MARYLAND DEPARTMENT OF TRANSPORTATION

April 7, 2020

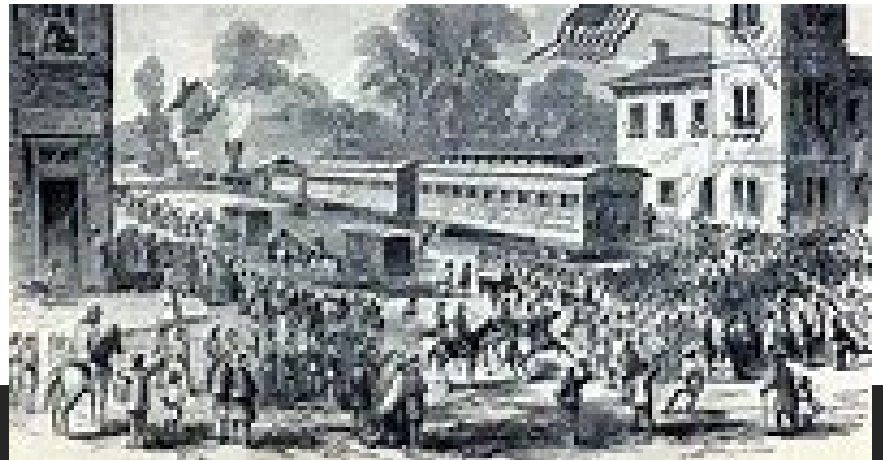
Sandy Hertz, Assistant Director

Office of Environment

MDOT Climate Change Adaptation Strategies for a Resilient Transportation System

Maryland transportation – a brief history….

- 1638 – First Established Toll for a River Crossing
- 1666 – First Road Law Passed
- 1787 to 1804 – Private Companies Built Turnpikes
- 1784 to 1848 – Focus on Railroads and Canals
- 1867 – First Government Involvement in Railroad/Canals
- 1904 – First Division of Highways
- 1929 – State Aviation Commission
- 1956 – The Maryland Port Authority
- 1969 – Metropolitan Transit Authority



Origin of MDOT

Established on July 1, 1971

Consolidated Independent State Transportation Agencies

- State Highway Administration
- Motor Vehicle Administration
- Maryland Aviation Administration
- Maryland Port Administration
- Maryland Transit Administration

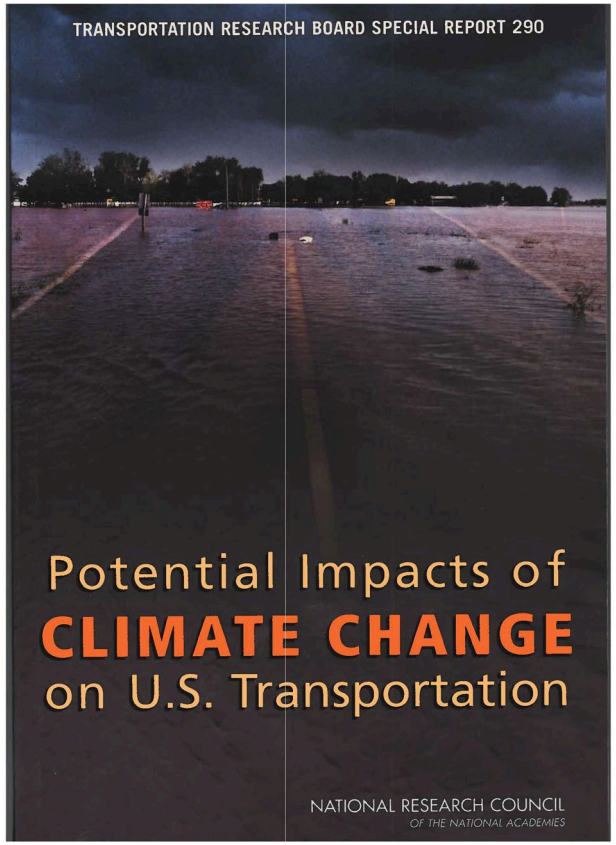
Maryland Transportation Authority

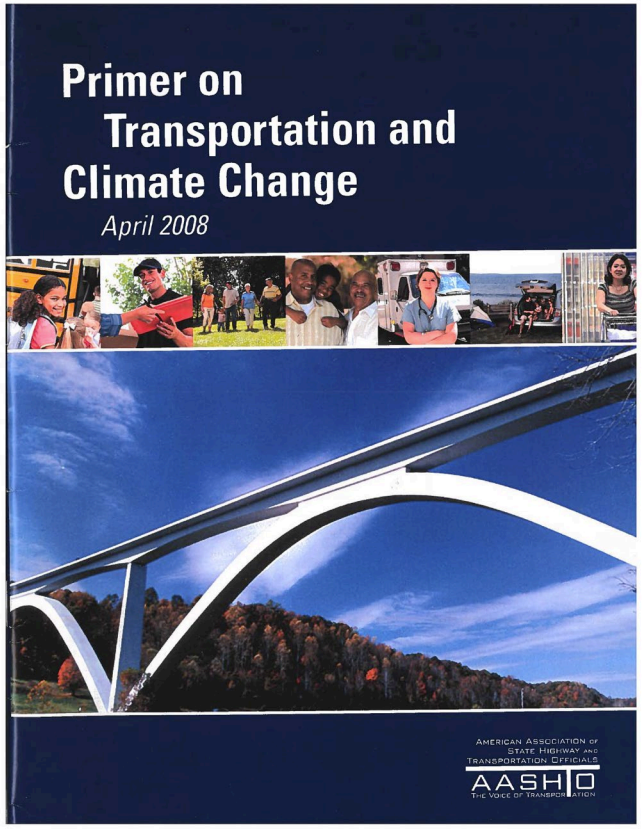
MARYLAND DEPARTMENT OF TRANSPORTATION

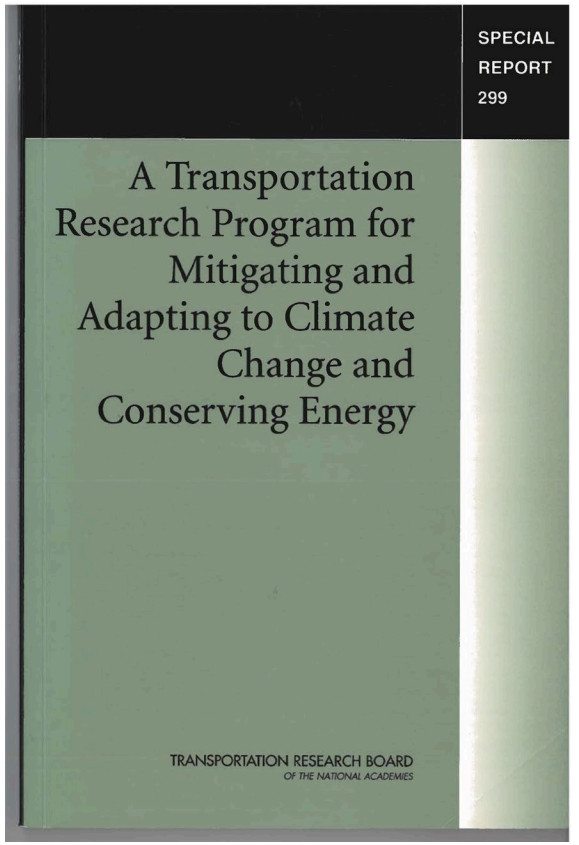
MISSION STATEMENT

"The Maryland Department of Transportation is a customer-driven leader that delivers safe, sustainable, intelligent, and exceptional transportation solutions in order to connect our customers to life's opportunities."

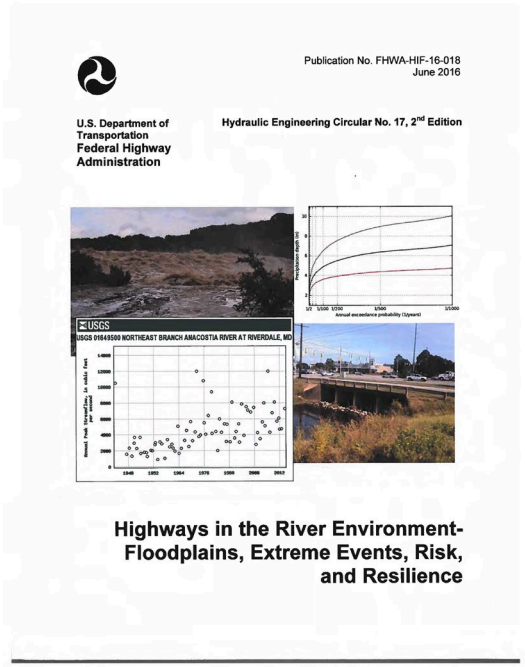
MDOT Mission

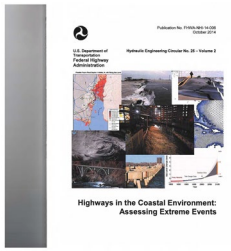


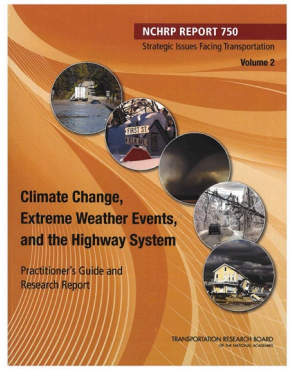


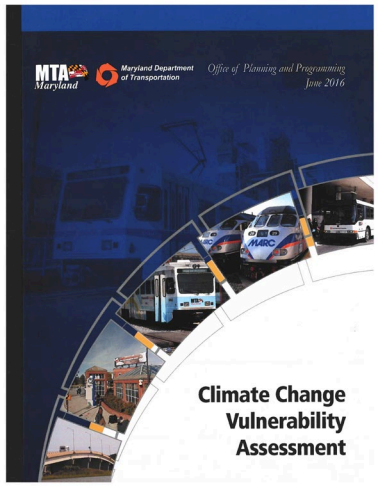


Identifying Hazards

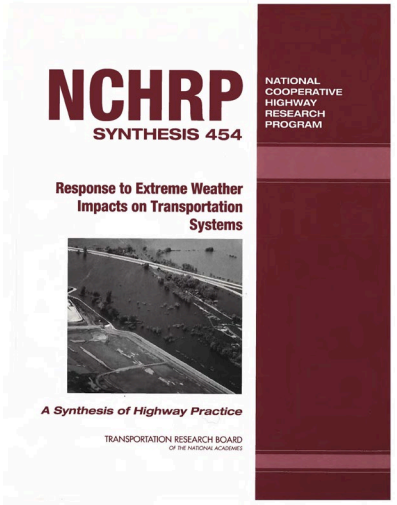

Publication No. FHWA-HIF-16-018
June 2016
U.S. Department of Transportation
Federal Highway Administration
Hydraulic Engineering Circular No. 17, 2nd Edition
USGS
USGS 01649500 NORTHEAST BRANCH ANACOSTIA RIVER AT RIVERDALE, MD
Highways in the River Environment-
Floodplains, Extreme Events, Risk,
and Resilience


Highways in the Coastal Environment:
Assessing Extreme Events


NCHRP REPORT 750
Strategic Issues Facing Transportation
Volume 2
Climate Change,
Extreme Weather Events,
and the Highway System
Practitioner's Guide and
Research Report
TRANSPORTATION RESEARCH BOARD


MTA Maryland
Maryland Department of Transportation
Office of Planning and Programming
June 2016
Climate Change
Vulnerability
Assessment


TR NEWS
Transportation
Systems Resilience
Preparation, Recovery,
and Adaptation

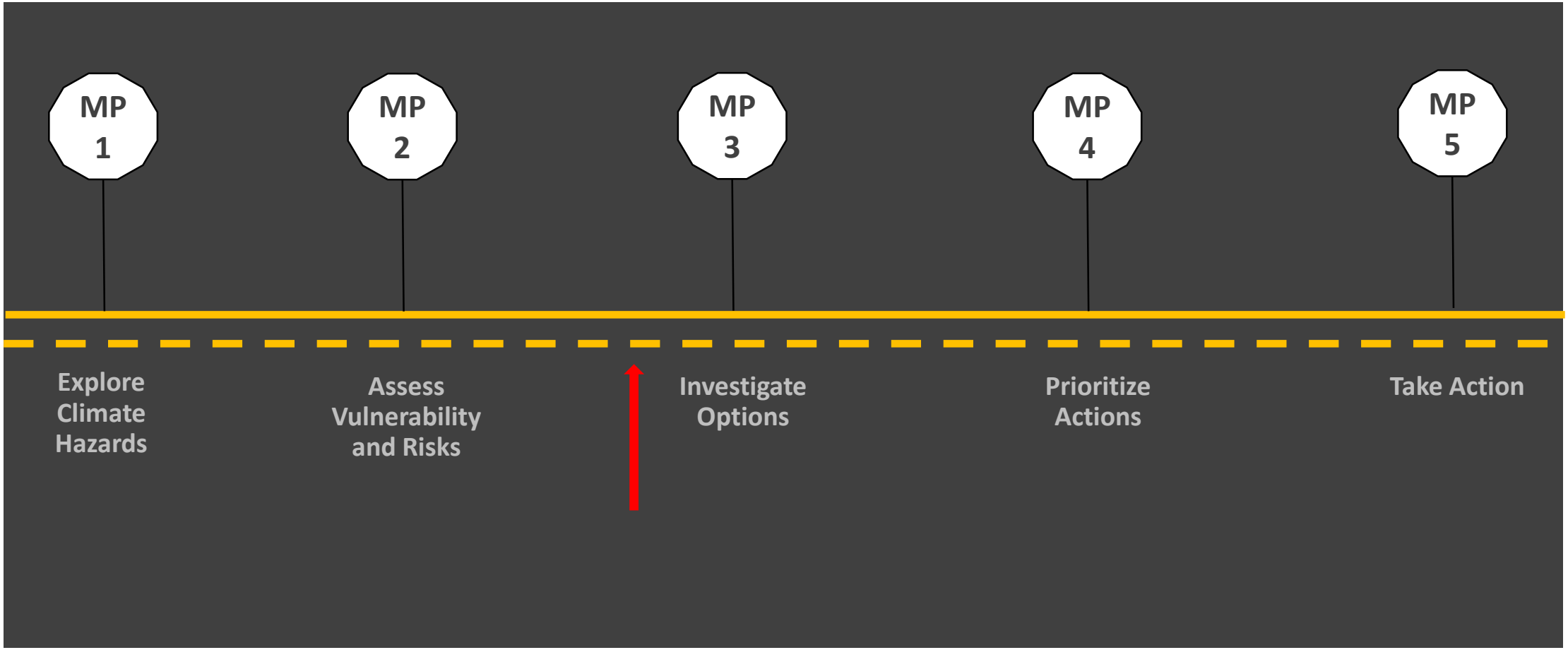

NCHRP
SYNTHESIS 454
NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM
Response to Extreme Weather
Impacts on Transportation
Systems
A Synthesis of Highway Practice
TRANSPORTATION RESEARCH BOARD

“Not so Fun” Fact

Hurricane Sandy caused over $10B in damage to coastal roads, rails, tunnels, and other transportation facilities in New York and New Jersey (Blake, *et al.* 2013, NOAA 2013).

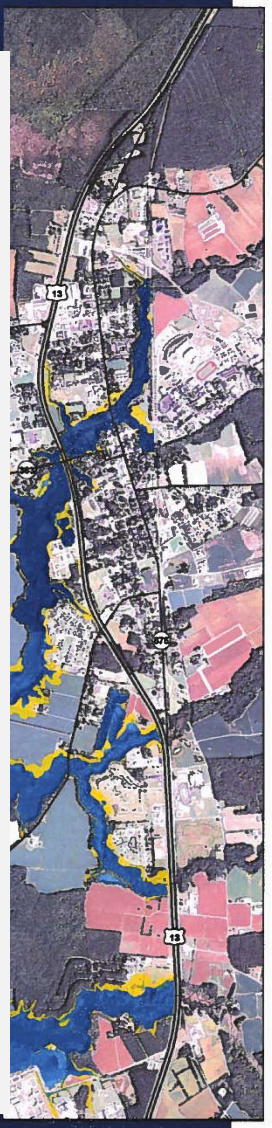
What’s a DOT to Do?

The “Road” to Achieving Adaptive Capacity & Resilience



Pilot Study Objectives

- Assess Vulnerability
- Develop Engineering Approaches
- Make Resiliency Improvement Recommendations



Maryland State Highway Administration

Climate Change Adaptation Plan with Detailed Vulnerability Assessment

Final Report – October 11, 2014

Prepared for:

The Maryland State Highway Administration

Prepared by:

Stantec Consulting Services Inc.

Exploring Climate Hazards

Temperature

Precipitation (rain, snow, freezing rain)

Sea Level Change

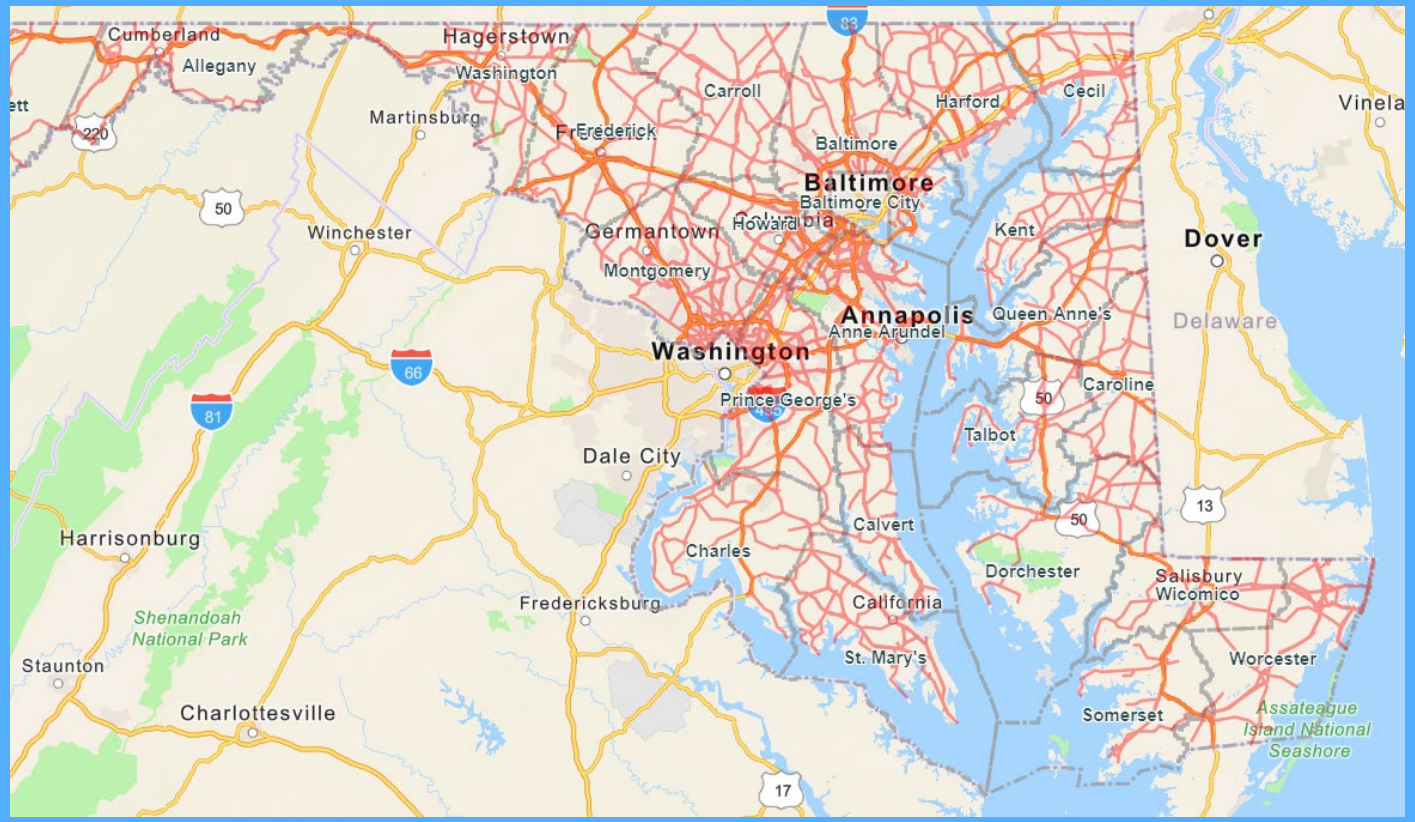
Extreme Weather Events

Cumulative Effects of Listed Stressors

Vulnerability Analysis Framework

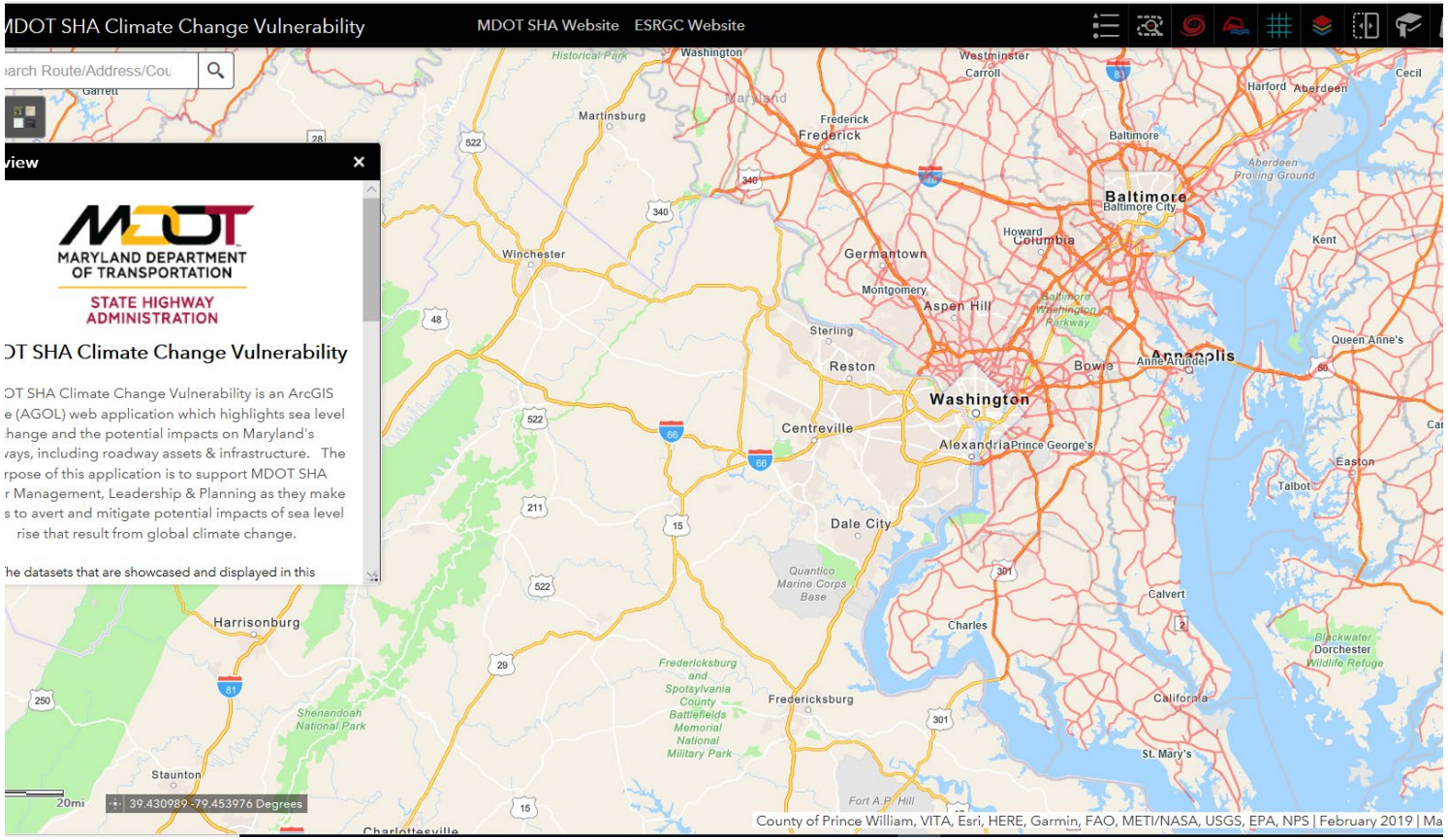
Compile	Develop	Evaluate
Compile Asset and Climate Information	Develop Predictive Models	Evaluate Primary Assets

Two Level Analysis



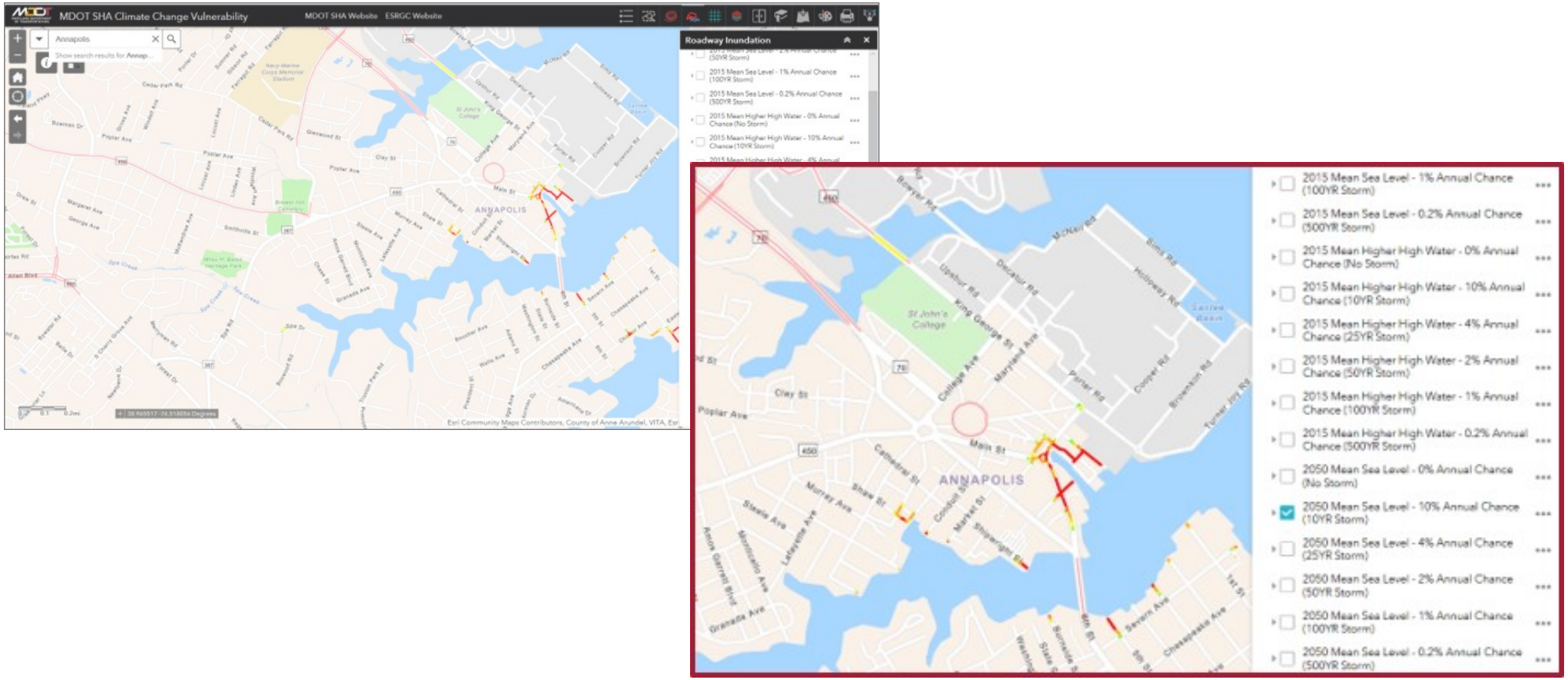
- TIER 1
  - Map Sea Level Change
  - Develop Climate Change Impact Zone
  - Analyze Flood Depth Grids with Centerline elevation
  - Develop Risk Indicators
- TIER II
  - Utilize Tools
  - Vulnerability Assessment Scoring Tool (VAST)
  - Hazard Vulnerability Index (HVI) = (Evacuation Code*0.5+1) + (Flood Depth Code+0.01)/4 + (0.7/Functional Classification)

PROVIDE ACCESSIBLE RESULTS



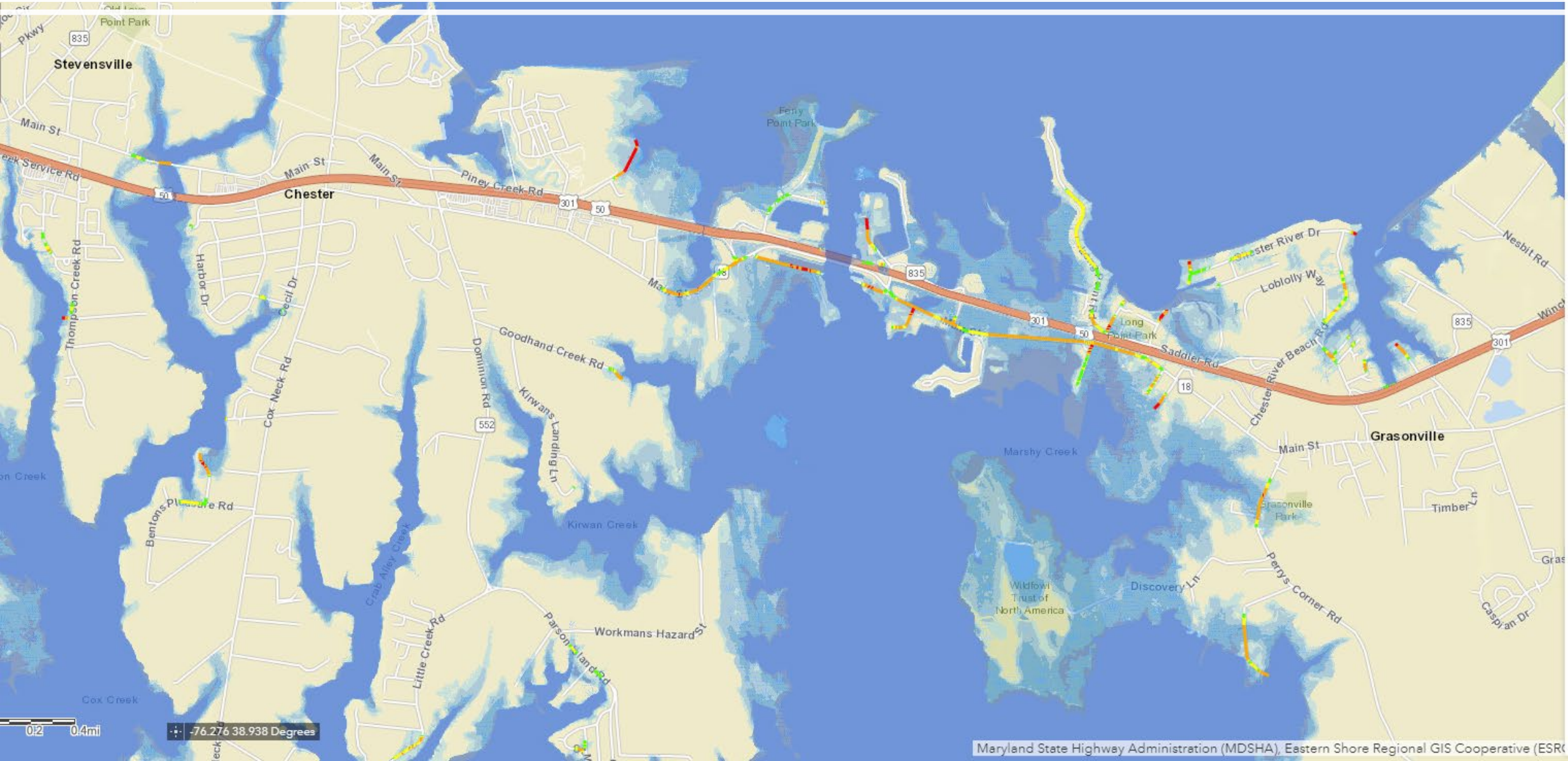
Climate Change Vulnerability Viewer

- https://arcg.is/ymbaW



CLIMATE CHANGE VULNERABILITY VIEWER

Kent Island 2015 50-Year Storm



Kent Island 2050 50-Year Storm

Aerial Photo/Model Comparison Crisfield, MD

- City of Crisfield Facebook Page (https://www.facebook.com/pages/City-of-Crisfield)
- Tony Laird drone footage

Evacuation	Code
No	0
Yes	1

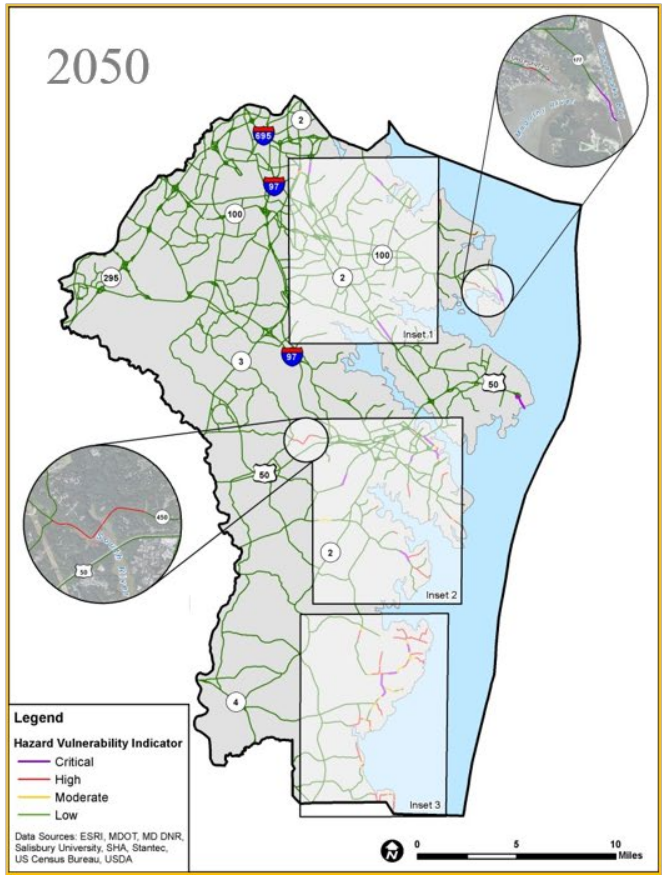
Flood Depth (Feet)	Code
No Flood	0
0 – 0.5	1
0.5 - 1	2
1 - 2	3
>2	4

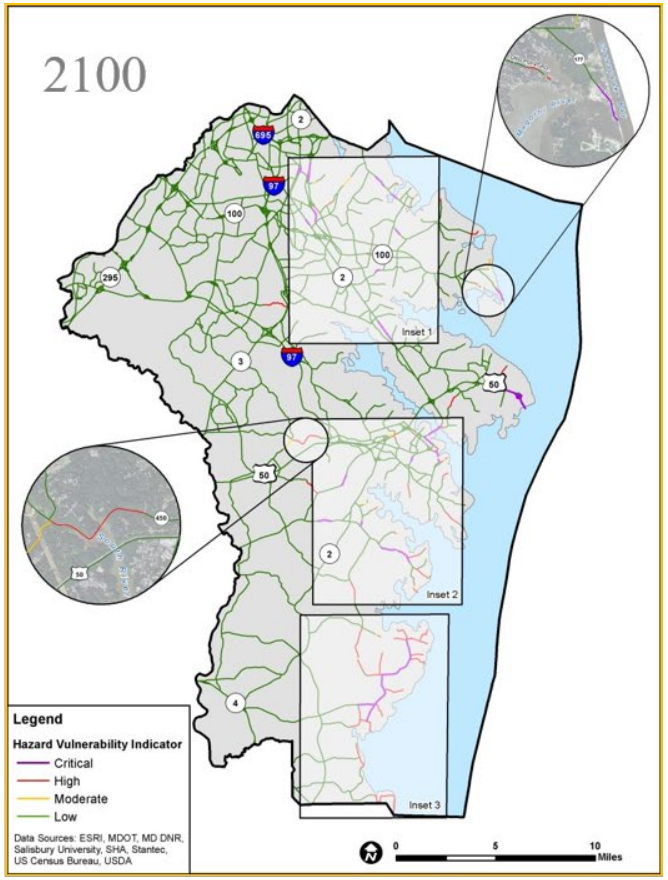
Value	SHA Functional Class
1	Interstate
2	Principal Arterial – Other Freeways and Expressways
3	Principal Arterial – Other
4	Minor Arterial
5	Major Collector
6	Minor Collector
7	Local

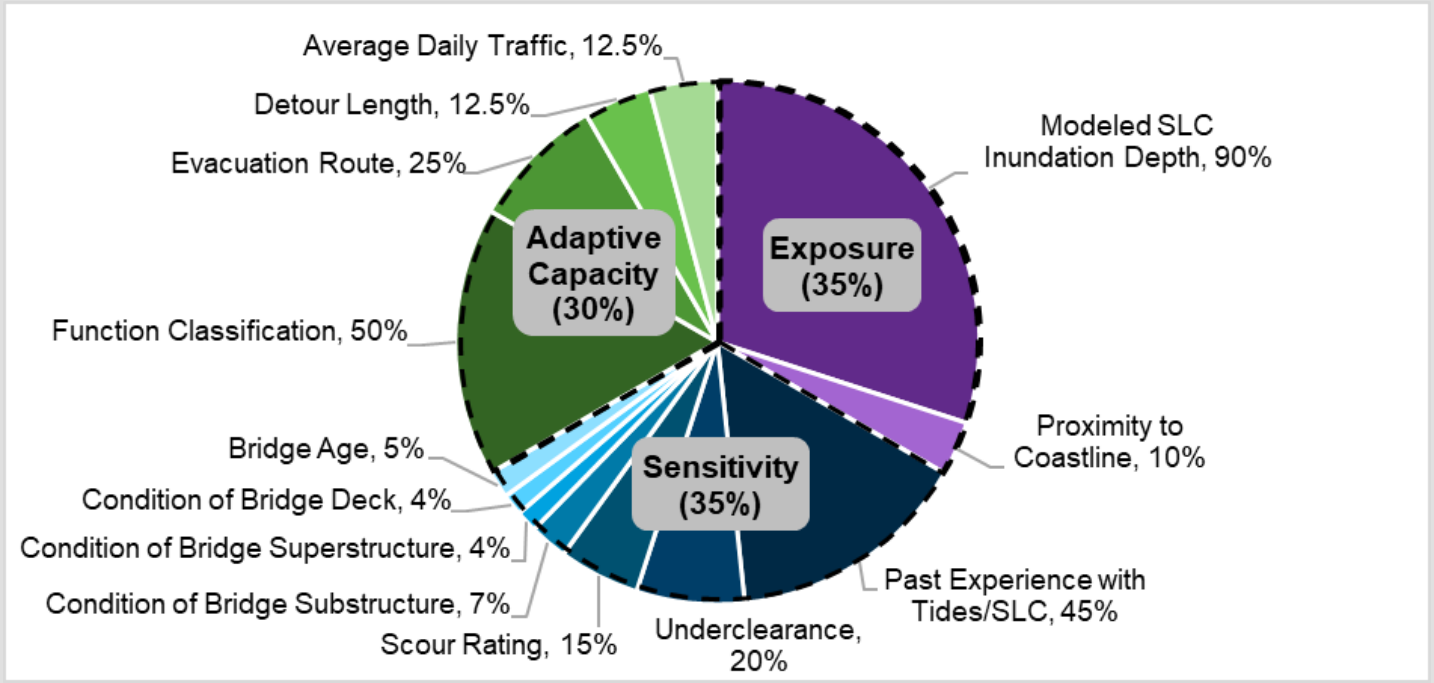
Hazard Vulnerability Index

- (Evacuation Code*0.5+1) + (Flood Depth Code+0.01)/4 + (0.7/Functional Classification)

HVI for Anne Arundel County







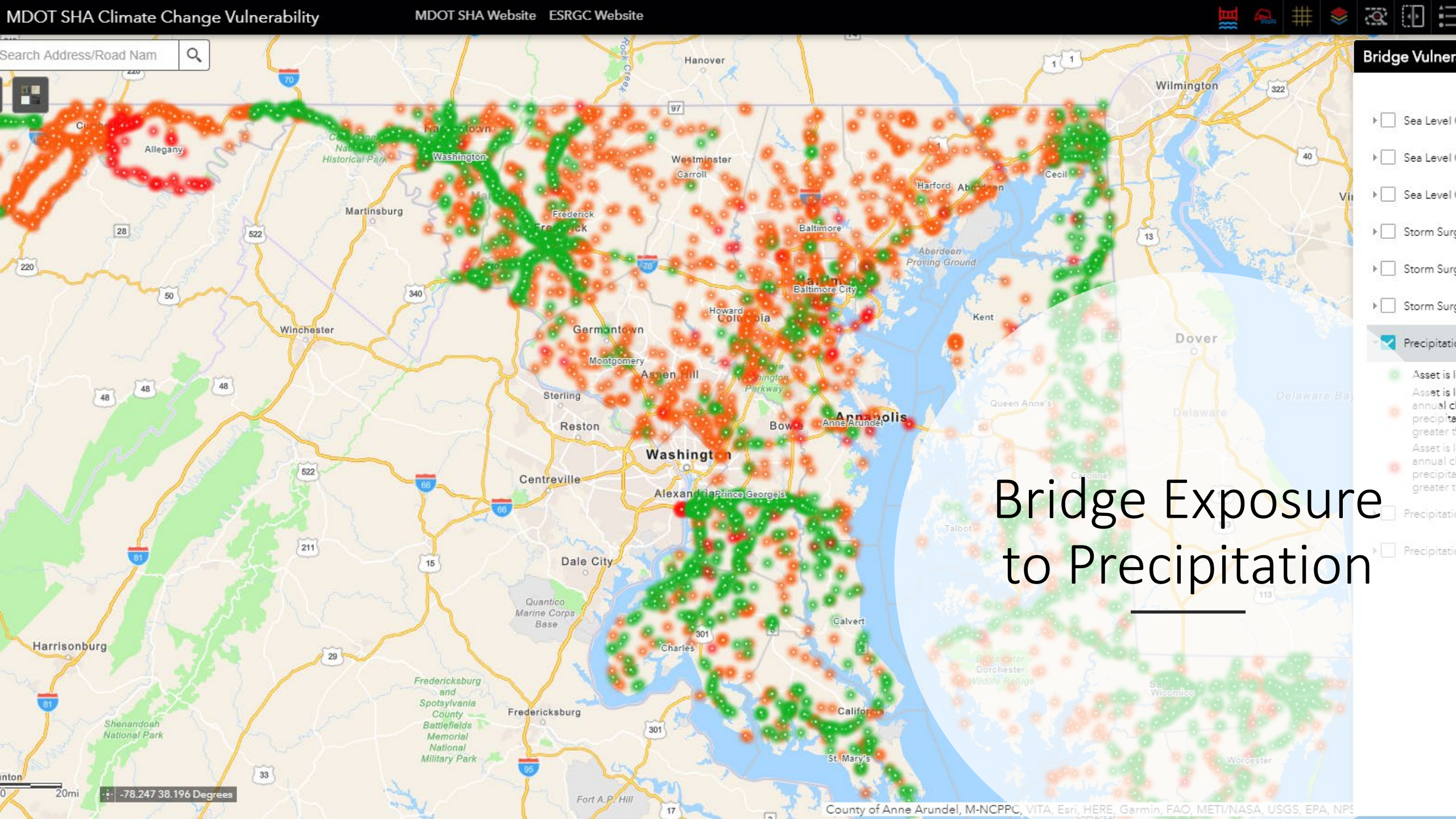
Bridge VAST Methodology - Sea Level Change, All Coastal Counties

Vulnerability Assessment: Results

Sea level change: 33 assets

Storm surge: 172 assets

Precipitation change: 102 assets


MDOT SHA Climate Change Vulnerability
MDOT SHA Website
ESRGC Website
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to Precipitation
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Wilmington
Allegany
Washington
Westminster
Garroll
Harford
Cecil
Martinsburg
Frederick
Baltimore
Aberdeen
Proving Ground
Baltimore City
Howard
Kent
Winchester
Germantown
Dover
Montgomery
Aspen Hill
Sterling
Reston
Bowie
Anne Arundel
Annapolis
Queen Anne's
Delaware
Centreville
Alexandria
Prince George's
Talbot
Caroline
Dale City
Quantico
Marine Corps
Base
Calvert
Charles
Harrisonburg
Blackwater
Dorchester
Wildlife Refuge
Fredericksburg
and
Spotsylvania
County
Battlefields
Memorial
National
Military Park
Fredericksburg
Shenandoah
National Park
St. Mary's
Worcester
Fort A.P. Hill
20mi
-78.247 38.196 Degrees
County of Anne Arundel, M-NCPPC, VITA, Esri, HERE, Garmin, FAO, METI/NASA, USGS, EPA, NPS

VAST – Data and Indicator Details

Component		Indicator	Weight	Indicator Value	Score	Justification
Exposure	35%	Modeled SLC Inundation Depth (2050 Mean Higher High Water)	90%	$x \geq 3$ Feet of inundation from MHHW	4	Locations with larger projected amounts of sea level change are likely to be impacted by projected changes in climate, including permanent inundation.
				$1.4 \leq x < 3$ Feet of inundation from MHHW	3	
				$0 < x < 1.4$ Feet of inundation from MHHW	2	
				$x \leq 0$ feet of inundation from MHHW	1	
		Proximity to Coastline	10%	$1 \leq$ Feet < 500	4	Assets that are located a shorter distance from the coastline are more likely to be affected by sea level change.
				$500 \leq$ Feet $< 1{,}000$	3	
				$1{,}000 \leq$ Feet $< 5{,}000$	2	
				$5{,}000 \leq$ Feet $< 24{,}576$	1	
Sensitivity	35%	Past Experience with Storm Surge	45%	Demonstrated at least moderate damage during past storm surge events	4	Structures that have demonstrated sensitivity in the past are likely to be sensitive in the future.
				Demonstrated at least minor damage during past storm surge events	3	
				No experience of damage beyond operational disruption during past storm surge events	2	
				No experience of prior storm surge	1	
		Underclearance	20%	A (< 10')	4	Assets with a lower underclearance are more likely to experience impacts when exposed. For example, surge is more likely to overtop the structure and cause damage or disruption.
				B (10' to < 20')	3	
				C (20' to < 30')	2	
				D (30' to < 40'), E (> 40')	1	

Integrating Results into Practice: Planning

Climate Change Impact Areas

Is this Project within an area potentially affected by Sea Level Change? Yes

Project must consider sea level change.

☒ Mean Sea Level 2050 ☒ Mean Sea Level 2100

See attached Sea Level Change Map, if applicable

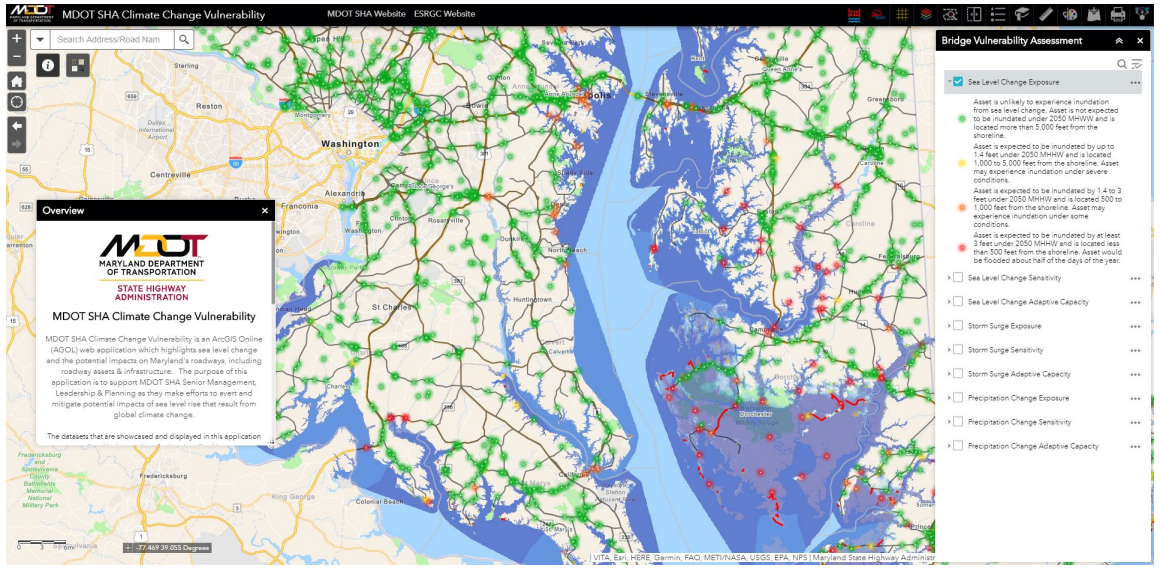
☒ Mean High High Water 2050 ☒ Mean High High Water 2100

Is this a non-state Project located on State lands? No

Is this project involving construction of a new road or bridge, or reconstructing an existing road or bridge due to a storm event? No

Is this project involving construction of a new building/facility or reconstructing an existing building/facility due to a storm event? No

Notes: The hydraulics analysis determined that up to 100-year storm flooding events would not overtop the bridge. The roadway approaches to the bridge are being raised between 1 to 2.5 feet. Additional roadway improvements may be needed to address future flooding.



FHWA Pilot Studies

- 2018 - 2020/2024 Resilience and Durability to Extreme Weather
- **2017-2019 Asset Management, Extreme Weather , and Proxy Indicators**
- 2016-2017 Nature-based Resilience for Coastal Highways
- **2013-2015 Vulnerability Assessments and Adaptation Options**
- 2010-2011 Vulnerability Assessments

View as list

MDOT's Renewable Energy Program

Energy Program

Energy Efficiency

Executive Order

MDOT Owned Solar Arrays

MDOT MTA

MDTA

MDOT MAA

MDOT MPA

Renewable Energy Development

RFP and TORFP Process

TO’s to date

Energy Efficiency

Executive Order 01.01.2019.08 – Energy Savings Goals for State Government

- State spends >$210M/year on energy-related utilities
- Reduction in energy costs since 2014
- MEA and DGS develop and manage an energy-savings initiative with the goals of, by 2029, **reducing energy consumption in State-owned buildings by 10%** compared to a FY18 baseline

MDOT Owned Solar Arrays

Photovoltaic Systems owned by MDOT through Energy Performance Contracts:

- MDOT MTA
- MDTA
- MDOT MAA
- MDOT MPA
  - Shed 10
  - Cruise Terminal

In 2016 MDOT used 385,000MW of conventional energy, equivalent to the same amount of energy used by 31,500 homes.

Renewable Energy Development

MDOT has installed solar, wind, and geothermal energy systems at MDOT facilities. In 2016, these systems generated 1.829MWh, saving $200,000 and reducing our CO2 emissions by 1,285 MT

- RFP Development
- Master Contractor Qualification
- Task Orders

MDOT's Sustainable Materials Management Program

Sustainable Materials Management Maryland (SM³)

E.O. 01.01.2017.13
Waste Reduction and Resource Recovery Plan for Maryland

SM³ Draft Strategic Plan

Vision

Improve the environment and create economic development and job creation opportunities in the State of Maryland by identifying and executing creative and innovative sustainable materials management projects and activities, through public and private sector voluntary collaborations, including the Maryland Department of the Environment (MDE) and other Maryland governmental entities.

Mission

Identify and collaborate with a wide range of multi-sector companies and entities, along with their suppliers, and key public-sector leaders to design and implement materials management initiatives and projects for Maryland in a way that will foster the establishment of new materials management businesses in Maryland; conserve natural resources; meet State climate change goals for 2030 and beyond; and, embrace new and more effective measures of success.

Recommended Actions

1. Identify Legislative Barriers

- RCRA
- State regulatory definitions
- Regulatory and legislative language
- Refining metrics and measures
- Engage Small Medium Enterprises (SME’s)
- Support the creation of new technologies
- Educate consumers

Recommended Actions

2. Creation of a new Maryland's Waste Reduction and Resource Recovery Innovation Center (MWR³ Innovation Center)

- Provide four areas of development focused on collecting and processing what has historically been called "wastes"
- Include a Research and Technology Center designed to attract and refine innovative technologies that can be used and applied to address new and creative ways to utilize various kinds of wastes

For more information on MDOT's Energy and Sustainable Materials Management Programs:

Eddie Lukemire

Program Manager, Office of Environment

Elukemire@mdot.Maryland.gov

(410) 865-2770

Thank You!

MARYLAND DEPARTMENT OF TRANSPORTATION

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