Hampton Roads Transportation Planning Organization

Integrating Resilience into Planning

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Principal Transportation Planner

the heartbeat of Hampton Roads TPO
Transportation Planning Organization

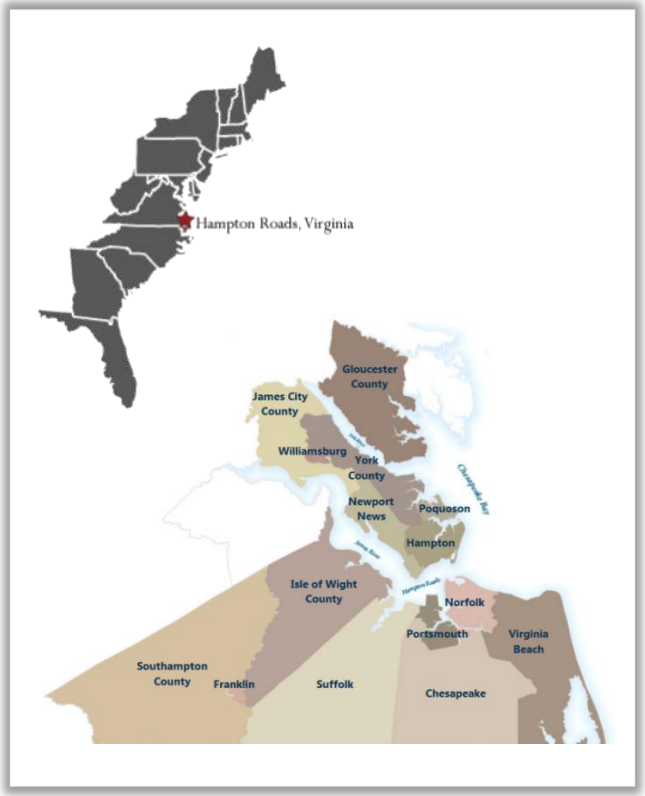
2045 LRTP


Resiliency Context in Hampton Roads
Resiliency Efforts (Assessing Operational Resilience)
Incorporating Resilience into Planning (Making Decisions about Investments in Resilience Assurance)
Information Gaps in Resilience Decision Making

Hampton Roads

Home to 1.7 Million People

Strategic location for Foreign Trade, Tourism, and Military Facilities



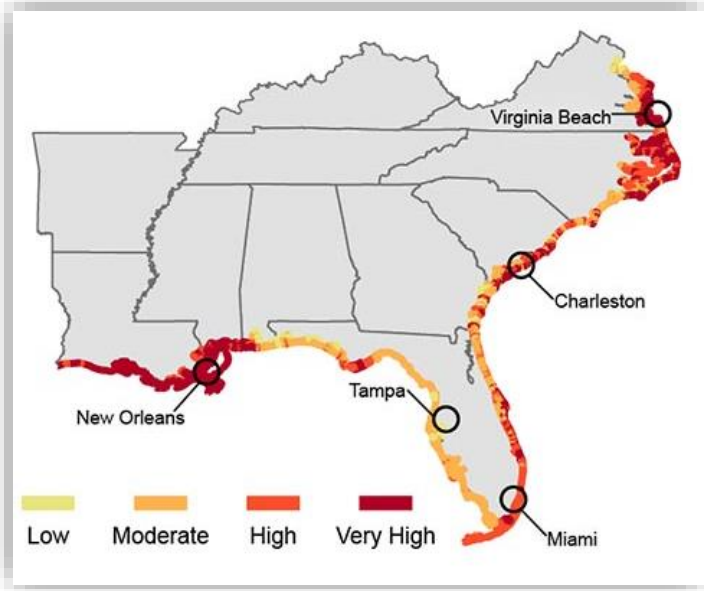
Hampton Roads Transportation Planning Organization (HRTPO)

- 15 Localities
- 3 Transit Agencies
- Federal and State Agencies
- 4 Virginia General Assembly Members
- Standing Committees:
  - Transportation Technical Advisory Committee
  - Community Advisory Committee
  - Freight Transportation Advisory Committee

Sea Level Rise in Hampton Roads

- Hampton Roads is experiencing the highest rate of relative Sea Level Rise on the East Coast
- Sea Level Rise will result in significant impacts:
  - Permanent inundation of some areas
  - More frequent flooding of other areas
  - Some areas that have not seen flooding will start to experience it

Vulnerability to Sea Level Rise (SLR)



Source: National Climate Assessment via EPA, data from Hammar-Klose and Thieler 2001

Resiliency Context: Flooding at Midtown Tunnel

2003 - Hurricane Isabel

- Stuck plate (tide gates couldn't close)
- Tunnel filled with 44 million gallons of water
- Closed for 30 days
- Elevated need for a second parallel Midtown tube

2011 - Hurricane Irene, 13ft Storm and Flood Surge

- All standing water pumped away within hours since tide gates were successfully closed

2014 - Heavy Rains Overwhelmed Pumps

- Norfolk approach fortified to reduce such flooding in the future

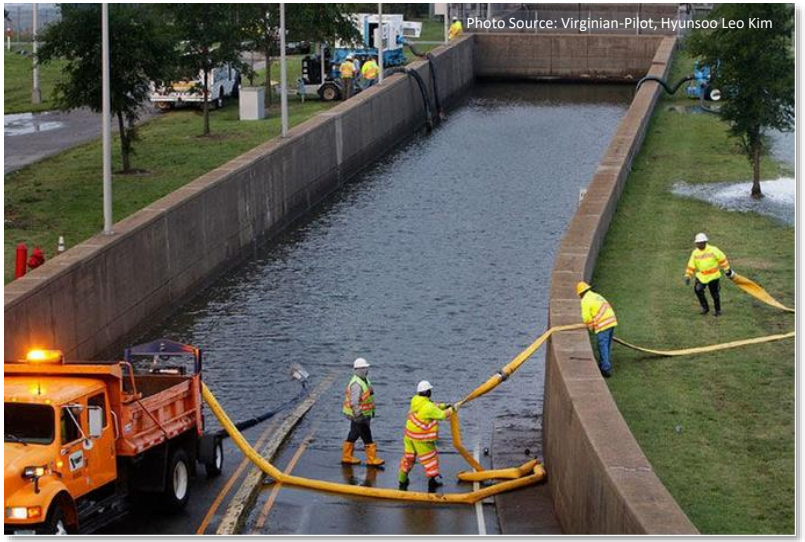
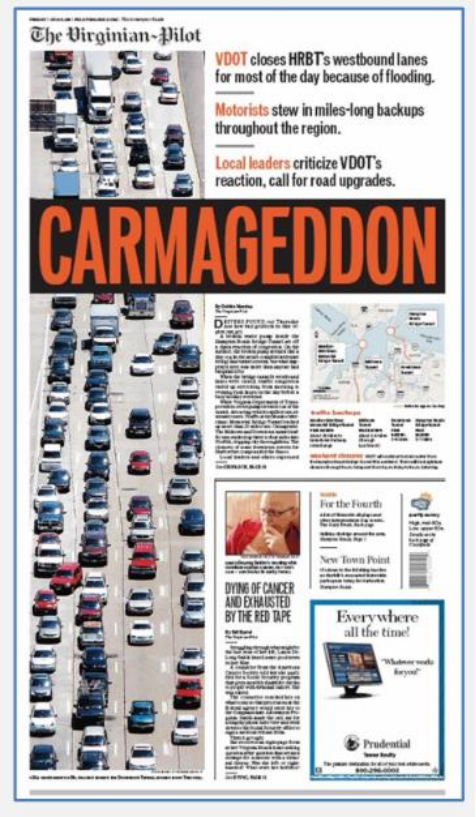


Photo Source: Virginian-Pilot, Hyunsoo Leo Kim

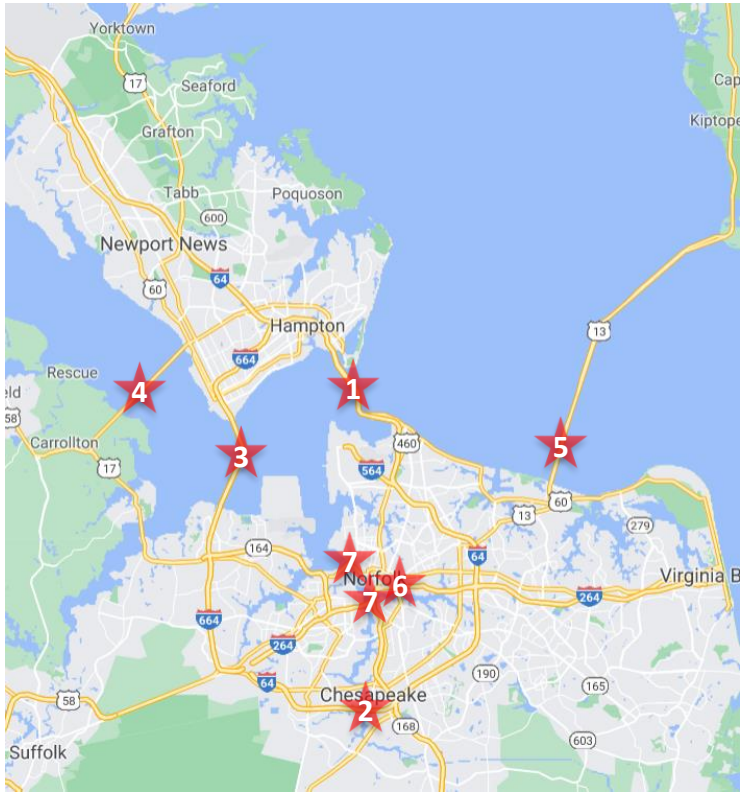
RESILIENCY CONTEXT: CARMAGEDDON

- "Carmageddon" (2009) – preview of what could happen in a systemic failure if a major tunnel(s) becomes inoperable
- System failure of this nature, although rare, exposes the region's vulnerabilities



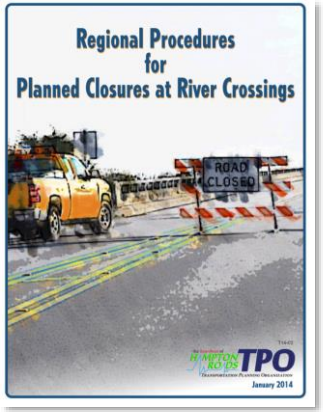
Resiliency Context: Carmageddon

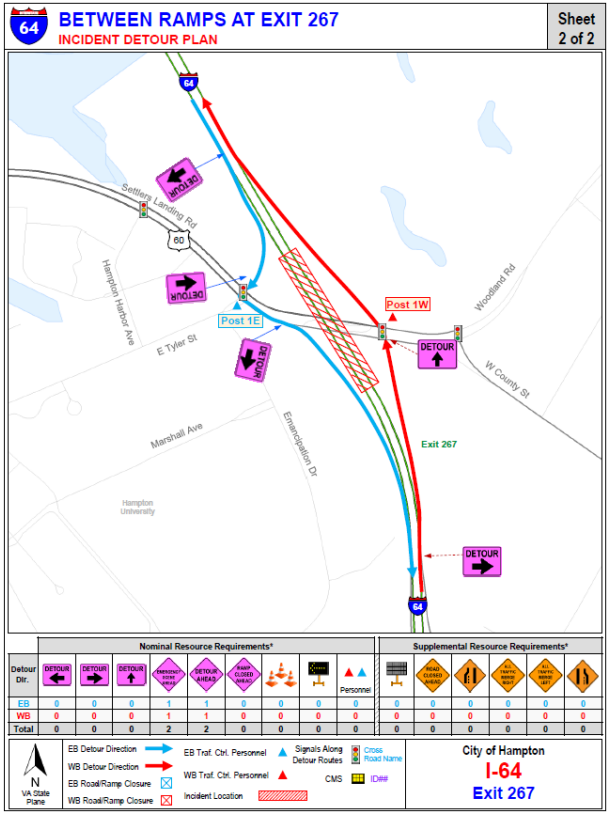
1. 8-inch water pump broke, flooding the Hampton Roads Bridge-Tunnel with 2 million gallons of water
2. One-car accident on the High-Rise Bridge
3. Three-car accident on the Monitor-Merrimac Memorial Bridge-Tunnel
4. Power line fell at the south entrance of the James River Bridge
5. Tractor-trailer overturned on the Chesapeake Bay Bridge-Tunnel
6. 3 Berkley Bridge openings
7. Severe congestion at Midtown and Downtown Tunnels due to HarborFest



Regional Efforts to Assess Operational Resilience

- **Hurricane Evacuation Studies**
  - Limited transportation options
  - Vulnerable populations
- **River Closure Procedures**
  - Coordination among regional partners
- **VDOT Incident Management Detour Plans**



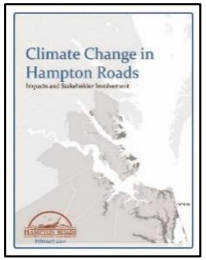


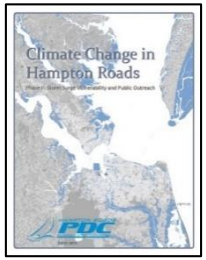
Regional Involvement in Planning for Sea Level Rise

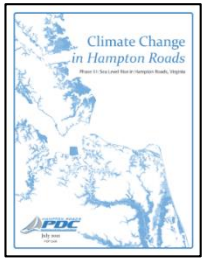
HRTPO and HRPDC Partnerships

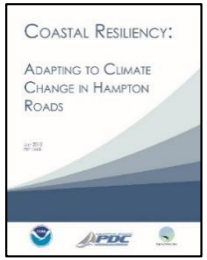
- Environmental Sustainability Best Practices for Transportation symposium
- Partnerships with other stakeholders
  - HRPDC Coastal Resiliency Committee
  - University Efforts (ODU, UVA, W&M, VT)
  - Virginia Institute of Marine Science (VIMS)
- Hampton Roads SLR Intergovernmental Planning Pilot Project
- Hampton Roads Adaptation Forum
- Hampton Roads Dutch Dialogues

HRPDC – Resiliency Planning Efforts

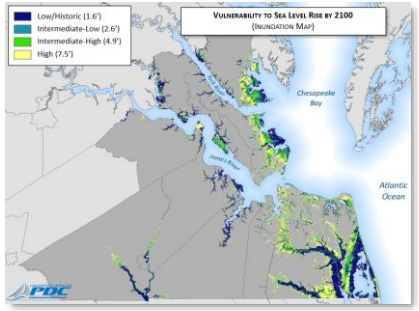


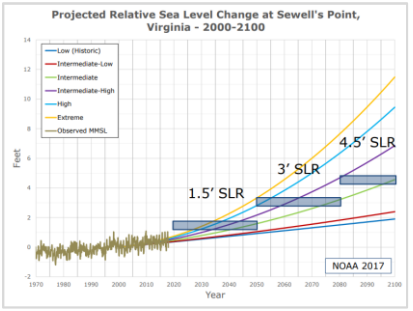


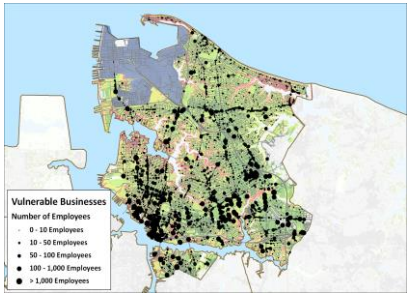




- Localized sea level rise projections and scenarios
- Local datasets – property, infrastructure, land use, etc.
- High resolution inundation maps
- GIS data layers
- Policy analysis

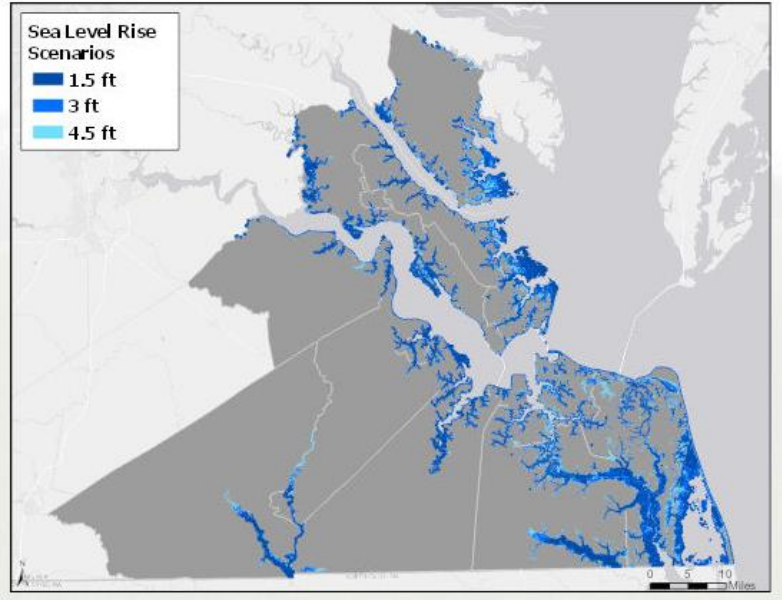






Storm Surge Analysis – Norfolk, Virginia

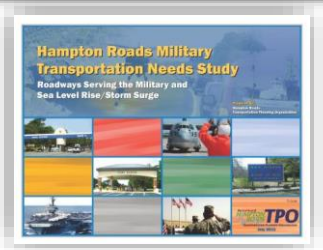
Regional Sea Level Rise Policy

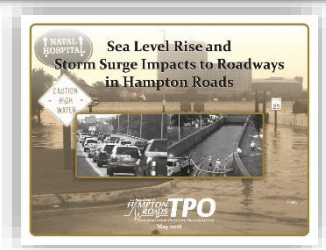


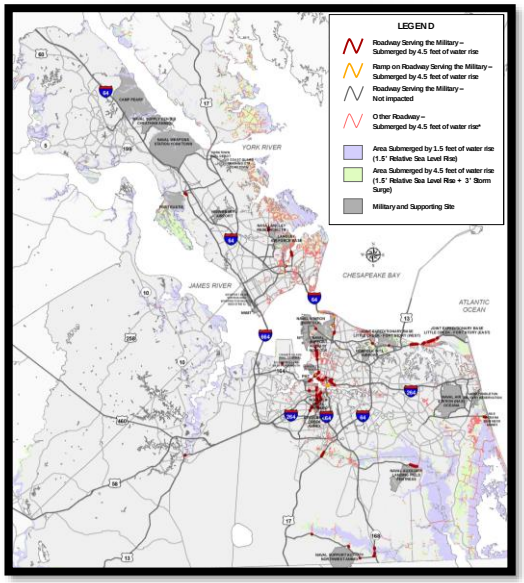
Regional Sea Level Rise Policy

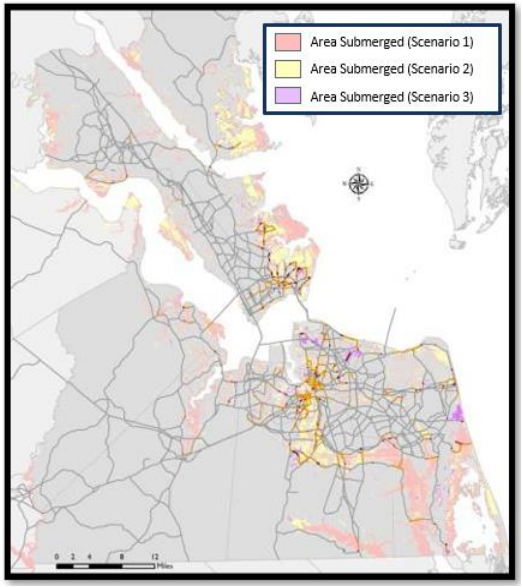
- **Screening values:**
  - 1.5 feet for near-term planning (2018-2050)
  - 3 feet for medium-term planning (2050-2080)
  - 4.5 feet for long-term planning (2080-2100)
- **Risk-based engineering:**
  - Utilize best available sea level rise projections
  - Explicitly account for construction timeline, project lifespan, criticality, and vulnerability to flooding
  - Determine possible sea level rise impacts
  - Perform benefit-cost analysis of adaptation options

HRTPO Studies – Vulnerability Analyses









Identify Vulnerabilities and Develop Adaptation Strategies

- Identify roadway segments vulnerable to flooding to develop adaptation strategies
- Raise awareness of potential flood locations to consider during design

Project Evaluation and Prioritization

- Use study results to add a "flooding vulnerability" component within the Project Prioritization Tool

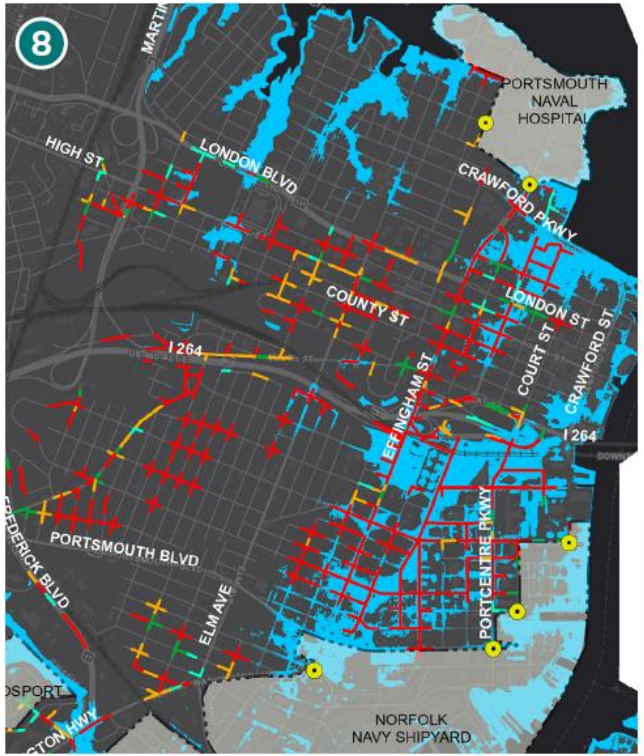
JOINT LAND USE STUDIES (JLUS)

Determine key issues affecting Navy operations

- Focus on investigating flooding vulnerability/resiliency of roadways that provide access to critical military installations

Measures of Effectiveness used in current regional JLUS efforts

- Congestion
- Delay
- Travel Time
- Vehicle Miles Traveled
- Capacity (Capacity Reductions)
- Vehicle Speeds



HAMPTON ROADS 2045 LONG-RANGE TRANSPORTATION PLAN

2045 LRTP

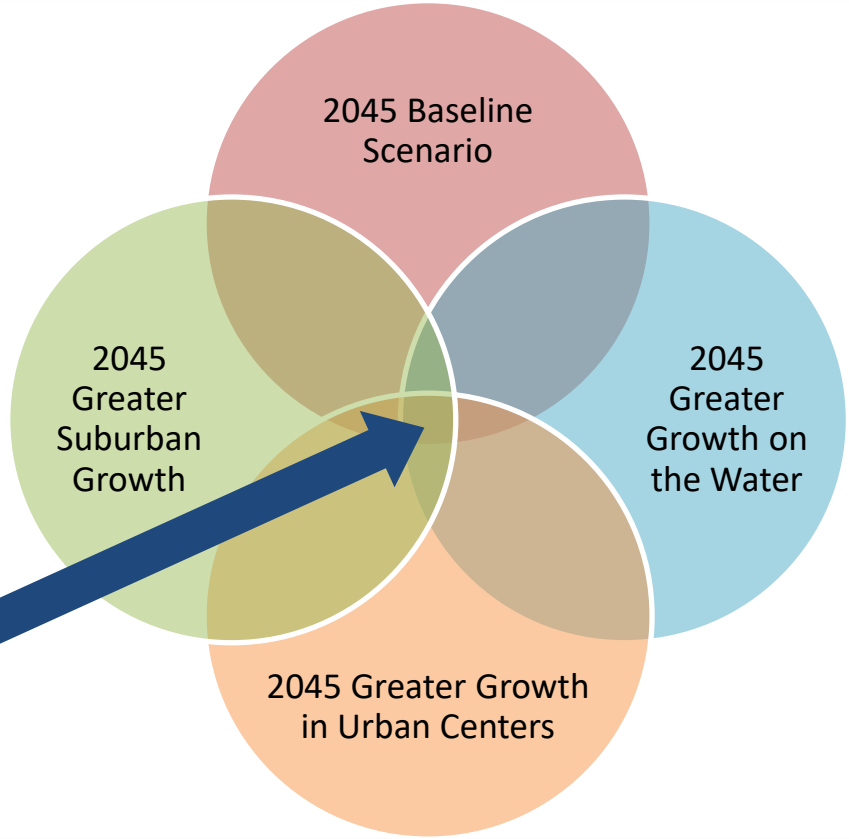
THE 2045 LONG-RANGE TRANSPORTATION PLAN WILL USE INNOVATIVE PLANNING TECHNIQUES TO ADVANCE AN ADAPTIVE TRANSPORTATION SYSTEM THAT SEAMLESSLY INTEGRATES TRANSPORTATION MODES FOR ALL USERS WHILE IMPROVING QUALITY OF LIFE AND PRESERVING THE UNIQUE CHARACTER OF HAMPTON ROADS.

Need for Scenario Planning

Update
HRTPO Project Prioritization Tool

HRTPO Regional Scenario Planning

- Plausible Futures
- Identify Projects that Fare Best
  - Most cumulative benefit regardless of alternative future scenario



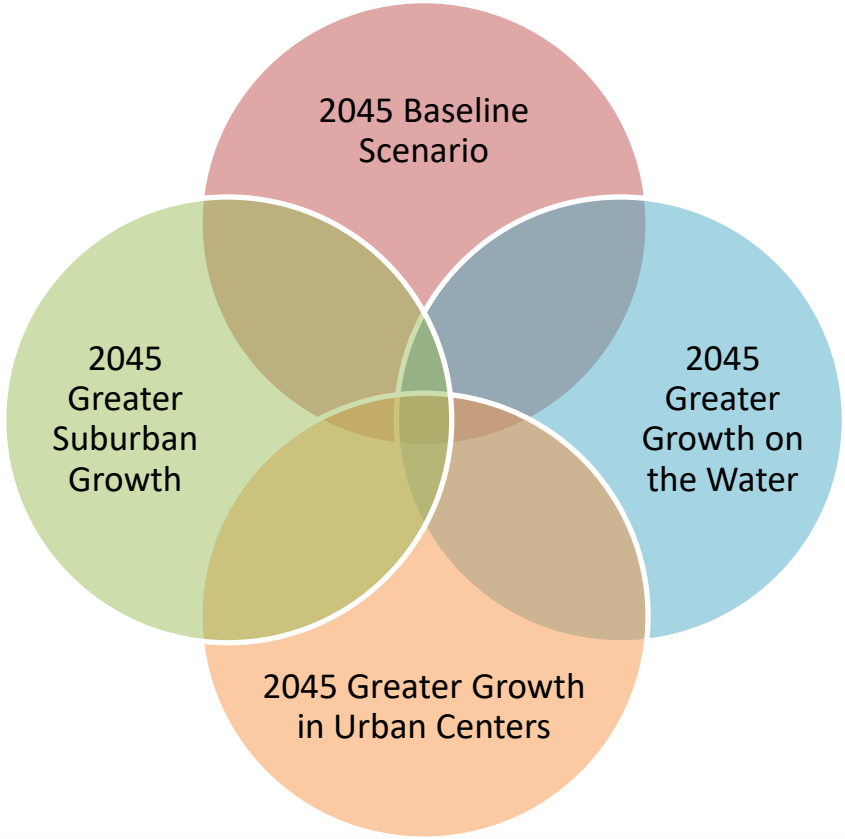
Evaluate and Rank Projects Across All Scenarios:

Most Robust Projects

HRTPO Regional Scenario Planning

- Plausible Futures
- Identify Projects that Fare Best
  - Most cumulative benefit regardless of alternative future scenario

Sea Level Rise Assumption: 3 Feet for all scenarios



HRTPO Project Prioritization

HRTPO Project Prioritization Tool

Project Utility:
Ability to solve a problem

Economic Vitality:
Potential for economic gain

Project Viability:
Project readiness

Examples of Regional Significance Prioritization Measures:

- Usage (Volumes/Ridership)
- Degree of Regional Impact
- Regional Travel Time
- Travel Time Reliability
- Diversion Impacts
- Impact to Freight Movement
- Incident Management/Evacuation Routes
- Defense, Port, Tourism Access
- Labor Market Access (Access to High Density Employment/Major Employment Centers)
- Access to Areas with High Unemployment and Low-Income Areas

New Resiliency/Flooding Vulnerability Measures

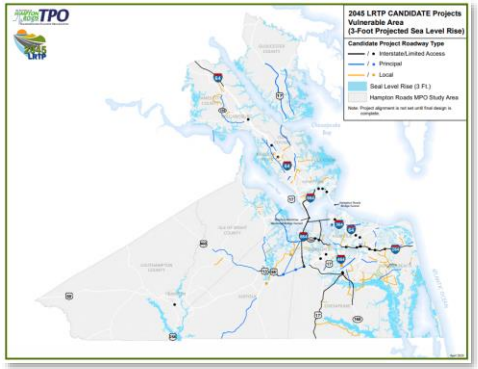
Is the Candidate Project in a vulnerable area for sea level rise/storm surge/recurrent flooding?

- If Yes, does the project include design features that make it resilient to flooding

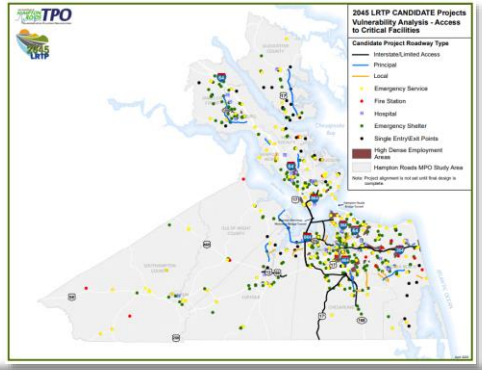
What is the level of access provided by the candidate project to critical areas or facilities* that are projected to be disrupted by flooding or related effects of climate change

*(e.g. hospitals, Fire-EMS, emergency shelters, dense employment area, and single entry/exit point for flood prone areas or neighborhoods)

Vulnerable Areas (3-Foot Projected SLR)



Access to Critical Facilities



Volpe Resilience and Disaster Recovery (RDR) Metamodel

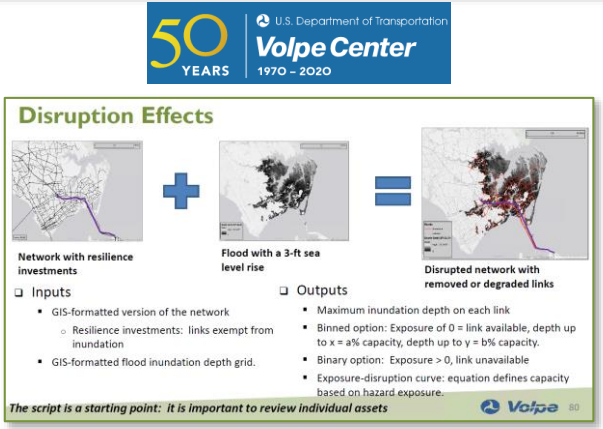
- USDOT/Volpe partnership with HRTPO/HRPDC
  - **May 2016 – Hampton Roads Climate Impact Quantification Initiative**
    - Goal: cost tool that considers financial impacts in infrastructure planning due to climate change and severe weather
  - **April 2017 – Hampton Roads Infrastructure Resiliency Quantification Initiative (IRQI)**
    - Goal: robust, nationally-replicable modeling tool that quantifies direct and indirect costs of disruptive events on transportation infrastructure
  - **July 2019 – Resilience and Disaster Recovery Metamodel**

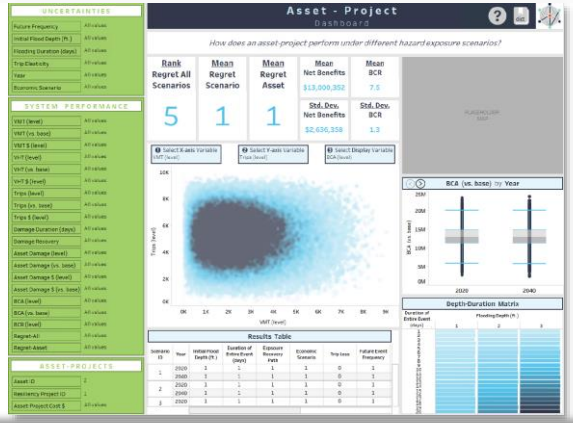
HRTPO Objectives with Volpe RDR Metamodel:

- **Support objective, data-driven resiliency measures for use in Project Prioritization Tool**
  - Identification of inundation and extent (SLR, low and high frequency events)
  - Quantify congestion as a result of flooding
  - Quantify avoided congestion of mitigating flooding
  - Cost-benefit ratio of resiliency improvements
- **Model multiple flooding scenarios efficiently**
  - Highest priority - quantify congestion with 3’ of SLR

VOLPE RDR METAMODEL: OBJECTIVES AND CONCEPT

- The RDR Metamodel is sponsored by FHWA in collaboration with the Office of the Assistant Secretary for Research and Technology (OST-A)
- **Objective:** Help State DOTs and MPOs make **informed investments in infrastructure resilience**
- Nationally replicable
- **Address a variety of hazard conditions** that affect transportation
- **Enable scenario comparisons for resilience investment return**





VOLPE RDR METAMODEL: MPO PLANNING APPLICATIONS

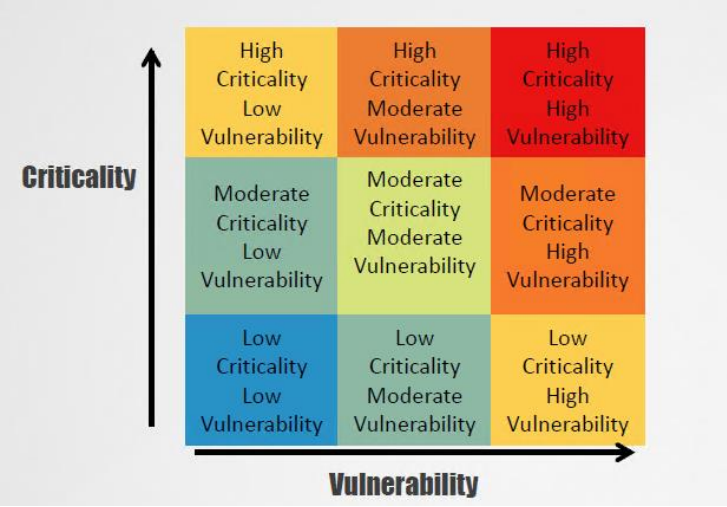
LRTP Planning Process

- Identification of vulnerable projects
- LRTP project evaluation/selection (input into Project Prioritization Tool)
- Fiscal-constraint (ensure most critical projects that can be constrained are included)
- Prioritizing build order

Other applications

- Project design/cost refinement
- Other regional studies

Measuring Criticality and Vulnerability

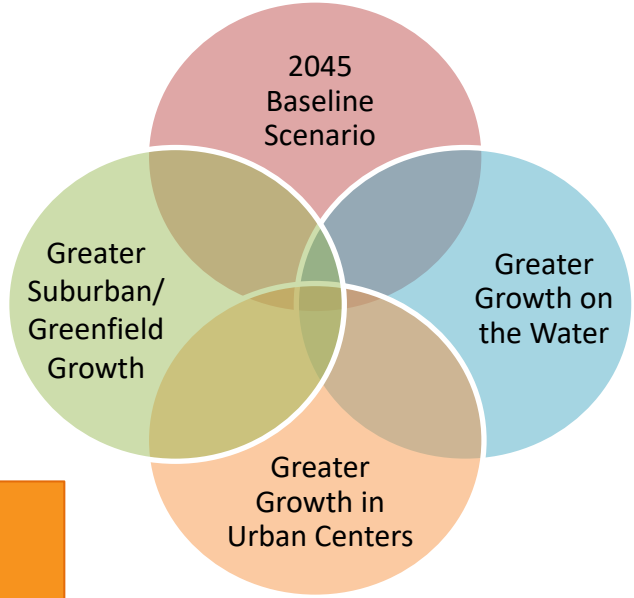


Source: H-GAC

LRTP Scenario Planning Process with RDR Metamodel

EXPLORE IMPACTS OF MORE THAN ONE SLR/FLOODING SCENARIO

Evaluate and Rank Project Across ALL Scenarios



Most Robust Projects

Scenario Modeling Tools

Land Use Model	Travel Demand Model	Economic Model	**Volpe RDRM**

Project Evaluation and Ranking Across Scenarios

Project Prioritization Tool	**Other Performance Measures**

Fiscal-Constraint Applied to Most Robust Projects

Long-Range Transportation Revenues	Project Costs	**Refined Project Design/Cost based on Resiliency**

2045 LRTP

Information Gaps in Resilience Decision Making

Other Data/information we would like to factor into our planning process to enhance the consideration of investing in resilience include:

- Transportation elevation data
  - Last return vs scraped Earth LIDAR data
- More seamless integration of robust transportation data with travel demand models
- Design Guidelines at State/Federal level

THANK YOU!

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the heartbeat of HAMPTON ROADS TPO
TRANSPORTATION PLANNING ORGANIZATION