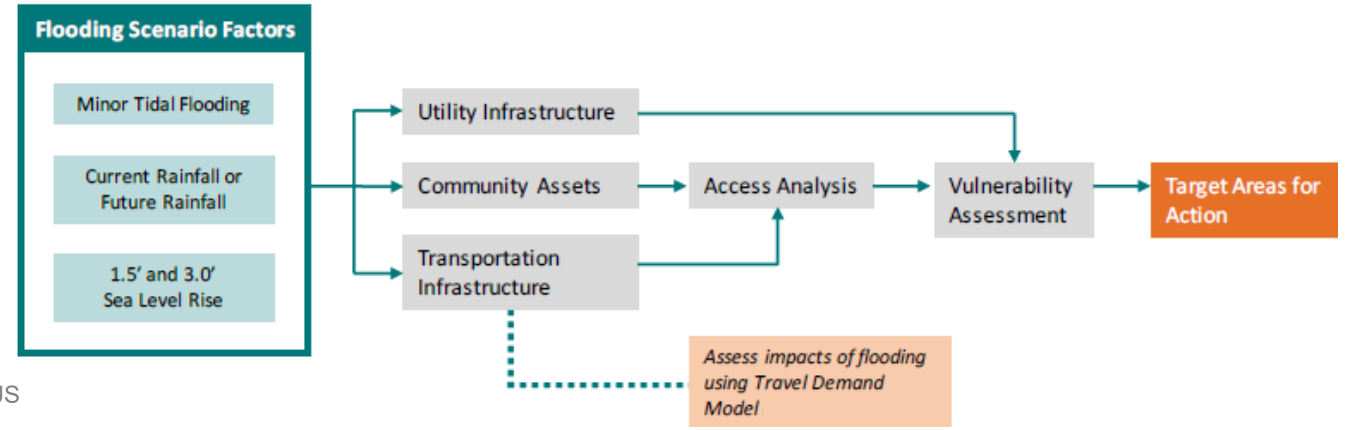
Areas Vulnerable to Flooding

- The flooding analysis for the JLUS evaluated impacts from flooding that occur on a relatively frequent basis, i.e., with a relatively high chance of occurring in any given year, as opposed to a large storm event.
- This type of flooding can reduce or block access to Navy installation gates, disrupt emergency response activities in and around the installation, and affect ability of Navy personnel to get to work.
- Flooded corridors can also prevent access to city services and more widespread disruption.
- The analysis was based on flood scenarios that used a combination of high tidal water levels and rainfall conditions and cover a range of tidal and rainfall events that would cause varying degrees of flooding today and in the future.
- The flood scenarios were used to assess impacts to different types of assets and infrastructure.



Areas Vulnerable to Flooding

- Eight flood scenarios were defined for the analysis
  - Sea Level Rise values of 1.5 and 3.0 feet were based on HRPDC planning guidance
  - A present-day 24-hour rainfall total was defined as 6.2 inches.
  - A future 24-hour rainfall total was defined as 6.8 inches

- Hydrologic and hydraulic (H&H) models of the cities' stormwater collection and drainage system were used to simulate both the high river level associated with tidal flooding and the rainfall runoff needed to evaluate the combined flooding as part of Scenarios 4 through 8.*

Scenario #	Description
Tidal Flooding with No Rainfall	
1	No Rain, No Sea Level Rise
2	No Rain, Estimated 1.5-feet of Sea Level Rise
3	No Rain, Estimated 3-feet of Sea Level Rise
Tidal Flooding with Current Rainfall Levels	
4	Current Rainfall (6.2-inches over 24 hours), No Sea Level Rise
5	Current Rainfall (6.2-inches over 24 hours), Estimated 1.5 feet of Sea Level Rise
6	Current Rainfall (6.2-inches over 24 hours), Estimated 3 feet of Sea Level Rise
Tidal Flooding with Future Rainfall Levels	
7	Future Rainfall (6.8-inches over 24 hours), Estimated 1.5 feet of Sea Level Rise
8	Future Rainfall (6.8-inches over 24 hours), Estimated 3 feet of Sea Level Rise

Note: The 1-year return period value of 2.8 feet NAVD88 is consistent with current stormwater infrastructure design practices in the JLUS partner cities and is similar to the minor tidal flooding level used in the Norfolk and Virginia Beach JLUS.

*Areas within Chesapeake were modeled by the JLUS team. Areas within Portsmouth were modeled by others, under a separate contract with Portsmouth.

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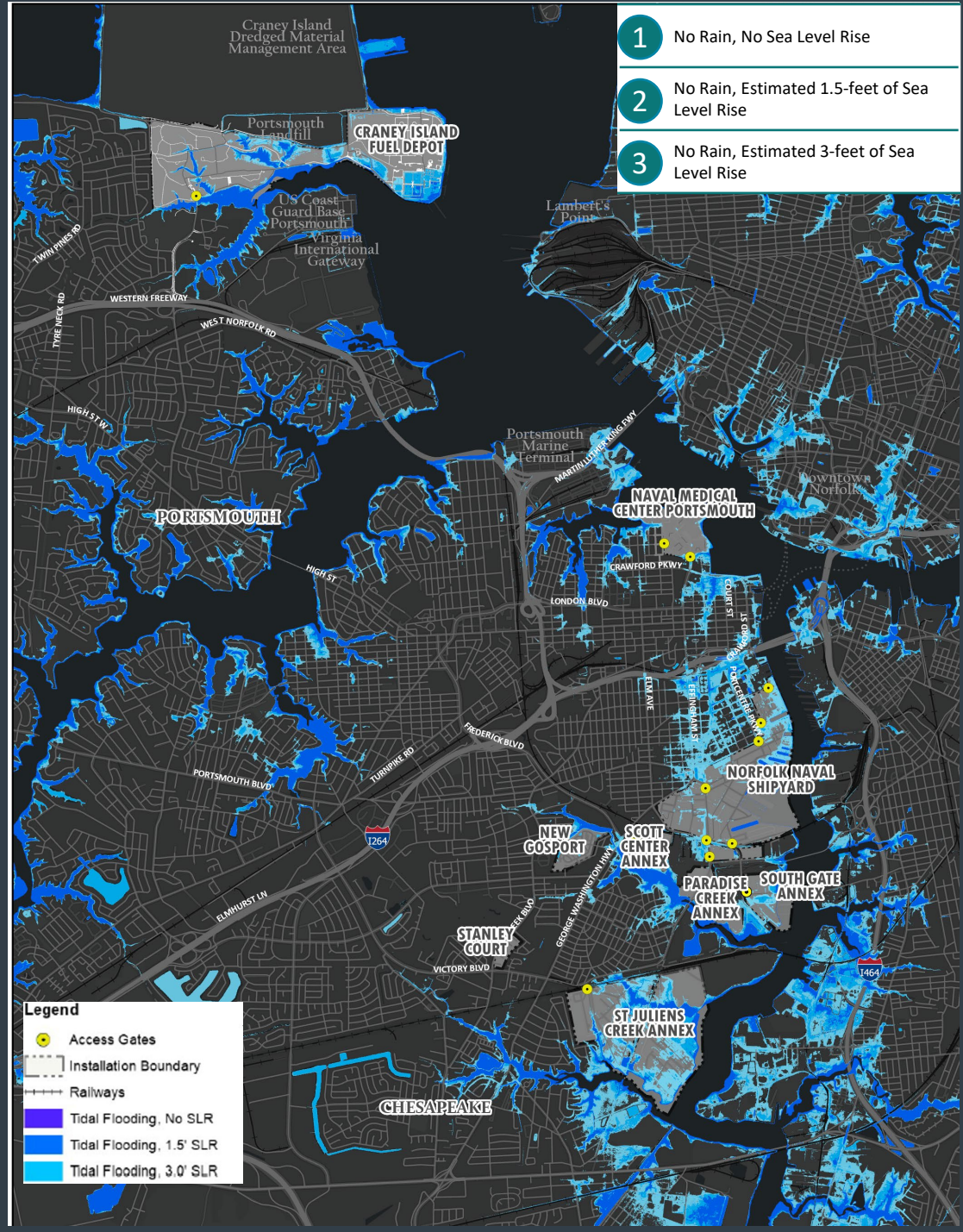
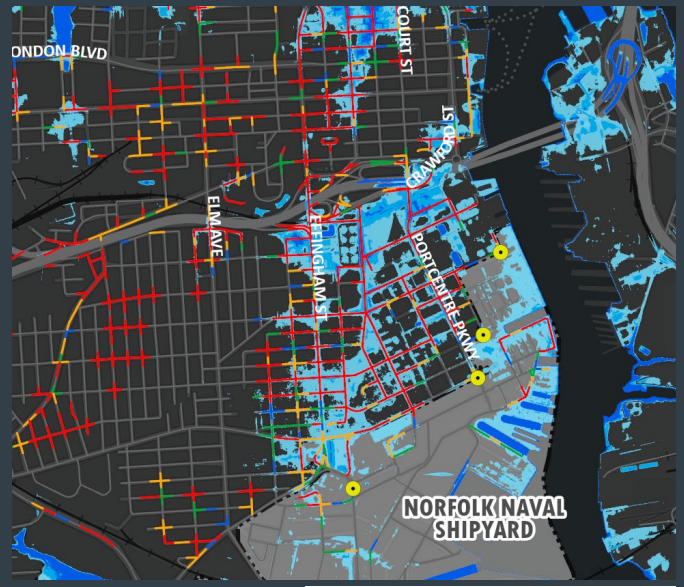
Estimated Flooding from Sea Level Rise Only (Scenarios 1, 2 and 3)

- This map illustrates the potential impact of 0, 1.5 and 3.0 feet of Sea Level Rise (no rainfall)
- Scenarios 1-3 were evaluated using the HRPDC Digital Elevation Model
- Areas along the shorelines will be impacted the most, including areas near the installations
- Heavily impacted areas include
  - Downtown Portsmouth
  - Park View
  - Effingham Street
  - Newtown/Southside
  - East side of Brighton/Prentis Park
  - Broadmoor
  - Woodland Terrace



Roadway Flooding Exposure Analysis

- Model results were brought into Geographic Information System (GIS) to visualize flooded areas and depth of flooding.
- Approximate flood depths were assigned to one of four categories:
  - < 3 inches
  - 3 – 6 inches
  - 6 – 12 inches
  - > 12 inches
- Flooding levels are shown in different colors based on approximate flood depth as shown on the example.



▲ Example depiction of estimated flood depths and the legend indicating how to read the depths

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Estimated Flooding from Sea Level Rise and Rainfall (Scenarios 5 through 8) – Near Craney Island Fuel Depot

The roadway segments affected by flooding in each scenario are shown in color.

Legend

- Access Gates
- Installation Boundary
- Railways

Street Flood Depth

- No Flooding
- Below 3 inches
- 3 - 6 inches
- 6 - 12 inches
- Above 12 inches
- Tidal Flooding, No SLR
- Tidal Flooding, 1.5' SLR
- Tidal Flooding, 3.0' SLR

5 Current Rainfall (6.2-inches over 24 hours), 1.5 feet Sea Level Rise

6 Current Rainfall (6.2-inches over 24 hours), 3.0 feet Sea Level Rise

7 Future Rainfall (6.8-inches over 24 hours), 1.5 feet Sea Level Rise

8 Future Rainfall (6.8-inches over 24 hours), 3.0 feet Sea Level Rise

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Estimated Flooding from Sea Level Rise and Rainfall (Scenarios 5 through 8) – Near the Shipyard and Hospital

The roadway segments affected by flooding in each scenario are shown in color.

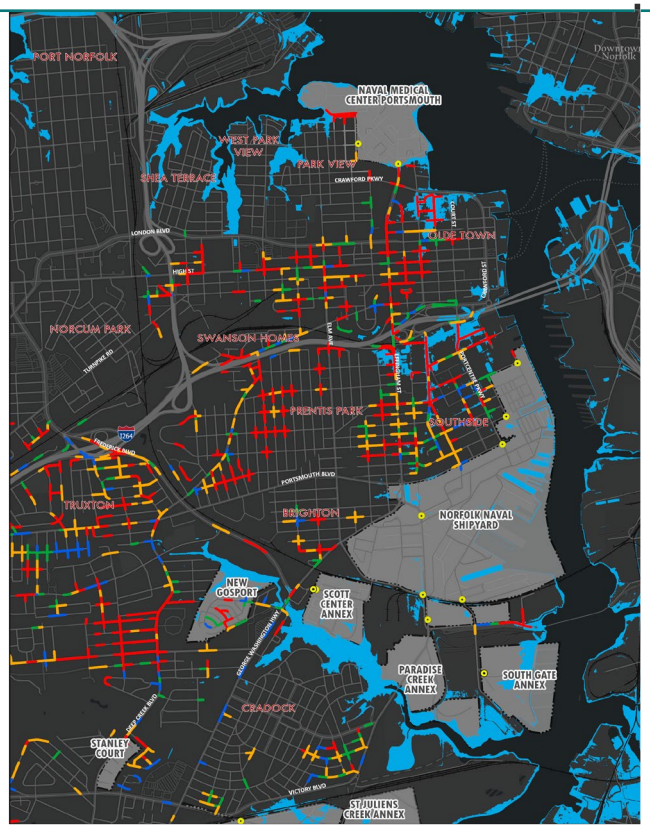
Legend

- Access Gates
- Installation Boundary
- Railways

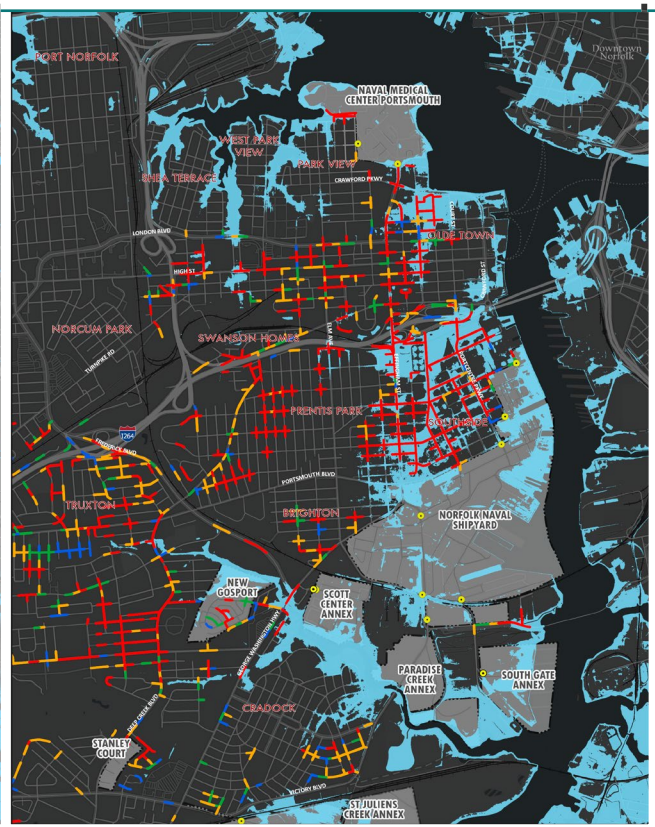
Street Flood Depth

- No Flooding
- Below 3 inches
- 3 - 6 inches
- 6 - 12 inches
- Above 12 inches
- Tidal Flooding, No SLR
- Tidal Flooding, 1.5' SLR
- Tidal Flooding, 3.0' SLR

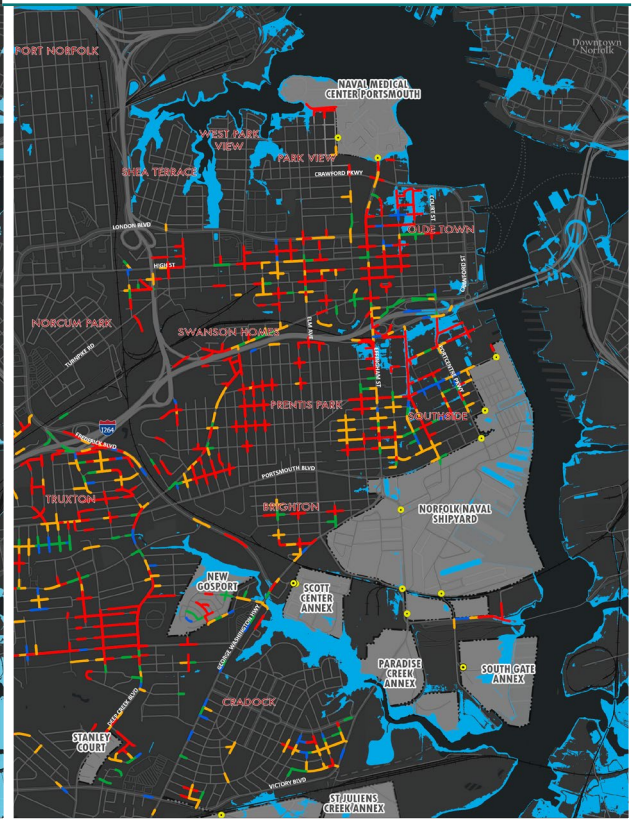
5 Current Rainfall (6.2-inches over 24 hours), 1.5 feet Sea Level Rise



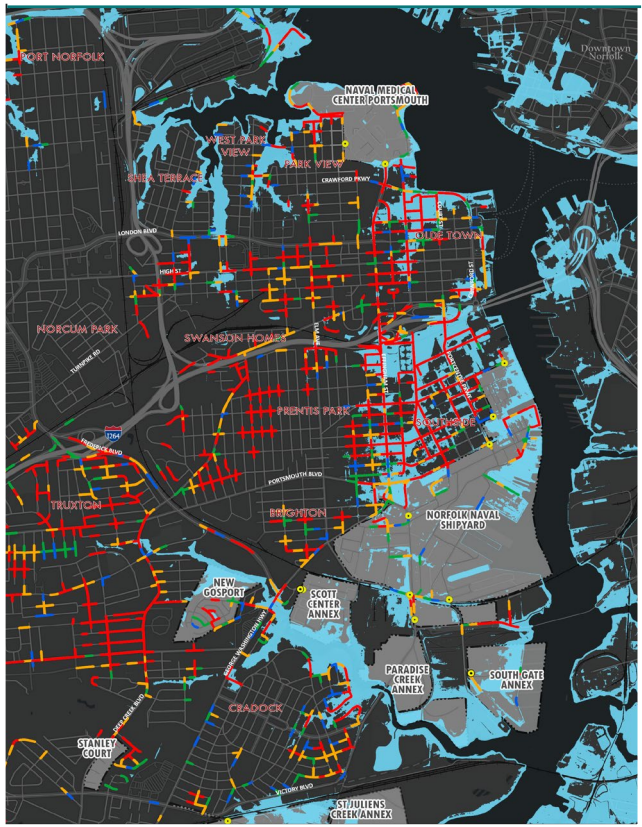
6 Current Rainfall (6.2-inches over 24 hours), 3.0 feet Sea Level Rise



7 Future Rainfall (6.8-inches over 24 hours), 1.5 feet Sea Level Rise



8 Future Rainfall (6.8-inches over 24 hours), 3.0 feet Sea Level Rise



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Estimated Flooding from Sea Level Rise and Rainfall (Scenarios 5 through 8) – Near St. Juliens Creek Annex

The roadway segments affected by flooding in each scenario are shown in color.

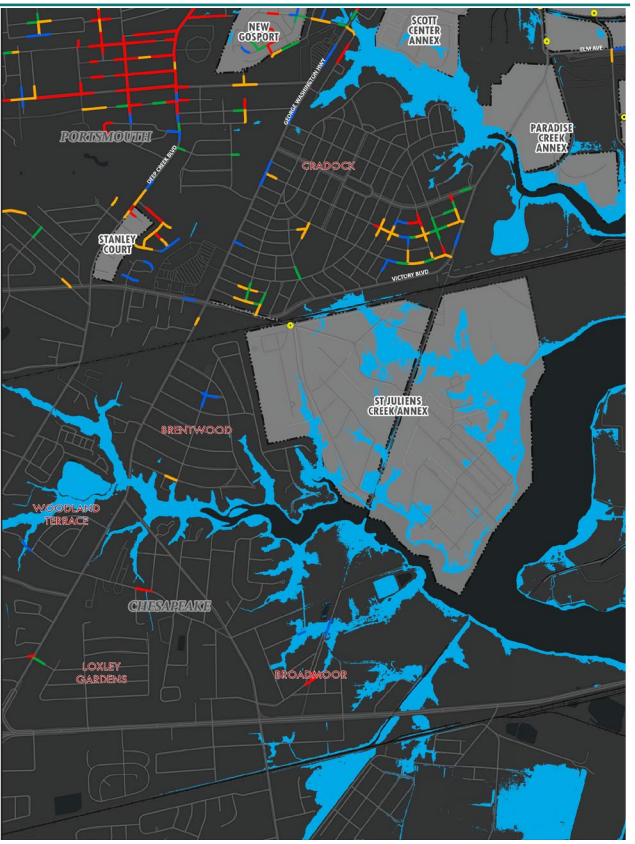
Legend

- Access Gates
- Installation Boundary
- Railways

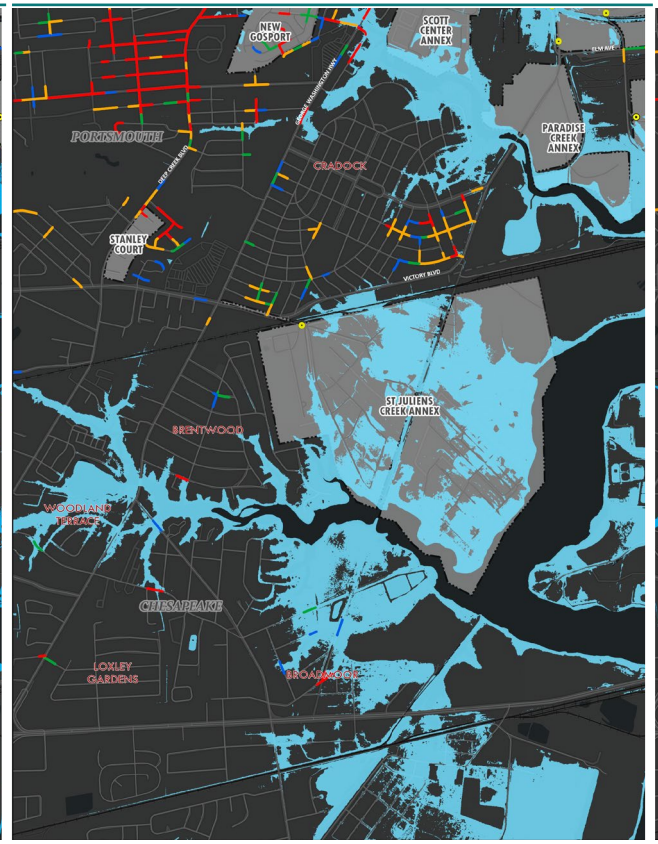
Street Flood Depth

- No Flooding
- Below 3 inches
- 3 - 6 inches
- 6 - 12 inches
- Above 12 inches
- Tidal Flooding, No SLR
- Tidal Flooding, 1.5' SLR
- Tidal Flooding, 3.0' SLR

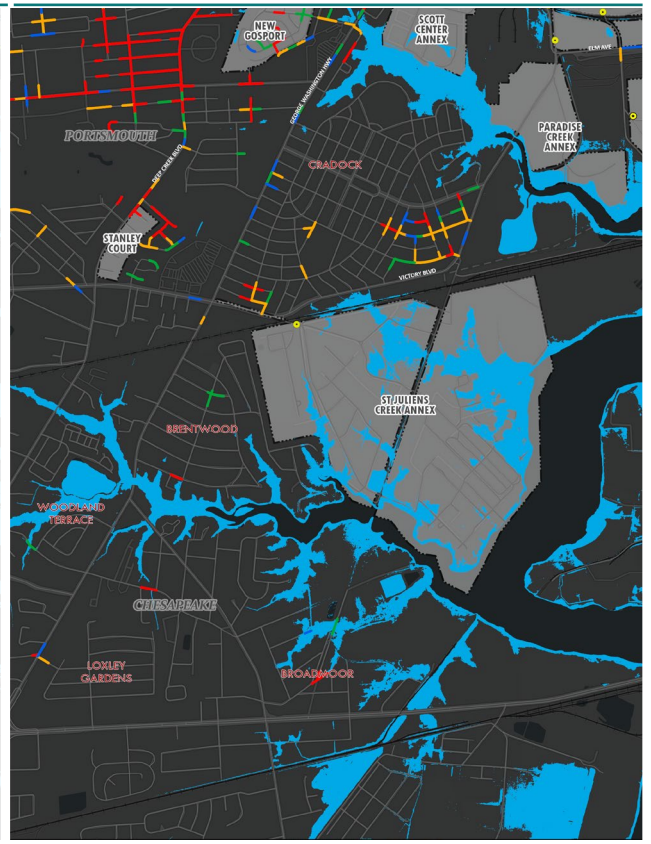
5 Current Rainfall (6.2-inches over 24 hours), 1.5 feet Sea Level Rise



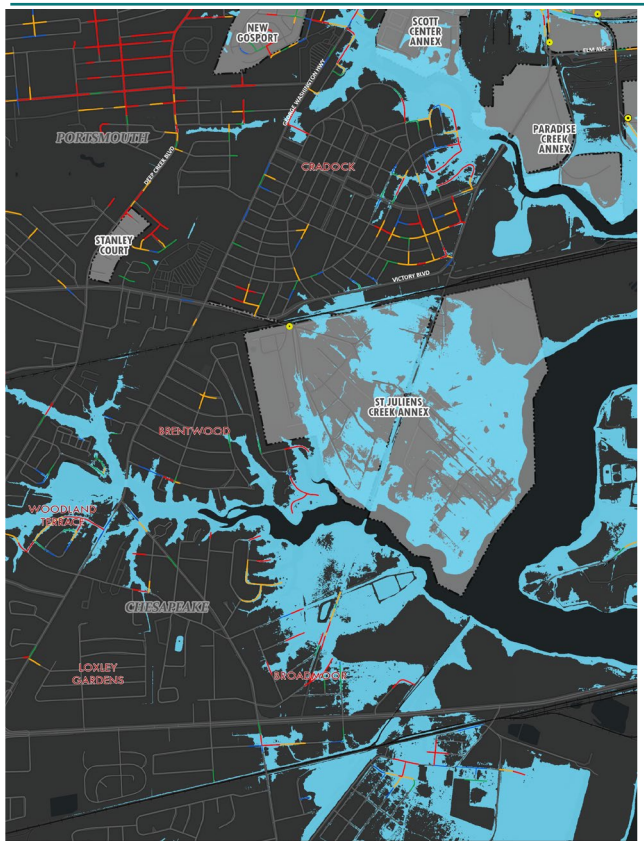
6 Current Rainfall (6.2-inches over 24 hours), 3.0 feet Sea Level Rise



7 Future Rainfall (6.8-inches over 24 hours), 1.5 feet Sea Level Rise



8 Future Rainfall (6.8-inches over 24 hours), 3.0 feet Sea Level Rise



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Roadway Flooding Exposure Analysis – Summary of Findings

- Portions of Effingham Street, Elm Avenue, Frederick Boulevard, and Portsmouth Boulevard will be directly impacted by flooding in the future – direct and indirect routes used to reach the installations
- Localized areas of flooding potentially exist on Victory Boulevard and George Washington Highway, routes that connect NNSY, Scott Center Annex, South Gate Annex, and St. Juliens Creek Annex to I-264, I-64, and Military Highway.
- On and Off-ramps to I-264 are also potentially impacted
- Travel between the Shipyard and Naval Medical Center will be more difficult, especially for emergency response
- Some segments of Cedar Lane near Craney Island Fuel Depot have the potential to flood. The main internal installation roadway is also likely to be directly impacted by flooding.

*Flood conditions will affect **multiple routes** at the same time and conditions could last a few hours to a day or more.*

This will cause traffic to shift elsewhere, increasing congestion on other corridors.

Alternate routes used today to avoid tidal or storm-based flooding will not provide the necessary relief in the future.

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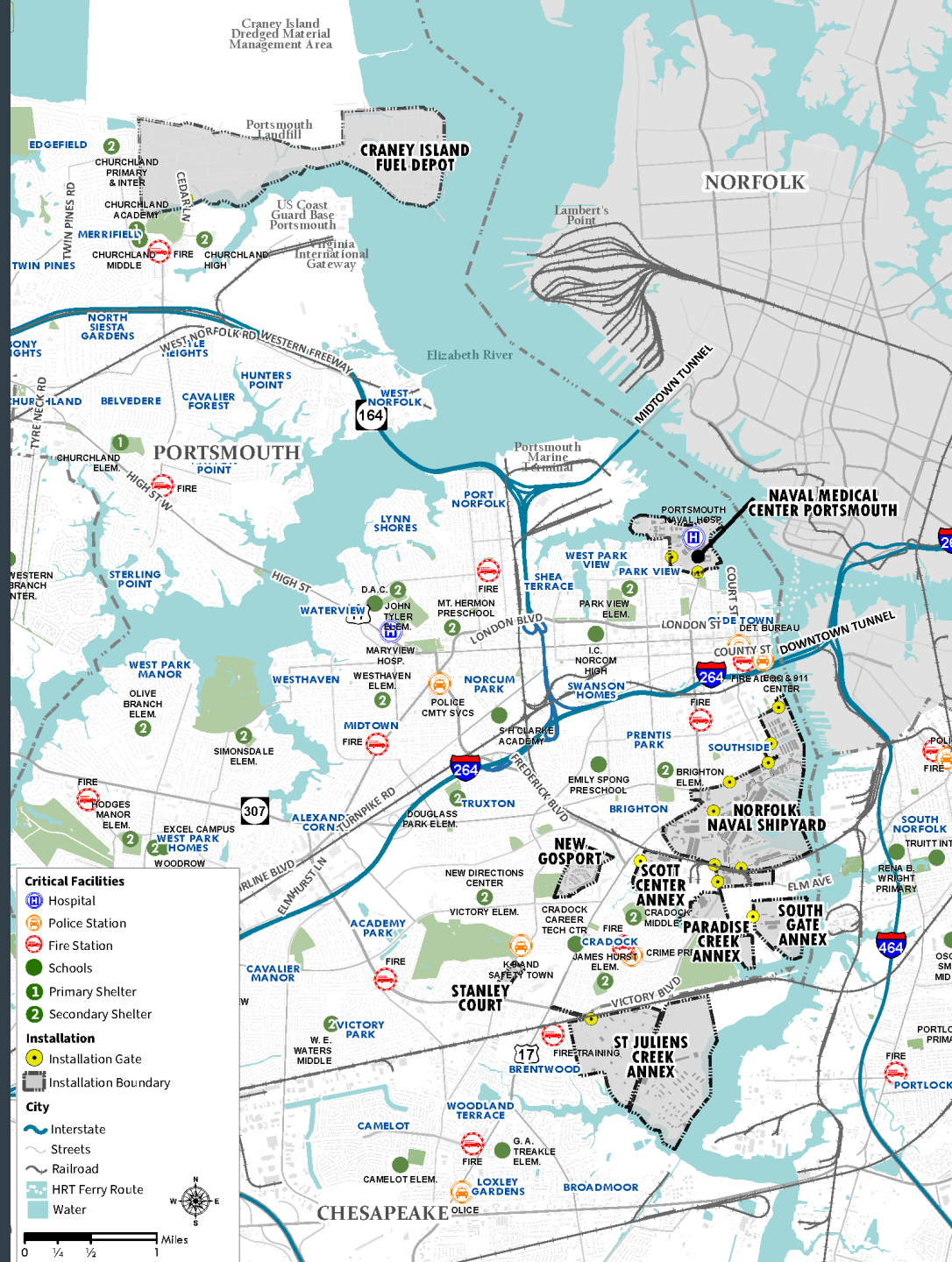
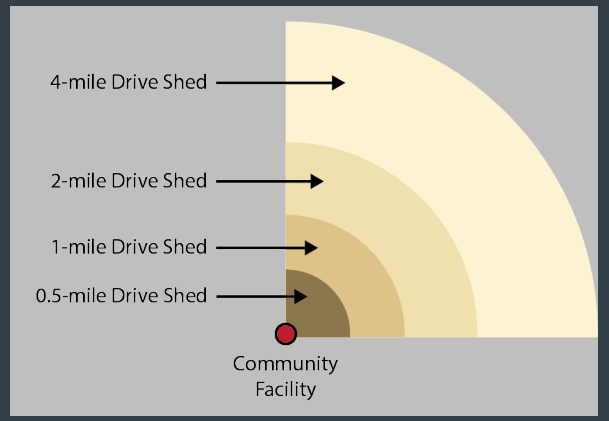
Community Facilities Flood Exposure Analysis

- Community facilities, life-safety facilities that directly serve the Navy personnel, military service members, and the broader community, are also impacted.
- 113 community facilities were evaluated to determine if the facility is exposed under tidal flooding and sea level rise (Scenario 3).
- Facilities evaluated include fire and police stations, emergency shelters, schools, emergency operations centers and Portsmouth City Hall
- The following facilities were identified as potentially impacted under Scenario 3:
  - Portsmouth City Hall
  - Portsmouth EOC and 911 Center
  - Naval Medical Center Portsmouth
  - Westhaven Elementary School
  - Fire Station #8 on George Washington Highway (Deep Creek)
  - Edwin W. Chittum Elementary School



Community Facility Access Analysis

- The same facilities were evaluated to understand potential impacts on access due to flooding.
  - This process measured the distance that could be driven from a community facility in unconstrained conditions (no flooding), versus under future flood conditions
  - The analysis used Scenario 8, 3.0-feet of Sea Level Rise and Future Rainfall (6.8-inches)
  - Driving distances (drivesheds) of 0.5-mile, 1-mile, and 2-miles, were mapped from each community facility based on the existing road networks; an additional distance of 4 miles was included for hospitals. These drivesheds illustrate the accessibility of traffic to and from a facility under constrained and unconstrained scenarios.
  - Roadways that had flooding depths of 6” or more inches were flagged as blocked for the analysis
- Under future flooded conditions, the driveshed from each facility evaluated was significantly constrained by roadways that were blocked due to flooding.
- The travel distance from a community facility could be limited in one or multiple directions.
- This analysis helped to identify areas of the community that might experience a reduced level of service.



◂ Driving distances are illustrated using stepped colors on the maps.

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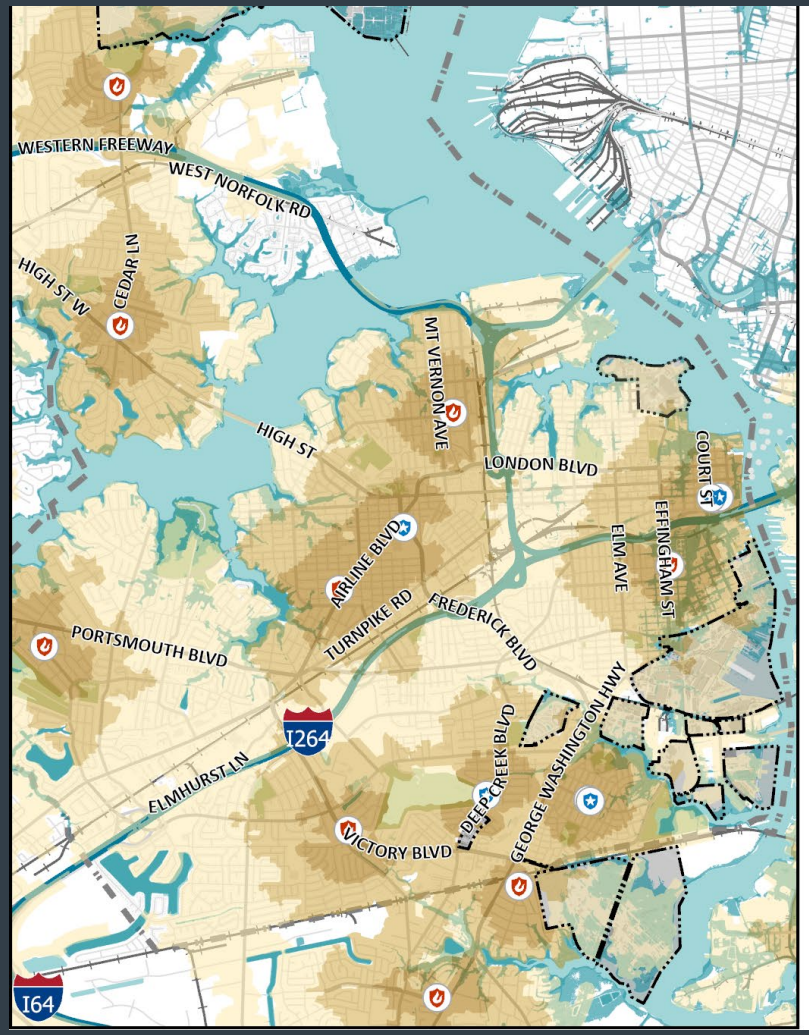
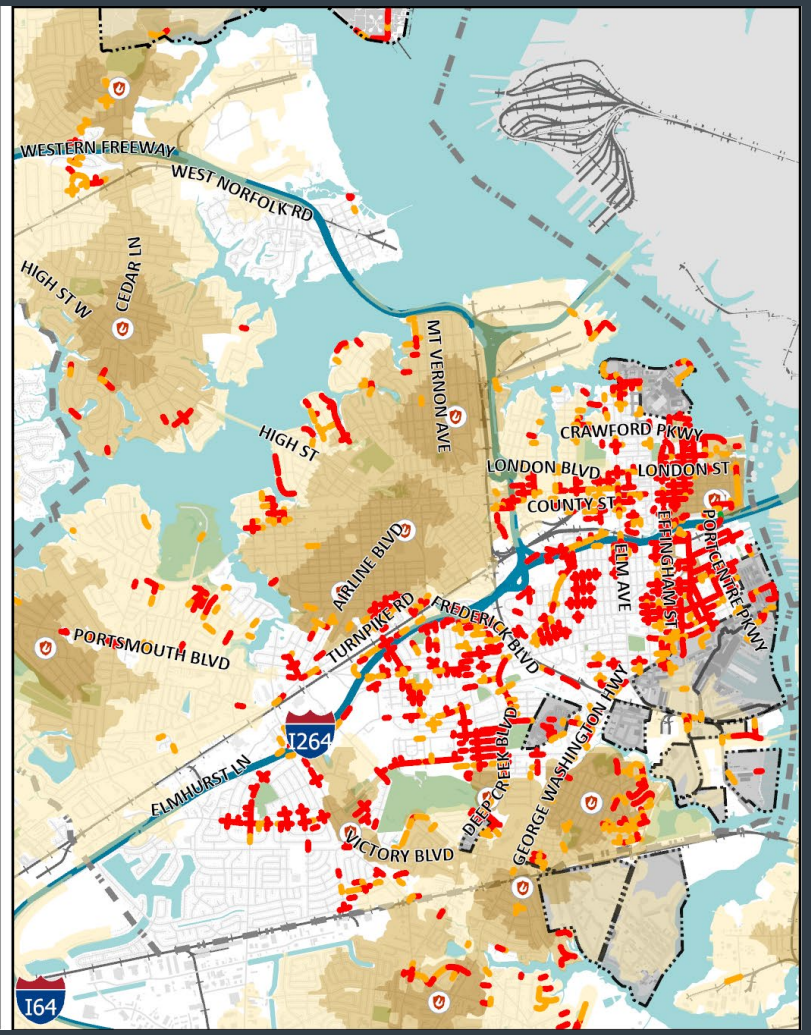
Community Facility Access Analysis – Fire and Police Facilities
Future Rainfall (6.8-inches over 24 hours) and 3.0 feet of Sea Level Rise

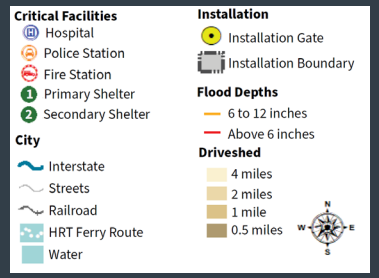
- Constrained drivesheds show significant access impacts for fire and police services south of I-264, in Downtown Portsmouth, and in areas around the Norfolk Naval Shipyard and the Naval Medical Center Portsmouth.

Unconstrained Fire and Police Access



Constrained Fire and Police Access





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