

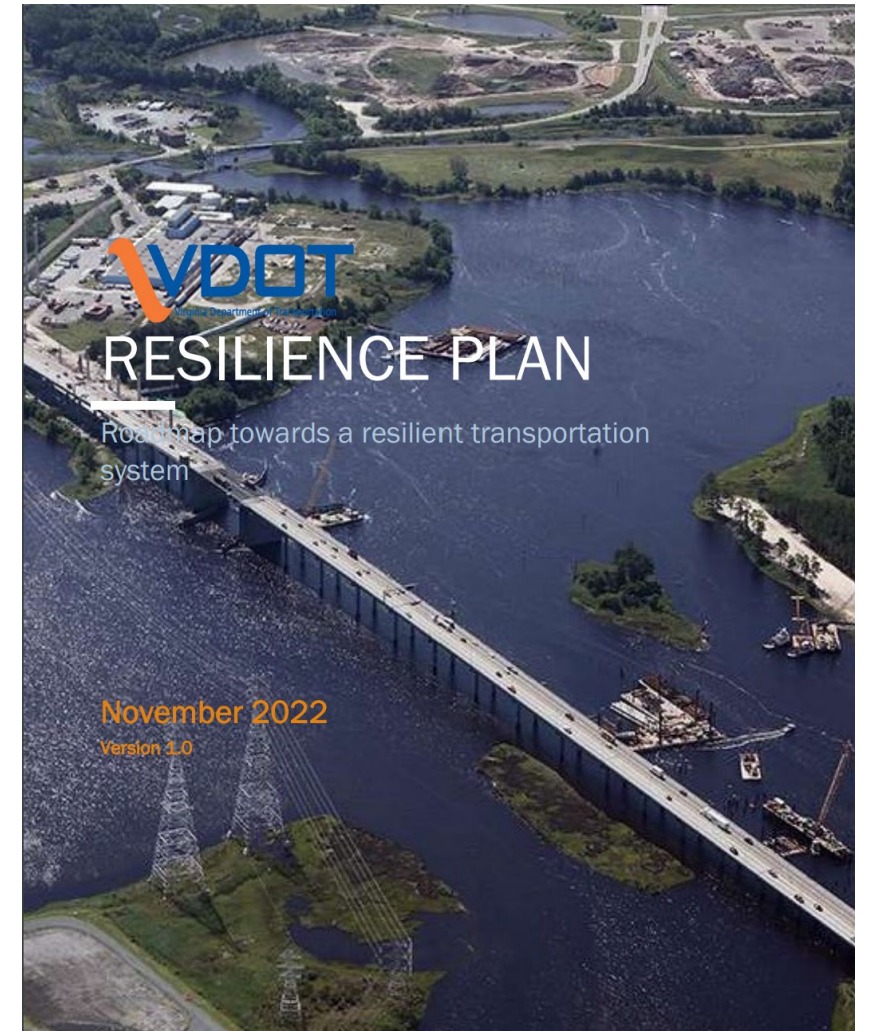
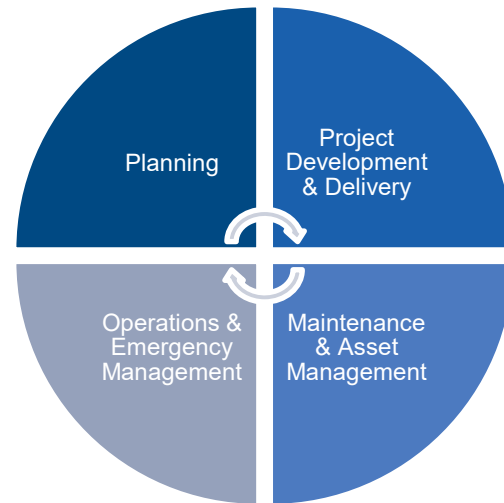
VIRGINIA DOT RESILIENCE PLAN UPDATE



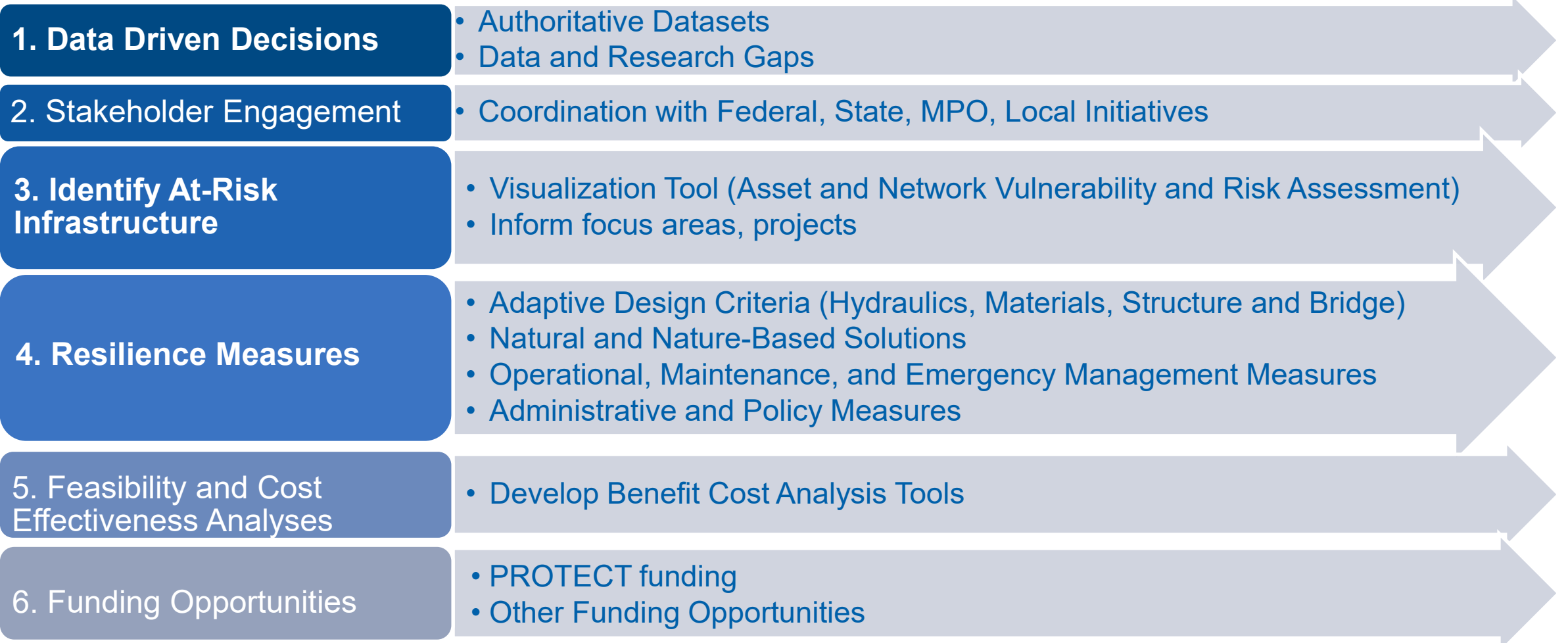
Transportation Resilience

Resilience is the capability of a transportation project or strategy to anticipate, prepare for, respond to, or recover from significant multi hazard threats with minimum damage and disruption to the transportation network, while preserving and incorporating natural and built infrastructure that helps to mitigate these threats.

Incorporate resilience into existing business practices



Resilience Plan Objectives & Strategies



Strategy 1: Data and Research Plan

Promote Data Driven Decisions

- Data and Research Plan to:
 - Identify existing and forthcoming datasets;
 - Evaluate the scope and limitations of existing datasets;
 - Designate authoritative datasets;
 - Identify data gaps and needs

Status Updates:

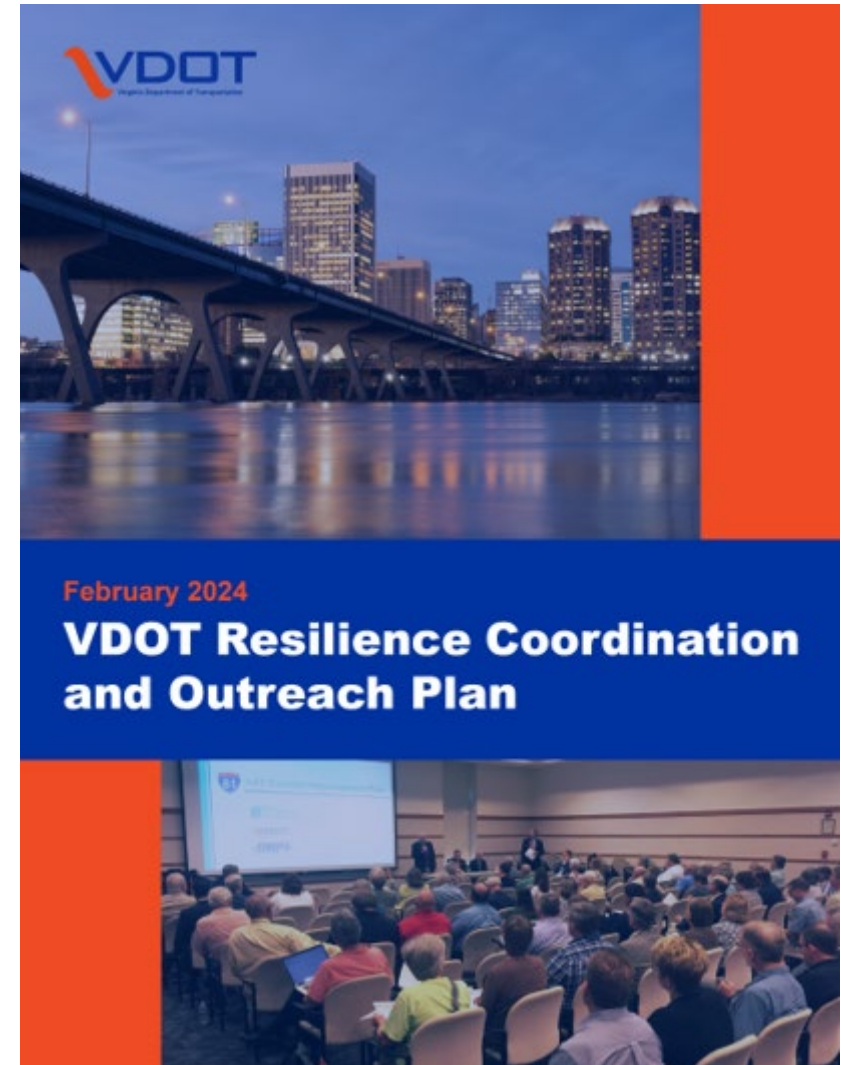
- 16 research projects underway
- Research focuses on hydraulics, materials, and geotechnical impacts, historical flooding, traffic operations, etc.
- Data & Research Plan undergoing reviews

Strategy 2: Coordination and Outreach Plan

- Stakeholder engagement
- Coordination with statewide policy and other local and regional efforts in the Commonwealth

Status Updates:

- Continued coordination and outreach: internal and external
 - CRMP, HRPDC, NVRC, MWCOCG, MRRI, Peer Exchanges and Pooled Fund Studies, Resilient VA – Resilience Academy Series, AASHTO CES Annual Meeting
- Coordination and outreach (C&O) plan – completed (2/2024)



Strategy 3: Identify At-Risk Infrastructure

Develop a methodology for determining asset vulnerability

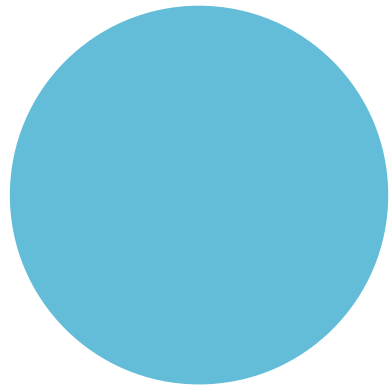
- A risk-based methodology that considers exposure, sensitivity, and criticality would provide a measure of overall vulnerability and a systematic, documented approach for the application of resilience strategies to VDOT assets

Status Update:

- Working towards final At-Risk Infrastructure Visualization Tool in 2024

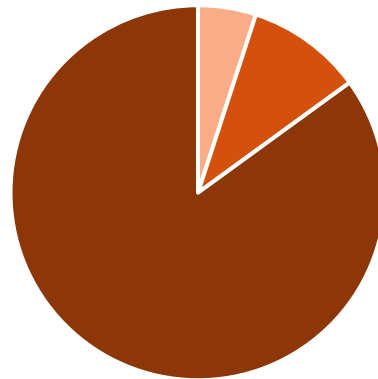
Methodology

For a given hazard (flooding/landslide), a vulnerability score is calculated based on three components:



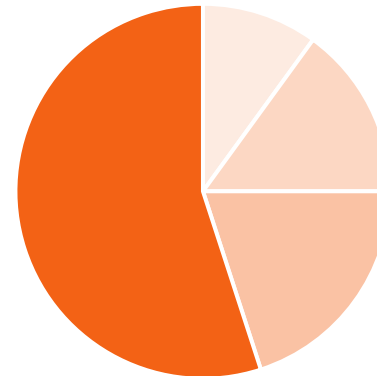
Exposure

Whether an asset is located in an area that has or will experience direct effects of climate variability and extreme weather events. Exposure is a prerequisite for vulnerability.



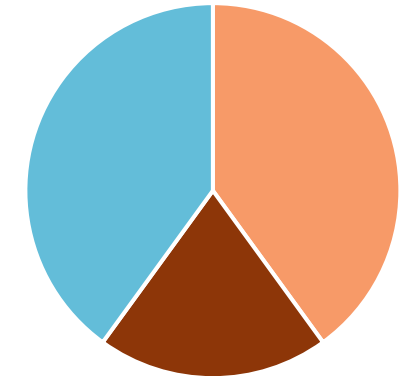
Sensitivity

How an asset responds to, or is affected by, exposure to a climate change stressor. A highly sensitive asset will experience a large degree of impact if the climate varies even a small amount.



Adaptive Capacity/Criticality

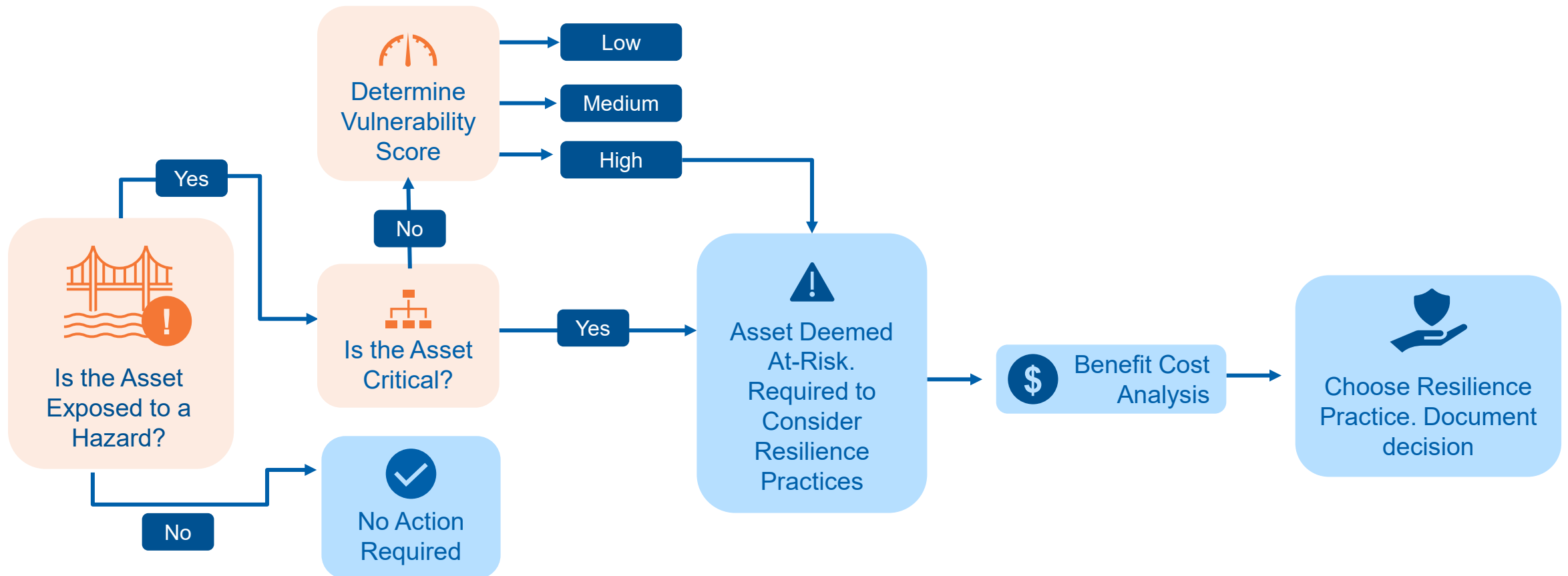
The ability of a transportation asset or system to adjust, repair, or flexibly respond to damage caused by climate variability or extreme weather.



Vulnerability

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change or extreme weather events.

At-Risk Infrastructure Visualization and Decision Support Tool



High-Level Planning

Project Planning

Welcome to the VDOT At-Risk Infrastructure Tool

What would you like to do today?

High Level Planning | **Project Planning** | Tutorial

Select this option if you are a project manager, engineer, or planner looking at a specific asset or project, and want to understand its vulnerability and if resilience practices should be considered for that asset. This data can inform project development and O&M decisions.

The tool will default to the **Strategic Planning** View, which provides baseline values for all asset filters, scoring parameters, and map layers. All of these controls are available to you in the tool and can be changed at any time.

Are you looking to analyze an existing or future asset?

- Asset exists
- Asset does not yet exist

For **Existing Assets**, we recommend:

- Searching for Existing Assets**
You can use the Search Tab to find assets by name or numerous other attributes, such as maintainer, district, county, locality, zip code, criticality, vulnerability, and others. Clicking on a search result will reveal its location on the map. Clicking the on icon will add the asset to your "pinned" list. This lets you easily find it again. You may also generate Reports from your list of pinned assets. Clicking the on icon will show you the details of that asset, including an in-depth look at its vulnerability scores across all hazards and indicators.
- Refining Scores and Filters**
You can use the Scoring Tab to refine the vulnerability results to your needs. This will change the visualization of asset scores on the map.
- Selecting Hazards and Map Layers**
You can use the Layers Tab to select the hazard scenario (e.g., Coastal Flooding vs Inland Riverine Flooding) and any combination of supplementary map layers provided to help you contextualize vulnerability results and evaluate locations for new assets.

VDOT Resilience
Risk Assessment Data Visualization

Scoring | Search | Layers | Weights | Pinned

Scoring

You are viewing **Strategic Planning** results. You can adjust any of the settings below to update which assets and scores are shown.

[Reset to Defaults](#) [Change View](#)

Select a year that best fits your plan or project.
This Impacts Indicators such as Sea Level Rise.

2040

Limit assets to a specific county?
Mathews

Limit assets to a specific district?
Any District

Limit assets to a specific locality?
Any Locality

What types of assets do you want to see?
Roads | Bridges | Culverts

You may select specific types of roadways, if you wish.
This is equivalent to the Functional Class of the roadway.

All

Select the vulnerability scores you wish to see.
Assets are grouped into Low, Med, and High bins according to their vulnerability scores.

Low | Med | High

You may filter assets by criticality.

VDOT Resilience
Risk Assessment Data Visualization

Scenario: Example One | Manage Scenarios
SLR Year: 2040
Asset Types: Road | Bridge | Culvert
Asset Scores: Low | Med | High

Asset Type: Hazard

Roadways

| Hazard | Exposure | Sensitivity | Criticality |
|--------------------------|----------|-------------|-------------|
| Coastal Flooding | 48% | 38% | 48% |
| Inland/Riverine Flooding | 48% | 38% | 48% |
| Landslides | 48% | 38% | 48% |

Structures

| Hazard | Exposure | Sensitivity | Criticality |
|------------------|----------|-------------|-------------|
| Coastal Flooding | 48% | 38% | 48% |

Asset Details
Type: Bridge
Name: R-VA 1509640B
Common Name: VDOT
Owner: VDOT
Maintenance: 894
County: Newport News
Zip Code: Hampton Roads
Federal ID: 29752

Vulnerability
Inland/Riverine Flooding: 1.78
Sensitivity: 0
Channel and Channel Protection: 0
Score Criticality: 0
Criticality: 2.7
Equity: 0
Exposure Factor: 3
Exposure: 1.75
Precipitation: 2.5
Motorway Adequacy: 1
Coastal Flooding: 1.8
Sensitivity: 0
Score Criticality: 0
Duration of Flooding: 0
Criticality: 1.5
Equity: 0
VDOT Coastal Network Resilience and Connectivity Analysis: 0
Exposure Factor: 3
Navigable Motorway: 3
Exposure: 3
Sensitivity: 3
Criticality: 2.7
Exposure Factor: 3
Sensitivity: 1
Precipitation: 2.5

DRAFT

Done

Strategy 4: Resilience Practices - Tools in the Toolbox

Resilience Practices Being Evaluated Include:

- Adaptive Design Criteria
 - Structure & Bridge Manual Chapter 33
 - Draft VDOT Drainage Manual Chapter 18
 - Draft Pavement Section 609, and Draft Geotech Section 3
- Other Physical Enhancement Practices
 - Small Scale Flood Barriers
 - Flood Attenuation: Breakwater, Groins, Riverine Veins, Flow Redirection Berms
 - Stormwater Improvements: Drainage/Storage Capacity, Alternative Designs, Newer innovations
 - Slope Stabilization: Revetments and Reinforcements

Strategy 4: Resilience Practices - Tools in the Toolbox

- Other Administrative and Policy Practices
 - Resilient Procurement
 - Enhanced Resilience Practices/Betterments
 - Resilience Certifications
 - Stormwater, Groundwater, and Green Infrastructure
 - Cool Pavements
- Operational, Maintenance, and Emergency Management
 - Enhanced Maintenance Practices in Advance of Weather Events
 - Maintenance Activities for Identified At-Risk Infrastructure
 - Early Warning Device Technology
 - Equipment Design Considerations for ITS and Traffic Operations
 - Power redundancy for ITS and Traffic Operations Equipment
 - Network Redundancy Review
 - Identify Mitigation Opportunities

Strategy 4c: Natural and Nature Based Solutions

Structural solution



Traditional Seawalls: concrete and riprap

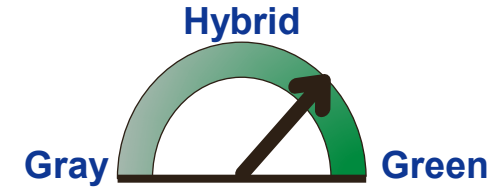
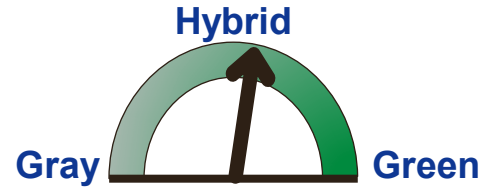
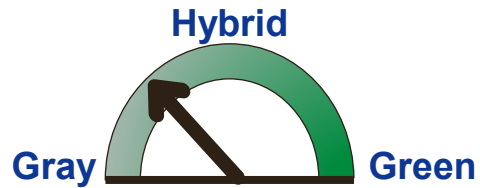
Constructed marsh, including fill and planting.
Can include breakwaters/sills to reduce wave energy

Nature-based solution

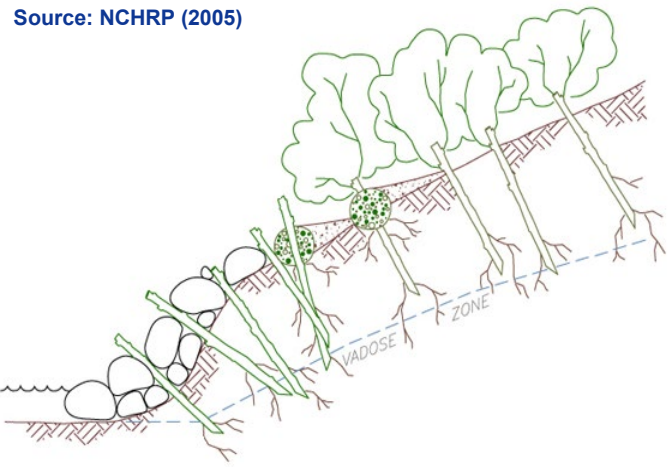


Strategy 4c: Natural and Nature Based Solutions

Conceptual Design Alternatives with corresponding benefit cost analysis



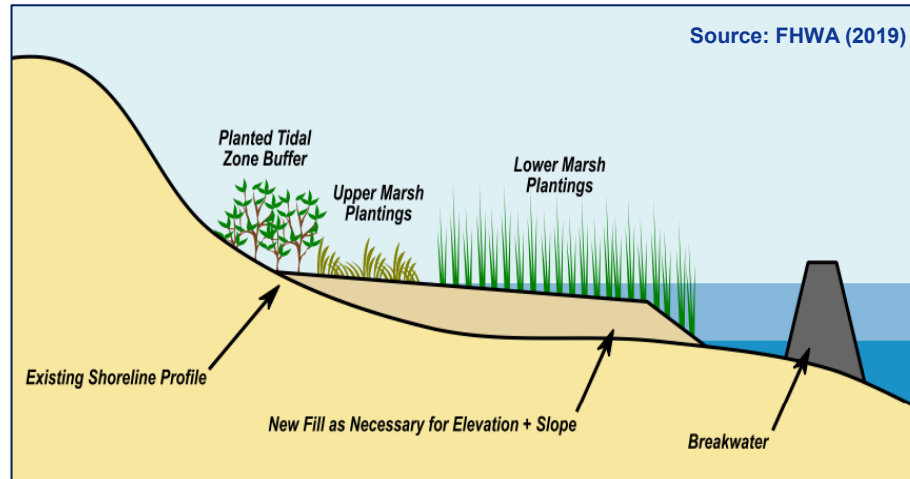
Source: NCHRP (2005)



Vegetated Revetment

- Simple materials
- Simple construction
- Low ecological benefits
- Low upfront costs

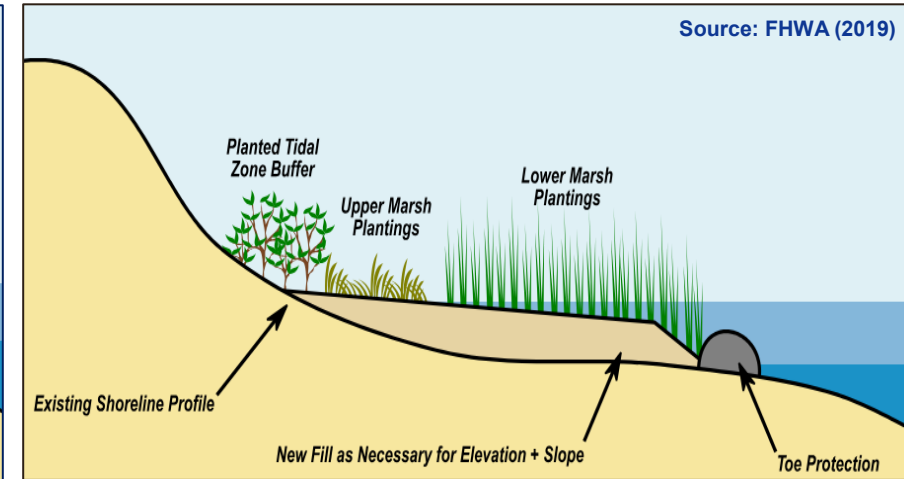
Source: FHWA (2019)



Marsh + Breakwater

- Reduces wave height
- Generates pocket beaches
- Moderate ecological benefits
- Moderate upfront costs

Source: FHWA (2019)



Marsh + Sill

- Attenuates wave energy
- Stabilizes marsh platform
- High ecological benefits
- High upfront costs

Strategy 5: Feasibility and Cost Effectiveness Methodology

- Benefit-Cost Analysis Tool under development

| | | |
|-----------|---|---------------------|
| Baseline | Hours of Closure per event | 36 |
| Resilient | Hours of Closure per event | 24 |
| Δ | Hours of Closure Reduced per year | 24 |
| | Miles of Detour | 2 |
| Δ | Detour Miles Saved per year | 48 |
| | Detour MPH | 45 |
| Δ | Detour Hours Saved per year | 1.1 |
| | AADT | 500 |
| | Truck % | 20% |
| Trucks: | Travel Time Savings per hour | \$ 33.50 |
| | Vehicle Operating Cost Savings per mile | \$ 1.32 |
| | Emissions Savings per mile | \$ 0.336 |
| | Total Truck Benefit per year | \$ 11,522.13 |
| | Car % | 80% |
| Cars: | Travel Time Savings per hour | \$ 19.60 |
| | Vehicle Operating Cost Savings per mile | \$ 0.52 |
| | Emissions Savings per mile | \$ 0.119 |
| | Total Car Benefit per year | \$ 20,631.47 |
| | Others? All summing to... | |
| D | Annual Traffic Benefit | \$ 32,153.60 |

Strategy 6: Resilience Needs Incorporation into Investment Processes

- Incorporate resilience needs in current investment processes and programs
- Identify opportunities to incorporate resilience into the Department's various funding programs
- Identify new funding opportunities available for resilience projects and initiatives
 - The Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT)

PROTECT Program

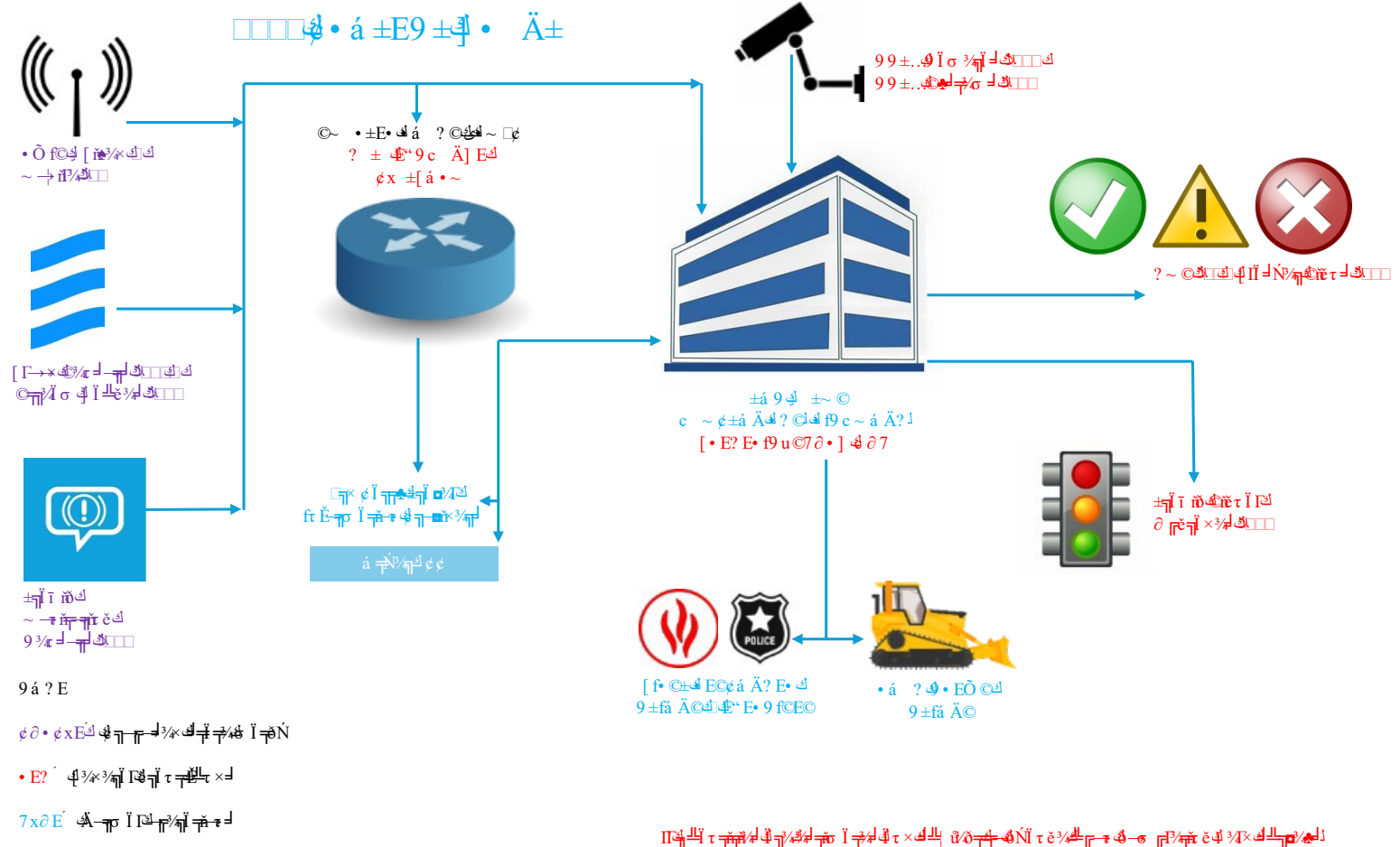
- Formula Funding and Discretionary Grants
 - Coastal Planning Activities, including Resilience Improvement Plan (RIP)
 - Resilience Improvements
 - Community Resilience
 - At-Risk Infrastructure
- Initial formula funding applied to:
 - Resilience planning, research, and capacity building;
 - Evacuation route planning;
 - Hardening and elevation of vulnerable bridges
- VDOT awarded a discretionary grant in 2024

MOVER Grant Project

**\$5.4M Award +
\$1.3M VDOT Match**

Hampton Roads | Fredericksburg |
Richmond | Central Office

- Closed-Circuit Television (CCTV) Cameras
- Dynamic Message Signs (DMS)
- Road Weather Information System (RWIS)
- Traffic Signal Upgrades (detection for ATSPM)
- Traffic Monitoring Sensors
- Flood Sensors
- Stream Gauges





Thank you