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

Topic: Roadway Flooding – Impacts on Roadway Operations

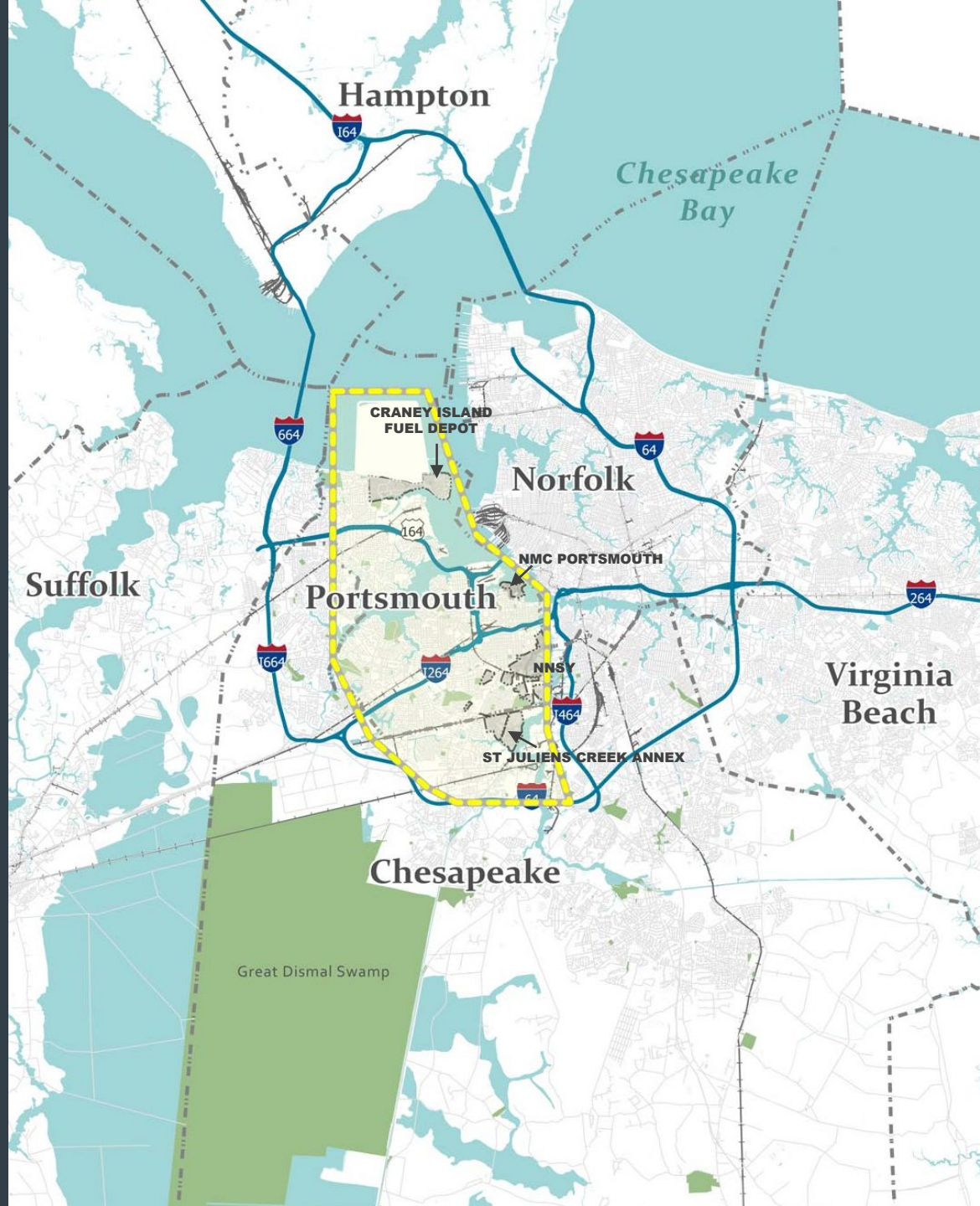
Introduction

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 how roadway flooding affects roadway operations.**

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.

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Analysis of Flooding Impacts on Travel

- An analysis was done to understand the impacts that anticipated future flood conditions could have on vehicle operations (i.e., congestion).
- This analysis provided a more detailed understanding about how trips are affected and how traffic responds to flooded roadway conditions based on existing roadway capacity.
- The 2045 Hampton Roads Long Range Travel Demand Model (TDM) was used to model capacity reductions due to anticipated future flood conditions and to report the resulting traffic operational metrics for further consideration.

Image Source: Virginian Pilot

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Analysis of Flooding Impacts on Travel

- The TDM analysis was completed using four (see table to right) of the flood scenarios.
- The process included the following steps:
  1. Overlay the flood scenarios onto the TDM roadway network.
  2. Classify flooding impacts into 4 flood depth categories for each roadway. (classifications shown below)
  3. Simulate operational impacts that would occur due to flooding by adjusting model factors. (middle column below)
  4. Rerun the model using the model adjustments to illustrate how flooding impacts the traffic model results.

Estimated Roadway Flood Depth	Model Adjustment	Explanation
Less than 0.1 inch	No adjustment	Surface flooding. Cars proceed as usual.
0.1-inch to 3-inches	Reduced speed to 25 MPH	Surface flooding and puddles. Traffic slows but cars continue to use roadway.
3-inches to 6-inches	Reduced speed to 25 MPH Reduced capacity by 50%	Large and deep puddles and ponding, especially along the edges. Traffic slows and sections of road are impassable by many.
More than 6-inches	Reduced capacity by 100%	Deep ponding. Roadway is obstructed and dangerous. Most vehicles cannot pass.

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

▲ The four flood scenarios used to analyze traffic impacts are highlighted.

◀ Flood depth classifications and associated model adjustments made to simulate flooding impacts.

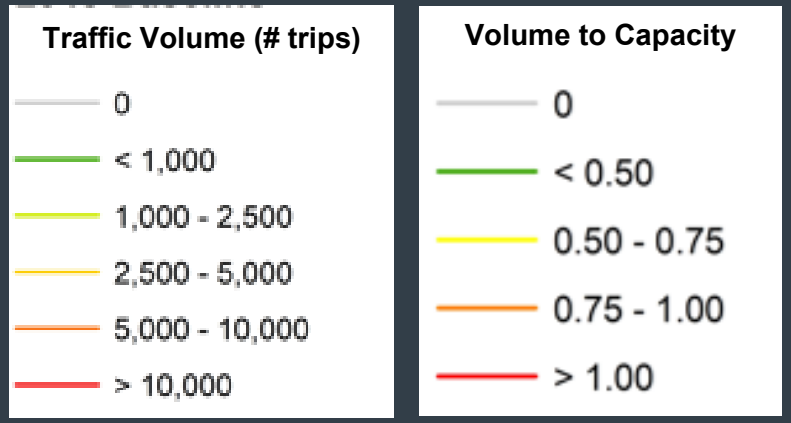
Analysis of Flooding Impacts on Travel

– The TDM results reported the following factors:

- Unmet Demand – The number of trips that were not able to be counted because flooded road segments prevented the trips from being loaded onto the network. In other words, flooded segments blocked travel. The example shows blocked links in black that prevent other links (grey) in the network from functioning.
- Traffic Volume – Measures the amount of traffic or number of trips on the roadway. Maps depicting volume can also show how traffic is diverted to other routes when roads are flooded.
- Roadway Capacity – The volume-to-capacity (V/C) score measures the level of traffic using a roadway as compared to how much traffic the roadway can carry (during flood conditions).
  - V/C scores of 0 indicates volume is below capacity (good/no congestion)
  - V/C scores greater than 1.0 indicate volume that exceeds capacity (bad/higher congestion)

* The TDM does not include local roadways as it is meant for regional analyses but does include major roads such as freeways, arterials, and collectors

Unmet Demand Example



Traffic Volume and Volume to Capacity Keys

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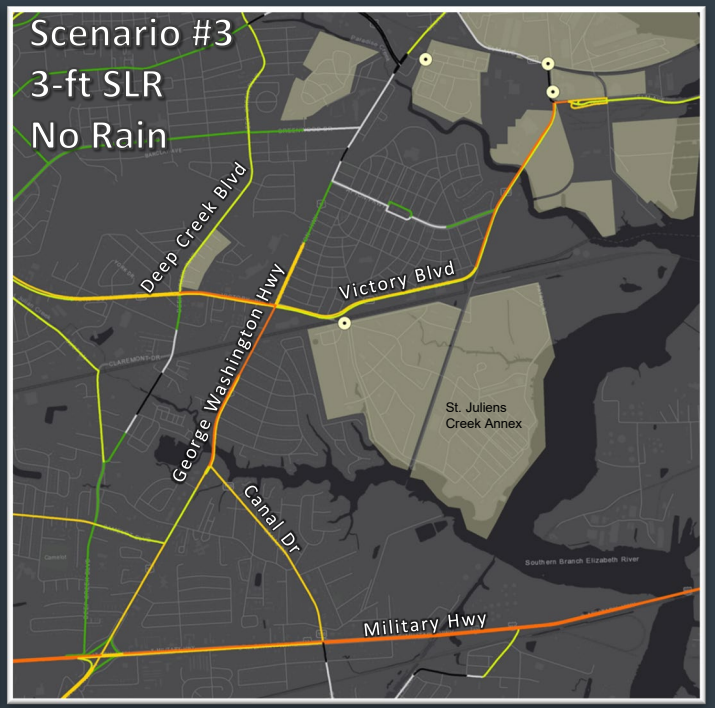
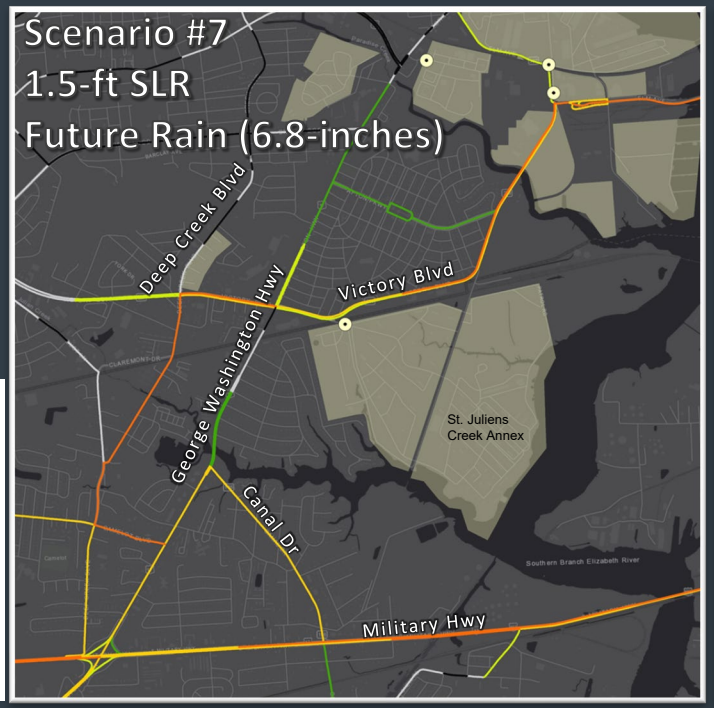
Observations: Traffic Volume Near Craney Island, NNSY, and NMCP

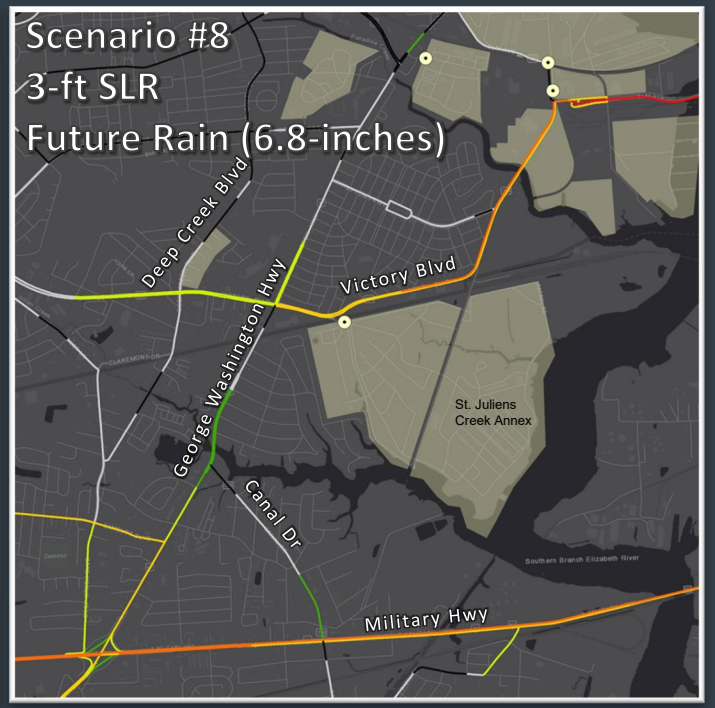
- Flooding on routes that directly serve primary installation gates will cause traffic to shift elsewhere, increasing congestion on other corridors.
- Several areas have no volume measurement (black or grey on map) because either the roadways is being flooded, or the access to the roadways is being flooded. In several areas with no volume, vehicle trips could not be loaded onto the network because of the flooding.
- Traffic reroutes to major roadways where available.
  - Victory Boulevard, I-264, and the Jordan Bridge see increased traffic levels
  - In many cases, there are no accessible alternate routes in Scenarios 7 and 8.

Observations: Traffic Volume Near St. Juliens Creek Annex

- Future rainfall in Scenarios 7 and 8 causes trips along some portions of George Washington Highway to be blocked from the network. The same issue occurs along Canal Drive.
- Increased congestion along Victory Boulevard and Military Highway also occurs.





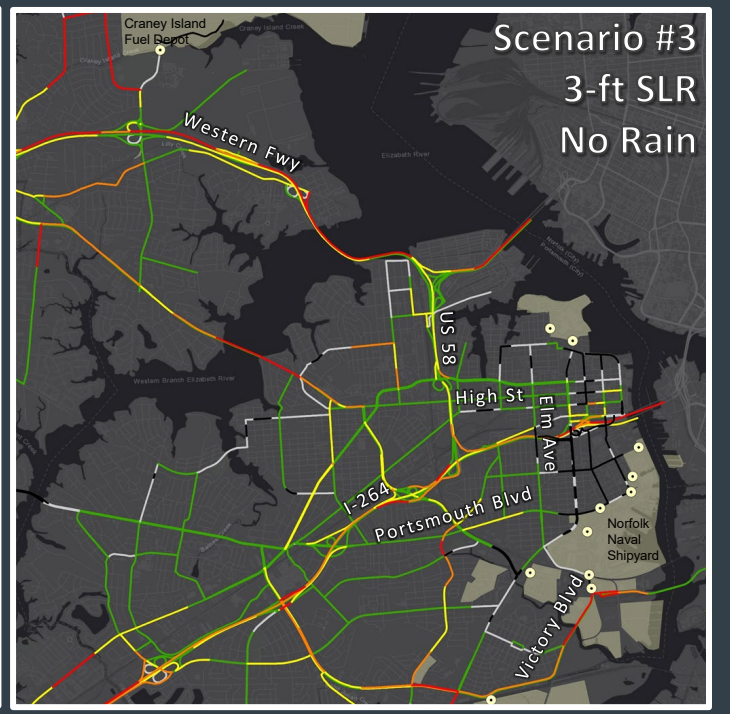


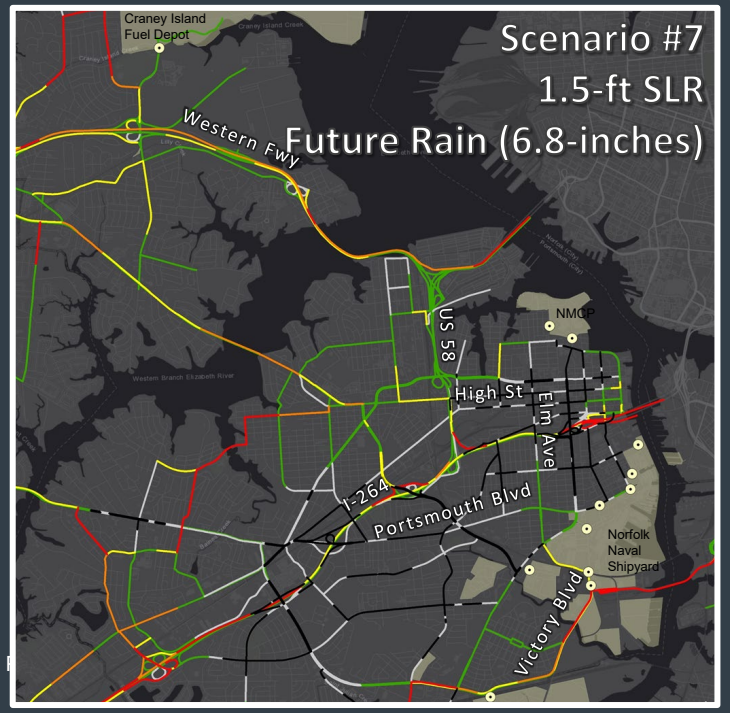
Traffic Volume (# trips)

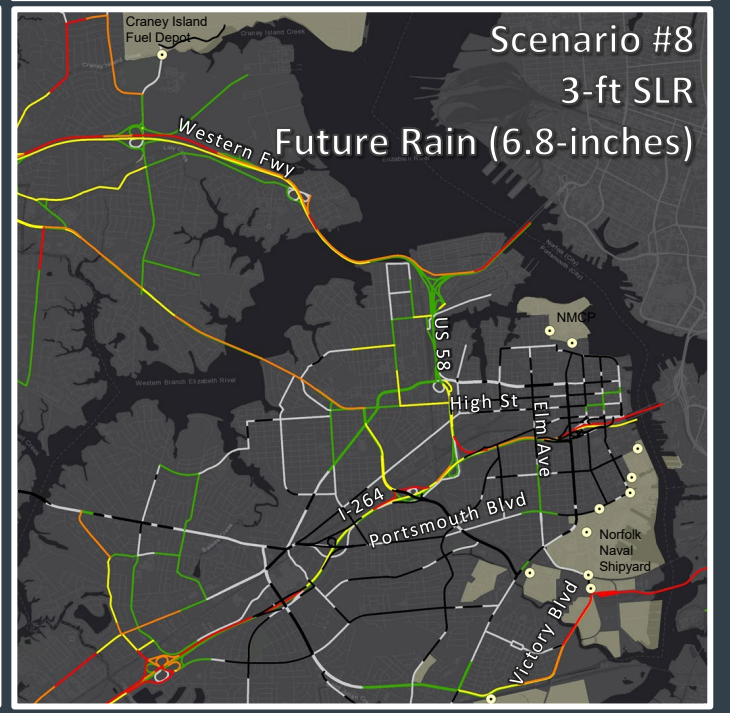
- 0
- < 1,000
- 1,000 - 2,500
- 2,500 - 5,000
- 5,000 - 10,000
- > 10,000

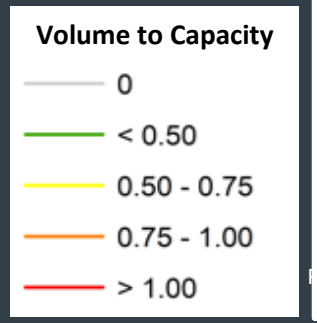
Observations: Roadway Volume to Capacity

- Many of the roadways around downtown Portsmouth and the Shipyard have a V/C ratio of 0. This correlates to areas of unmet demand, meaning that trips were unable to be loaded onto the network due to roadways being blocked due to flooding.
- The Western Freeway and I-264 also see traffic volume exceed capacity.



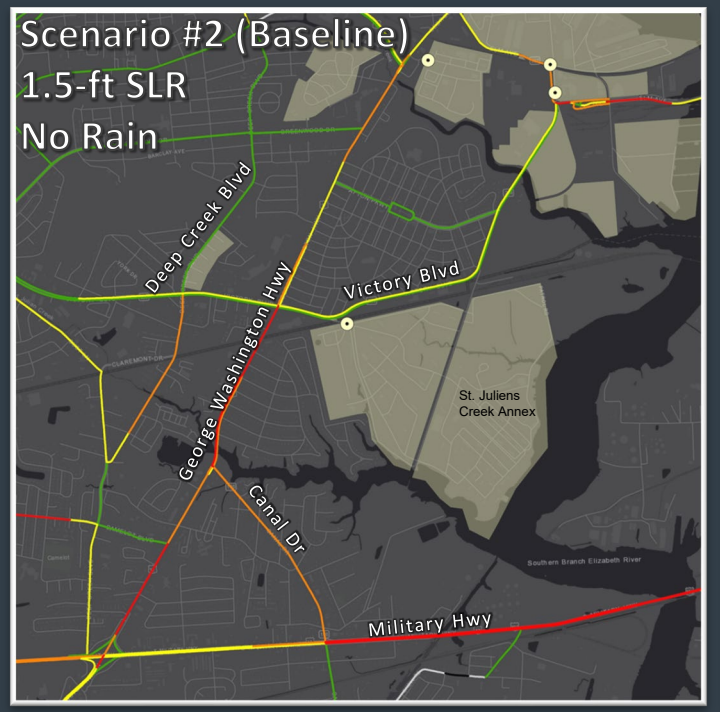


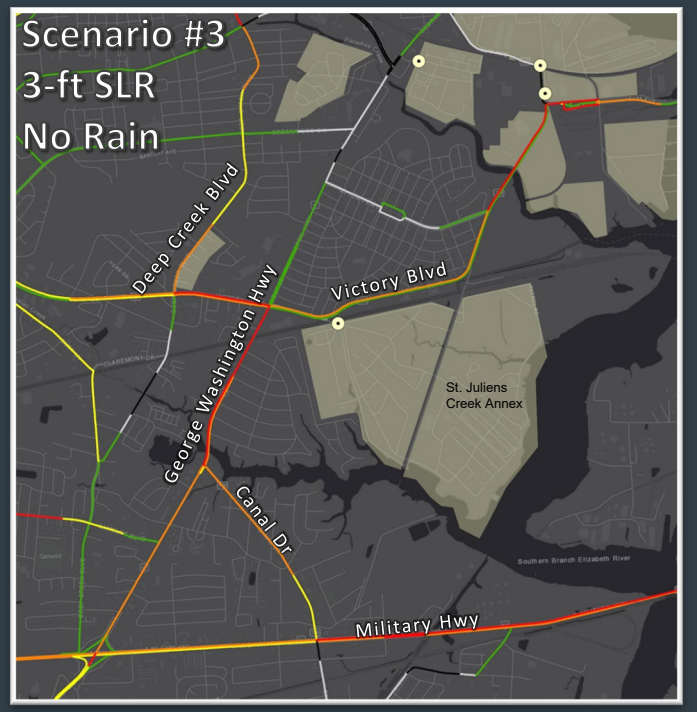


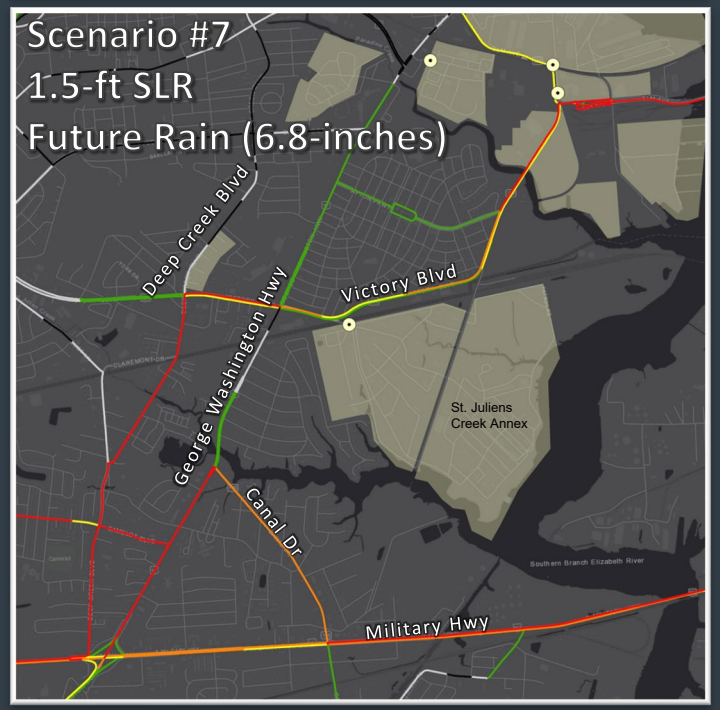


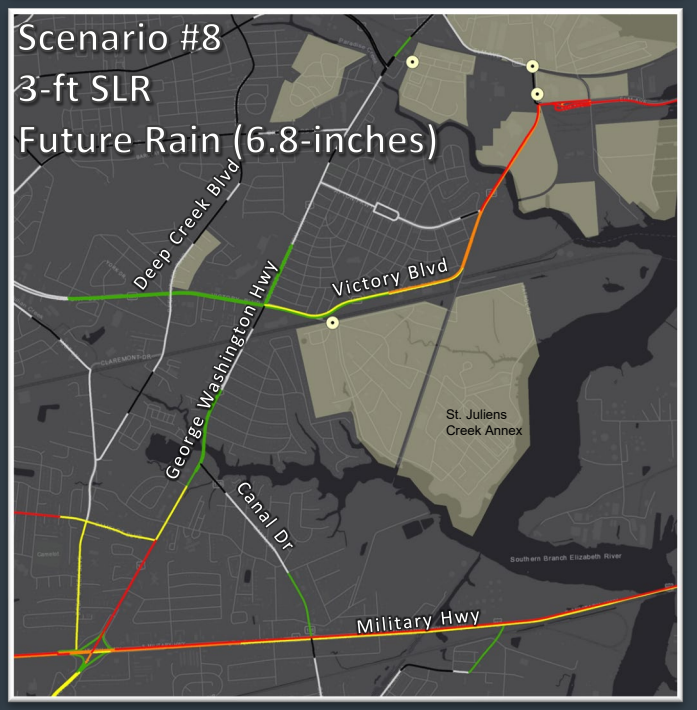
Observations: Roadway Volume to Capacity

- Victory Boulevard experiences high levels of traffic in all flood scenarios which causes Victory Boulevard's volume to exceed capacity and leads to a low level of service.
- The Jordan Bridge, George Washington Highway, and Military Highway also see traffic volume exceed capacity.









Volume to Capacity

- 0
- < 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- > 1.00

Impact of Flooding on Installation Accessibility

- Gates 1 and 2 at Naval Medical Center Portsmouth are expected to become inaccessible under all modeled future flood scenarios.
- Norfolk Naval Shipyard gates and Cedar Lane at Craney Island Fuel Depot are expected to be inaccessible under the scenarios with 3' SLR.
- Victory Boulevard from NNSY to George Washington Highway open to traffic during all modeled scenarios.

Summary of model results related to installation access			Future Flooding Scenario			
			No Rain		Future Rainfall (6.8-inches over 24 hours)	
Installation	Area	Location	1.5 feet SLR #2 (Baseline)	3.0 feet SLR # 3	1.5 feet SLR # 7	3.0 feet SLR # 8
NMCP	Gates	Gates 1 & 2	●	✖	✖	✖
	Effingham St	North of London Blvd	●	✖	✖	✖
		London Blvd to I-264	●	●	✖	✖
	Elm Ave	North of London Blvd	●	✖	✖	✖
		London Blvd to I-264	●	●	✖	✖
NNSY/ St. Juliens Creek Annex	Gates	North Gates (3, 10, 10B, 14A)	●	✖	✖	✖
		Main Gate (15)	●	✖	●	✖
		Southern Gates (29, 36)	●	✖	●	✖
		Scott Center Annex	●	●	✖	✖
		St. Juliens Creek Annex	●	●	●	●
	Elm Avenue	George Washington Hwy to Victory Blvd	●	✖	●	✖
	Victory Boulevard	NNSY to George Washington Hwy	●	●	●	●
		George Washington Hwy to I-264	●	●	✖	✖
Craney Island	Gate	Cedar Lane	●	✖	●	✖

● *Accessible Roadway*

✖ *Flooded Roadway*

Key Takeaways – Naval Medical Center Portsmouth Area

The analysis of flooding impacts and potential improvements highlight the importance of **Effingham Street, north of I-264, as a critical facility within the roadway network.**

- Flooding blocks Effingham Street and access to NMCP
- Access to I-264 and U.S. 58 is blocked
- Alternative access to I-264 via other City roadways is not feasible due to widespread flood impacts

When the flooding impacts were removed and capacity and speeds were returned to normal, the model showed:

1. Effingham Street provides a direct connection between NMCP and I-264
2. Greater reliance on I-264, U.S. 58, and Western Freeway (State Route 164) compared to local roadways
3. Drivers rely on Effingham Street to provide alternative routes to other flooded east-west roadways

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Key Takeaways – Shipyard North

The analysis of flooding impacts and potential improvements highlight the importance of **Effingham Street** as a critical connection south of I-264.

- Flooding blocks Effingham Street and access to/from NNSY
- Access to I-264 is blocked
- Portsmouth residents and NNSY staff cannot traverse the transportation network between Effingham Street and Port Centre Parkway

When the flooding impacts were removed and capacity and speeds were returned to normal, the model showed:

1. Effingham Street provided a direct connection between NNSY and I-264
2. An increase in drivers relying more on I-264 and less on U.S. 58, Western Freeway, and other critical City roadways
3. Less reliance on the Jordan Bridge

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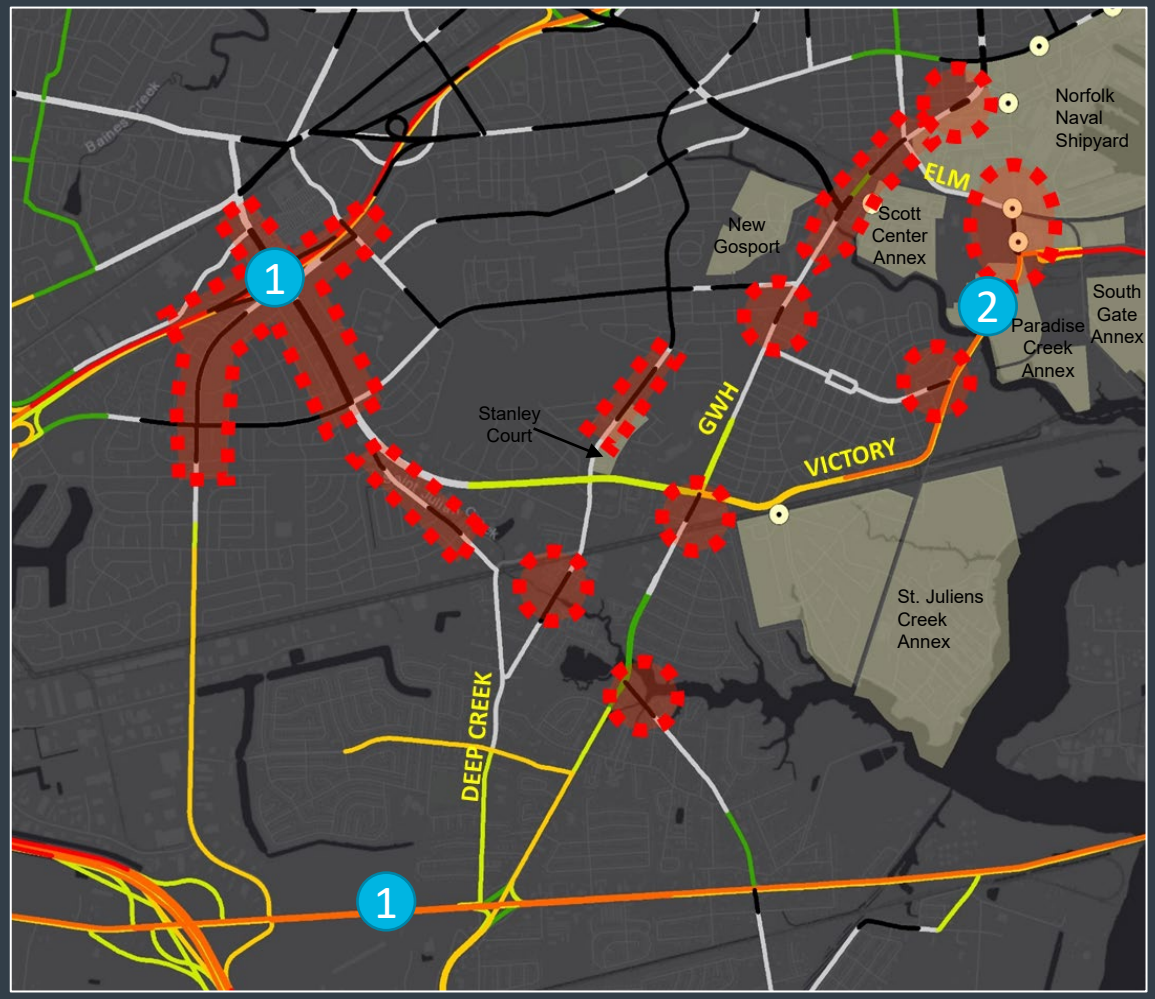
Key Takeaways – Shipyard South

The analysis of flooding impacts and potential improvements illustrate the importance of critical corridors south of NNSY.

- Flooding blocks I-264 access and key arterial connections south and west of NNSY

When the flooding impacts were removed and capacity and speeds were returned to normal, the model showed:

1. Improved access to both I-264 and I-64
2. Victory Boulevard and George Washington Highway are critical facilities for providing roadway connectivity to/from NNSY and St. Julien's Creek Annex
3. Less reliability of U.S. 58, Western Freeway, and several other major arterials north of NNSY



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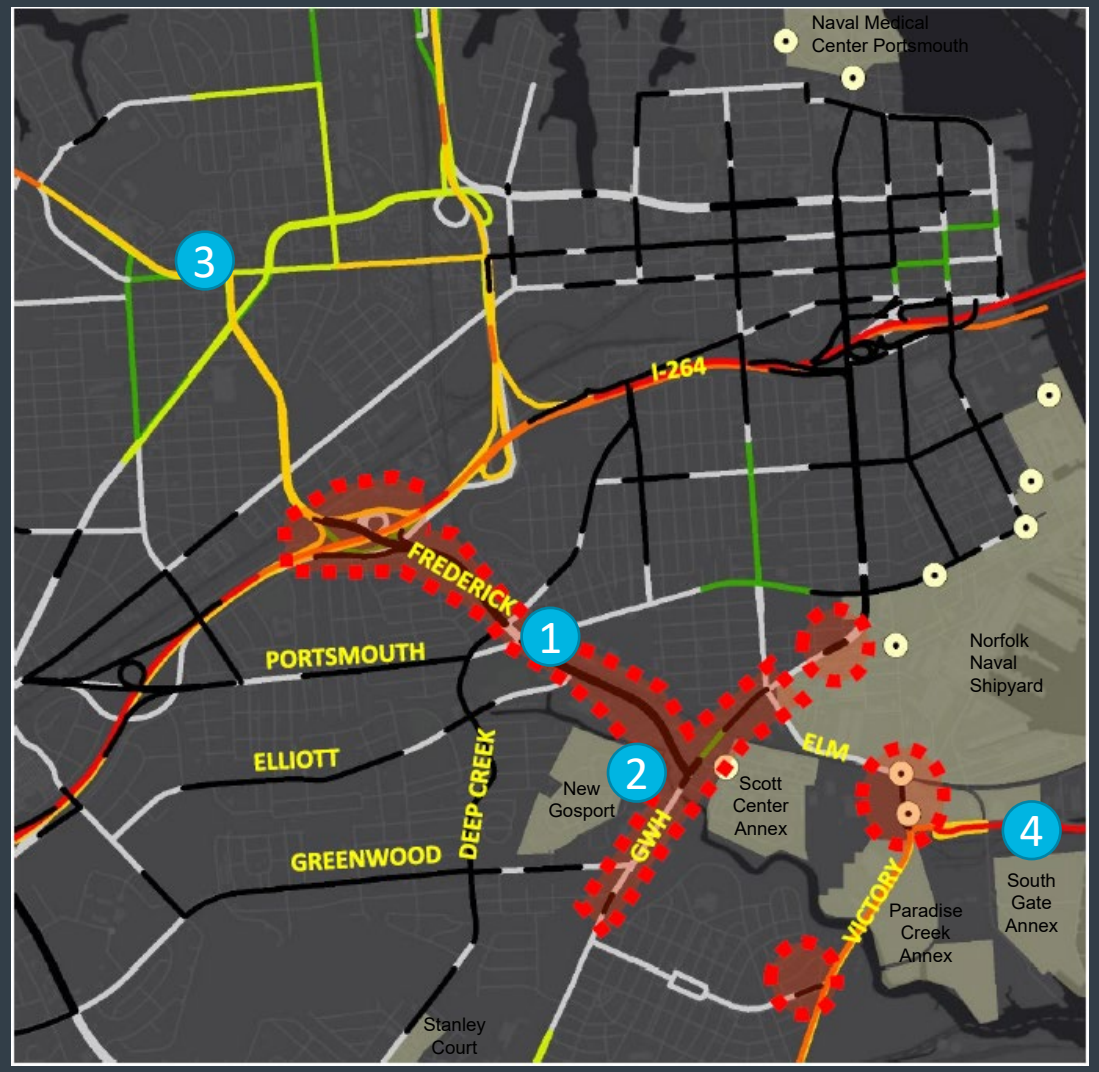
Key Takeaways – Frederick Boulevard

The analysis of flooding impacts and potential improvements illustrate the importance of **Frederick Boulevard** and **George Washington Highway**.

- Flooding blocks Frederick Boulevard and access to NNSY
- No access to I-264 or George Washington Highway

When the flooding impacts were removed and capacity and speeds were returned to normal, the model showed:

1. Frederick Boulevard provides a connection between NNSY and I-264
2. Frederick Boulevard acts as a prominent commuter route for NNSY staff
3. An increase in drivers relying more on I-264 and less on U.S. 58, Western Freeway, and other critical City roadways
4. Less reliance on the Jordan Bridge



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Key Takeaways – Victory Boulevard and Portsmouth Boulevard

The analysis of flooding impacts and potential improvements illustrate the importance of **Victory Boulevard** and **Portsmouth Boulevard**.

- Flooding blocks I-264 interchanges and key sections of Portsmouth Boulevard and Victory Boulevard
- Traffic is either unable to enter the network or is forced to use few remaining viable routes

When the flooding impacts were removed and capacity and speeds were returned to normal, the model showed:

1. Victory Boulevard provides a connection to I-264 and reduces reliability of the Greenwood Boulevard interchange
2. Victory Boulevard provides direct access between NNSY, St. Julien's Creek Annex, and I-264
3. There was reduced reliance of U.S. 58, Western Freeway, and High Street with Portsmouth Boulevard and Victory Boulevard becoming viable routes again

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Key Takeaways – Cedar Lane

Flooding issues along **Cedar Lane** were minimal, but the roadway is vital because it provides the only access to Craney Island Fuel Depot.

When the flooding impacts were removed and capacity and speeds were returned to normal, the model showed:

1. Reliable access to Craney Island Fuel Depot's main gate.
2. Improvements internal to the installation provide access to the fuel depot facilities.

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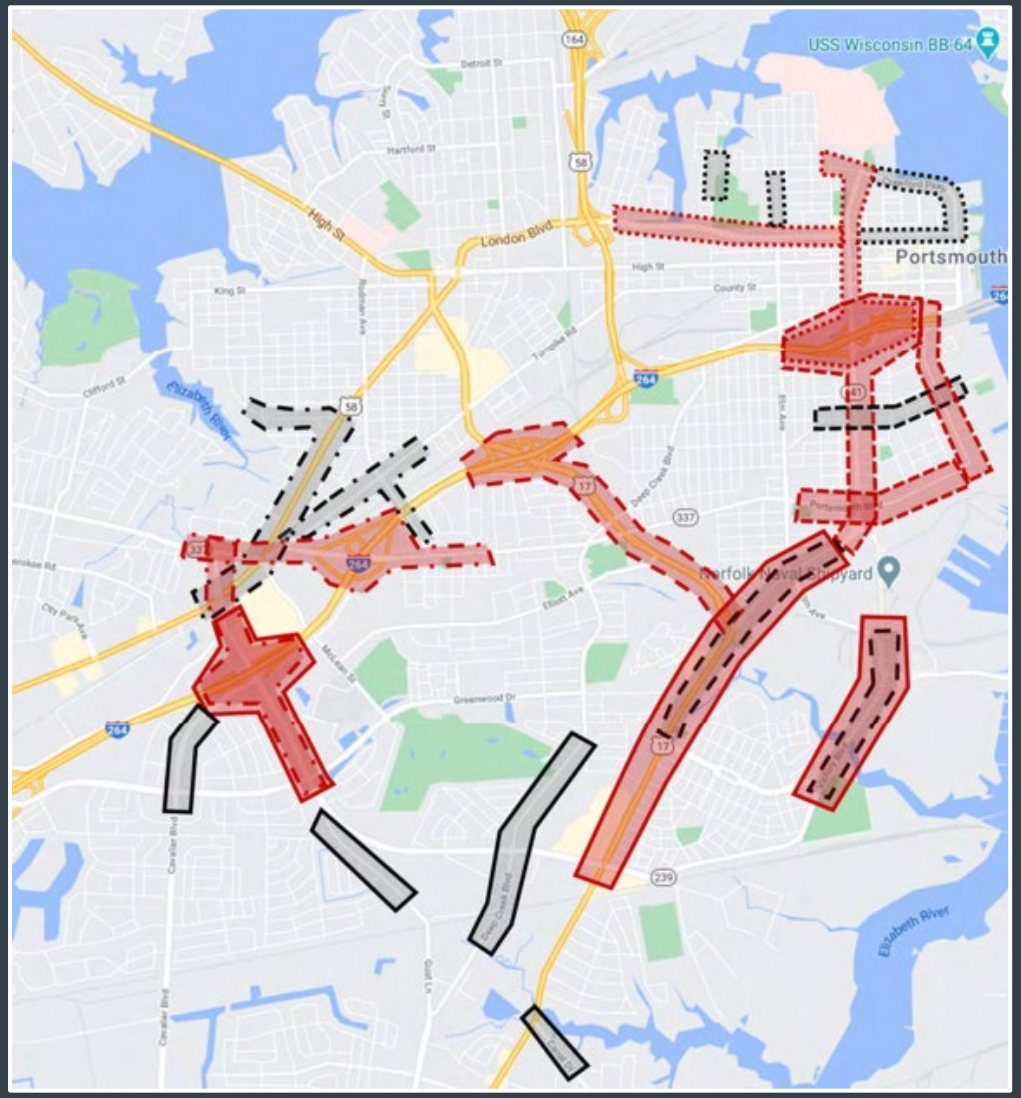
What We Learned

- Based on the flood analysis findings within each smaller sub area, the following corridors were given high priority for exploring and developing potential flood mitigation strategies:
  - Effingham Street (north and south of I-264)
  - Portsmouth Boulevard
  - Victory Boulevard
  - Frederick Boulevard
  - George Washington Highway
  - Cedar Lane (While not part of a final improvement package, Cedar Lane serves as the only ingress and egress roadway at Craney Island Fuel Depot)



Red + black areas = all roads that were studied in more detail

Red areas represent recommended priority roadways or segments for action

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