FDOT

U.S. Department of Transportation
Federal Highway Administration

Session 3: Peer Exchange – Resilience Investments

August 28, 2020

HOUSEKEEPING

- Keep your lines muted unless speaking
- To ask a question, type into the **chat pod** or “**raise your hand**” using the hand icon in the toolbar to be called on
- Video encouraged, especially during discussions
- Sessions will be recorded

GOALS AND OBJECTIVES

- **Share approaches** for using the MPO planning process to increase natural hazard resilience.
- Ensure all MPOs in the state share an **understanding of approaches and best practices**.
- Create an opportunity for **peer-to-peer collaboration** on how to integrate resilience into planning at individual agencies.

This session: Hear from MPOs on approaches and lessons learned from their experience with resilience challenges

AGENDA

Speakers:

- Pramod Sambidi & Kathryn Vo , Houston-Galveston Area Council (H-GAC)
- Jennifer Fogliano, North Jersey Transportation Planning Authority (NJTPA)
- Dale Stith, Hampton Roads TPO
- Scott Smith, U.S. DOT Volpe Center

Discussion

PollEverywhere

POLL EVERYWHERE QUESTION

- What was your key takeaway from Session 2: Resilience Needs and Strategies?

Peer Presentations

PRAMOD SAMBIDI & KATHRYN VO, H-GAC

Dr. Pramod Sambidi is a Socioeconomic Modeling Manager at the Houston-Galveston Area Council (H-GAC). Pramod leads H-GAC's efforts in developing long-range demographic, economic, and land use forecasts for the Greater Houston region. He also leads H-GAC's efforts in designing and developing interactive web mapping applications/tools to assist local governments, planners, researchers, and businesses in effective decision-making process. Pramod has more than 15 years of experience in modeling, regional and urban economics, and data management. Pramod holds a Ph.D. in Agricultural Economics from Louisiana State University.

Kathryn Vo is a Senior Planner at the H-GAC. Originally from the San Francisco Bay Area, Kathryn graduated from the University of California, Davis with a degree in Environmental Policy Analysis & Planning with an emphasis in Transportation & Energy.

She is an accomplished transportation planner with five years of planning expertise in bus transit, multimodal transportation, and small-scale placemaking innovations. Kathryn designs equitable, resilient regional transportation systems to protect communities from economic and environmental hardships. If you're in the Loop, you may see Kathryn roller skating along one of Houston's many bayous.

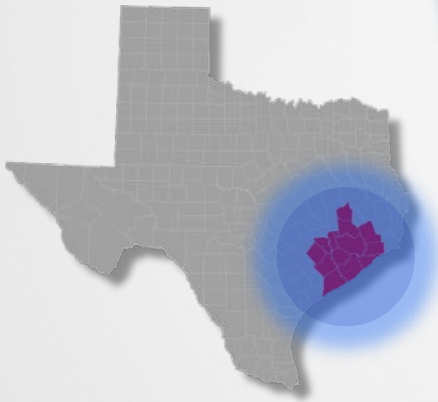
H-GAC’s Resiliency and Durability to Extreme Weather Pilot Study

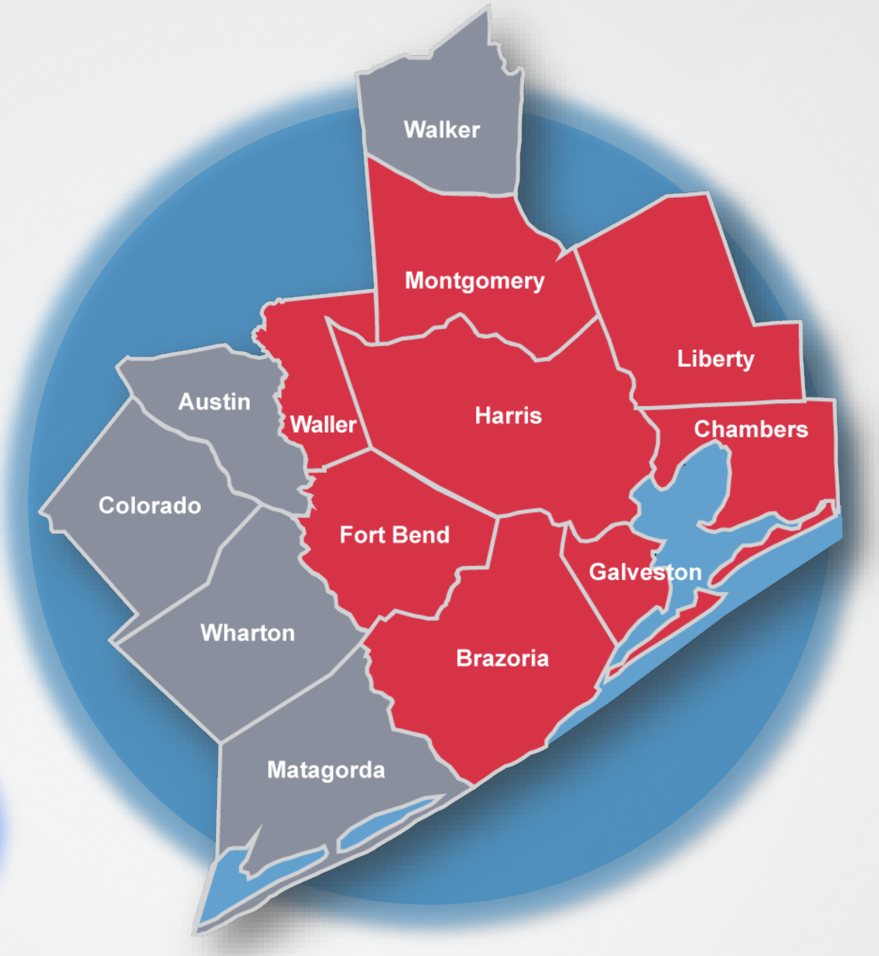
Pramod Sambidi PhD and Kathryn Vo
Houston-Galveston Area Council

FHWA-FDOT Resilience Peer Exchange August 28, 2020

H-GAC serves:

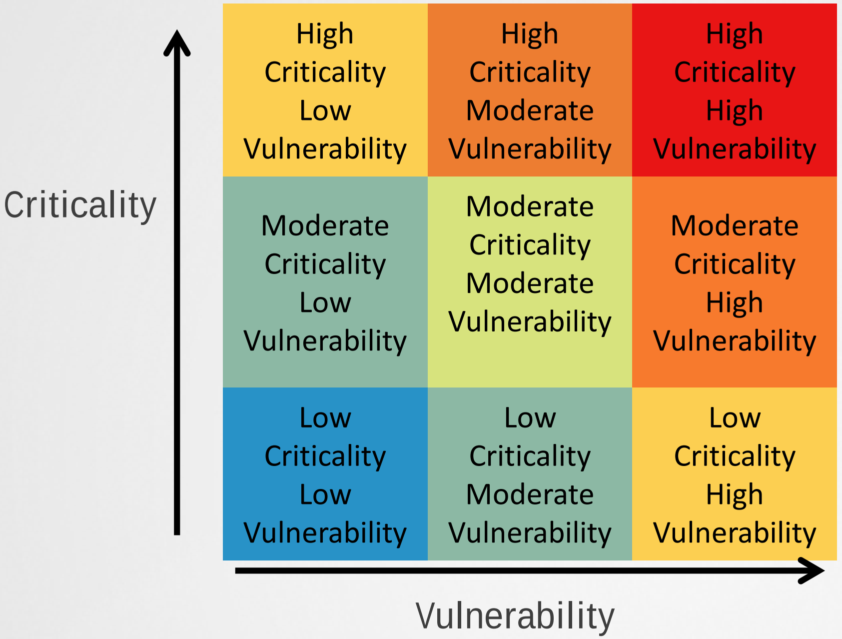
- **13 counties**
- **134 cities**
- **7 million people**
- **3 million jobs**
- **MPO for 8-county metro area**





Study Goals

- Measure Criticality and Vulnerability of Regional Transportation Assets to Extreme Weather Events



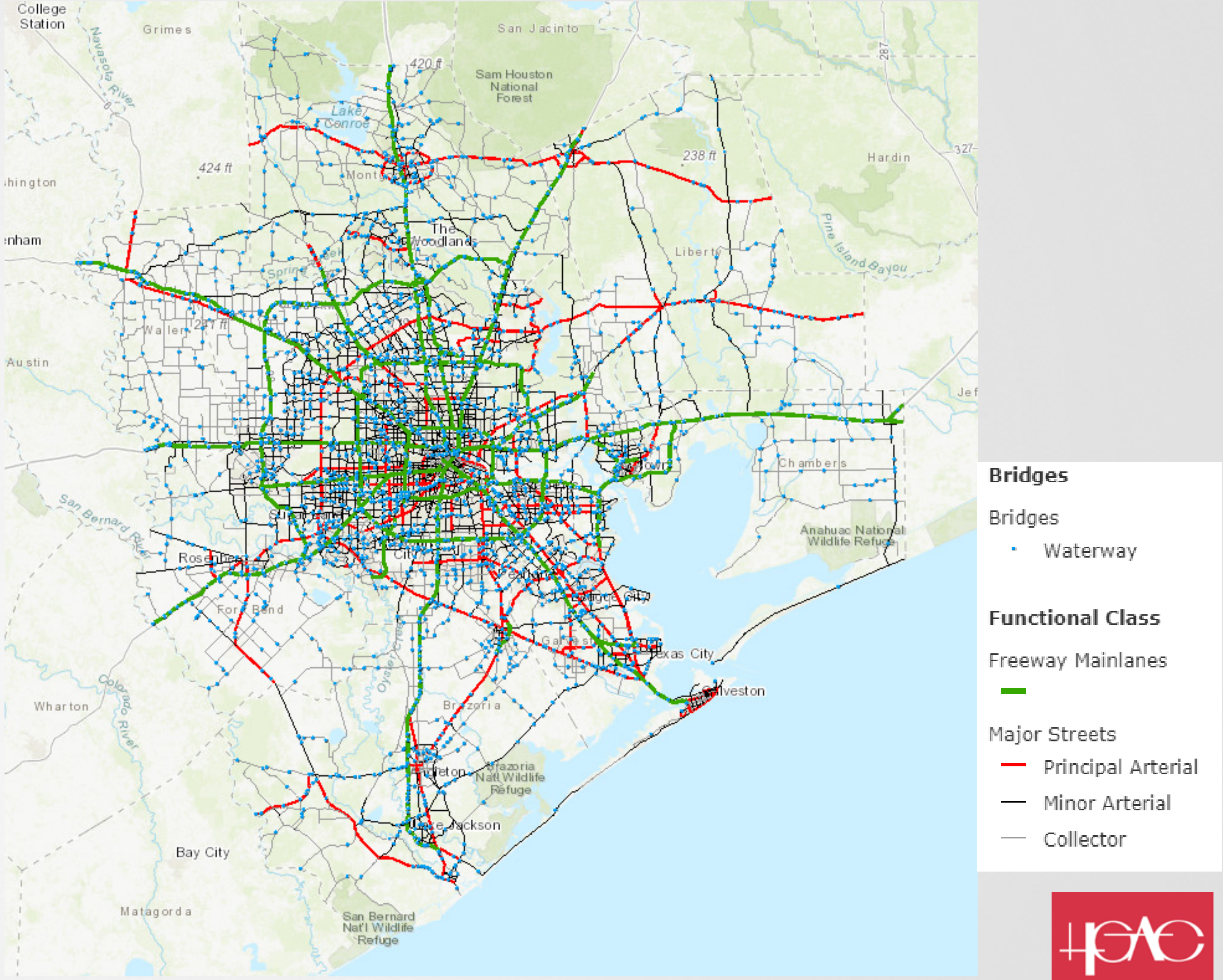
High Criticality Low Vulnerability	High Criticality Moderate Vulnerability	High Criticality High Vulnerability
Moderate Criticality Low Vulnerability	Moderate Criticality Moderate Vulnerability	Moderate Criticality High Vulnerability
Low Criticality Low Vulnerability	Low Criticality Moderate Vulnerability	Low Criticality High Vulnerability

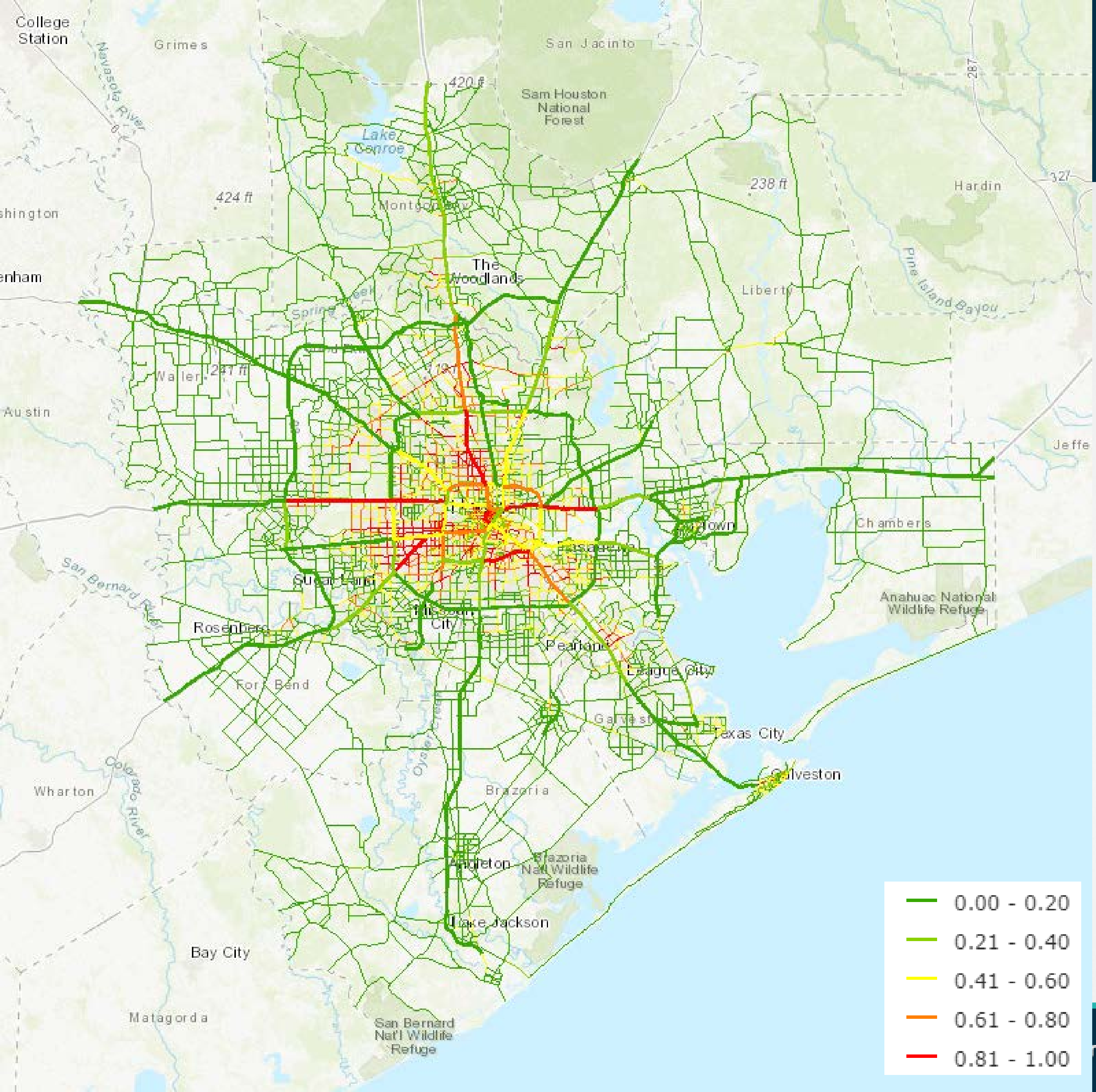
- Develop Adaptation Strategy Decision Tool that Provide Recommendations for a Resilient Transportation Infrastructure

- Update H-GAC publications and future project selection criteria

Transportation Assets

- Freeways (83 segments)
- Major roads (7,696 segments)
  - major arterials
  - minor arterials
  - collectors
- Bridges (3,489) with waterway





Criticality Assessment

- **Socio-economic importance (20%)**

  link to airport; link to port; service to activity population

- **Operational & usage importance (40%)**

  AADT; AADT-truck; transit ridership

- **Health & safety importance (30%)**

  link to hospitals; link to fire stations; service to vulnerable population

- **Emergency response importance (10%)**

  evacuation route; link to shelters; link to EOCs; military access

Scope, Climate/ Extreme Weather Threats

FEMA Disaster Declarations

1967 - 2018

13	Floods
11	Severe Storms
6	Hurricanes
3	Fires
2	Coastal Storms

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Work Group Feedback

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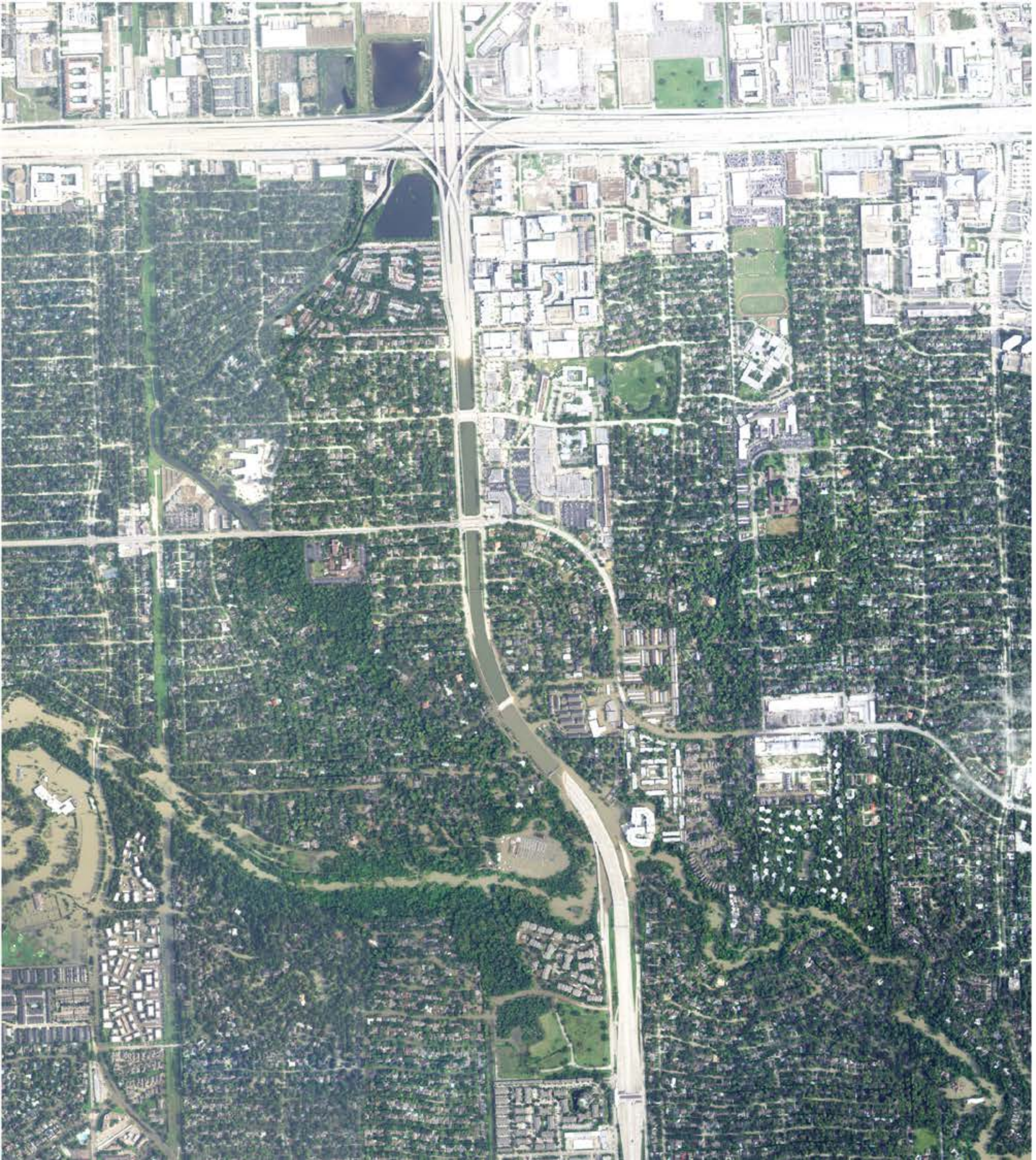
Extreme Weather Threats to Study:

1) Inland Flooding
2) Coastal Flooding



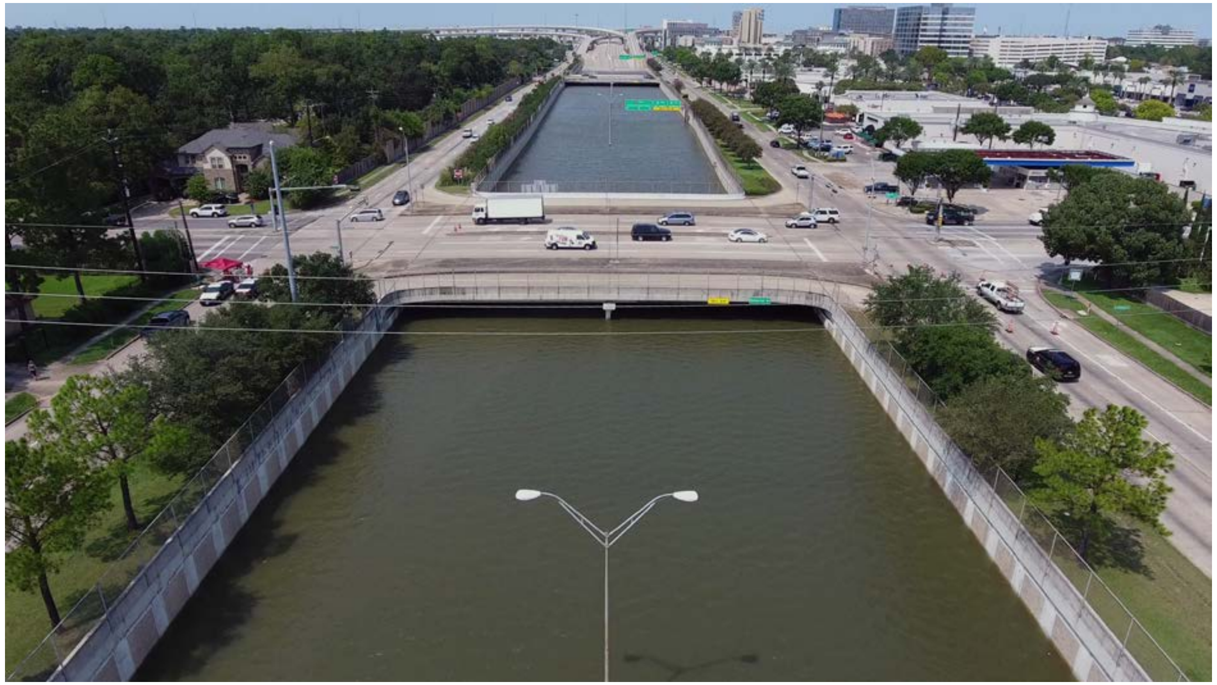
Exposure Assessment: Harvey Flooding

BW 8 at IH-10 South

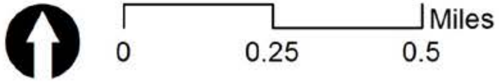
Post Harvey Aerial Imagery (2017)

Flight Timeline

- Aug. 30, 2017 - Sept. 8, 2017



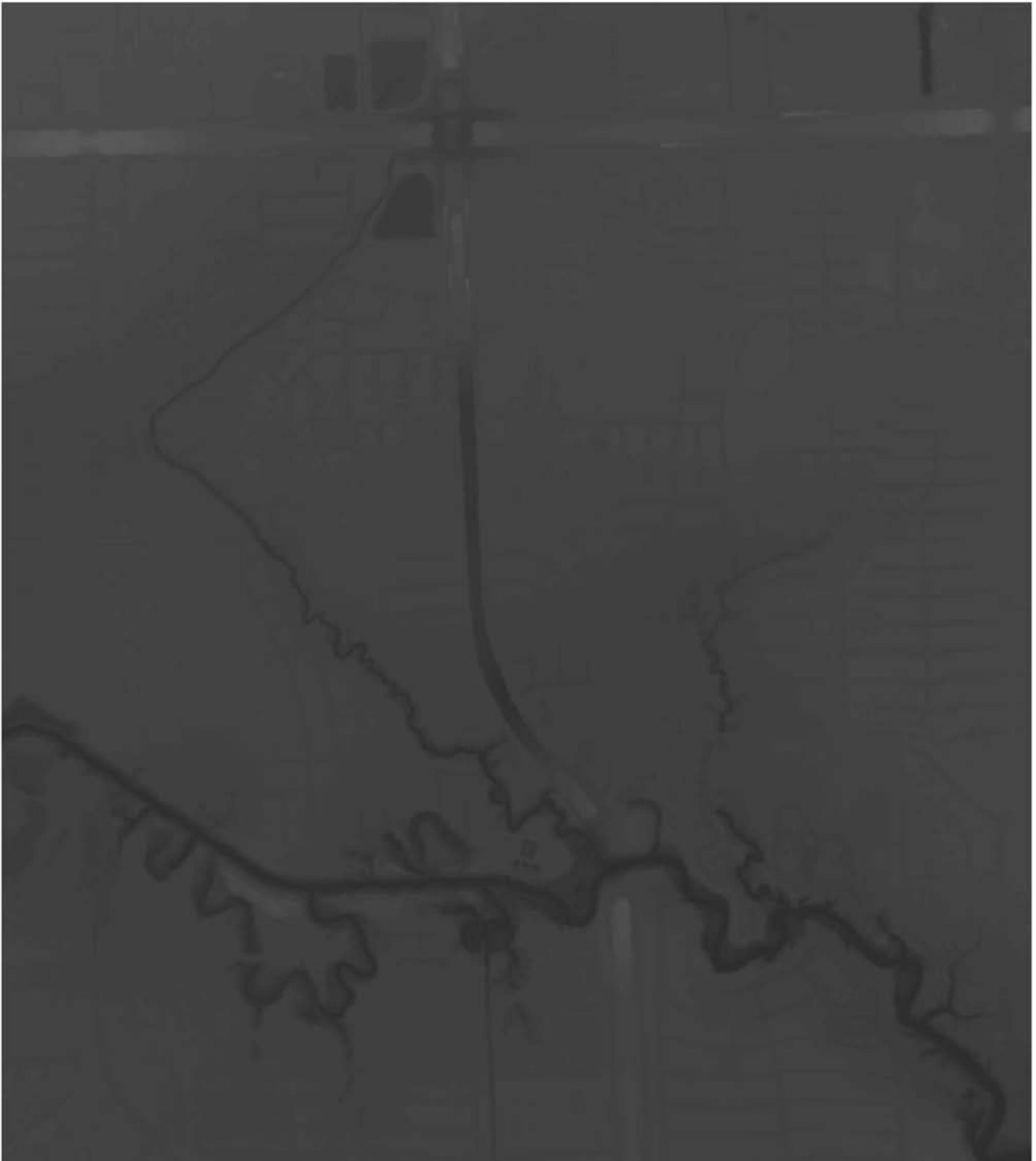
BW 8 at Memorial Drive



METROPOLITAN PLANNING ORGANIZATION

Measuring Level of Exposure

- Ground Elevation (LiDAR Data)
- Surface Elevation (Roadways and Bridges) (LiDAR Data)
- Water Depth (FEMA, NOAA, H-GAC Modeling)

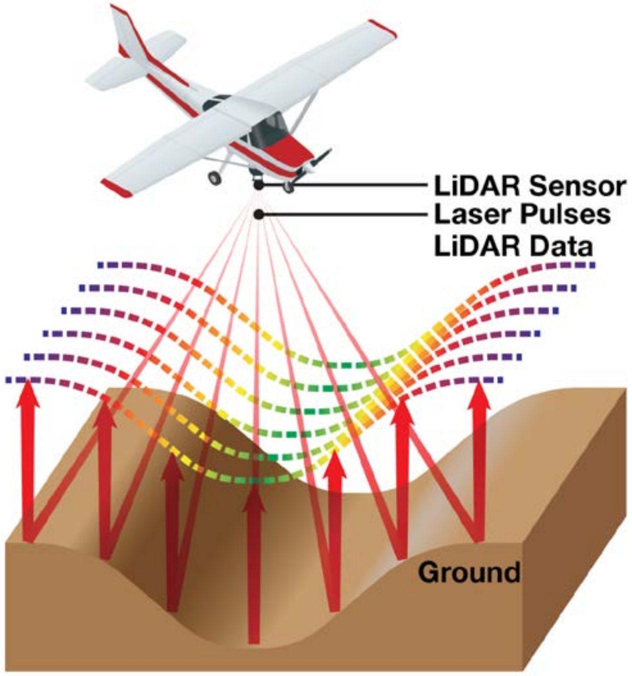


Exposure Assessment: Harvey Flooding

BW 8 at IH-10 South

Digital Elevation Model (DEM) from 2018 LiDAR

Digital Elevation Model (DEM) is a digital representation of a terrain's elevation data derived from 2018 LiDAR.



Legend

DEM

High

Low

0 0.25 0.5 Miles

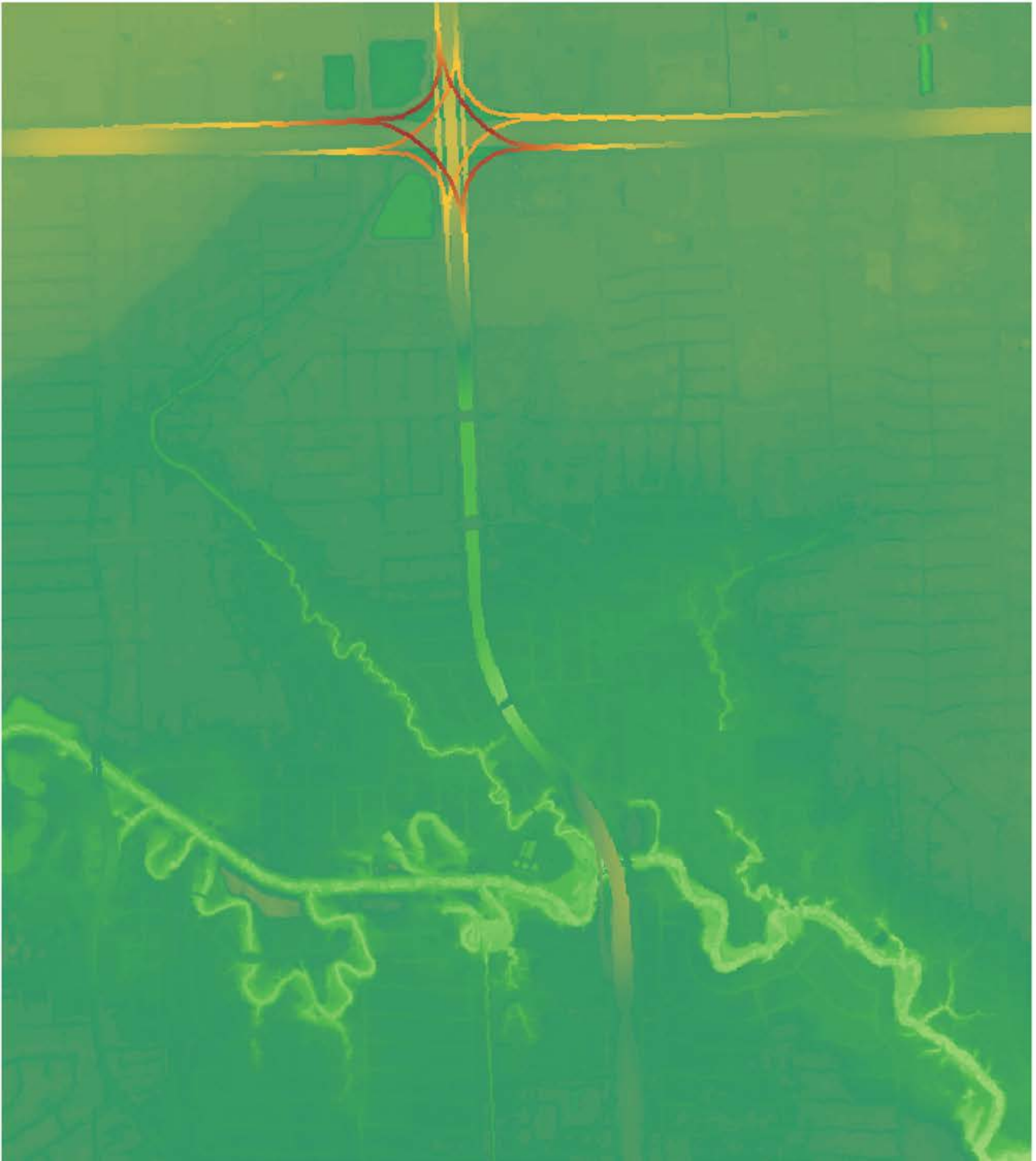
METROPOLITAN PLANNING ORGANIZATION

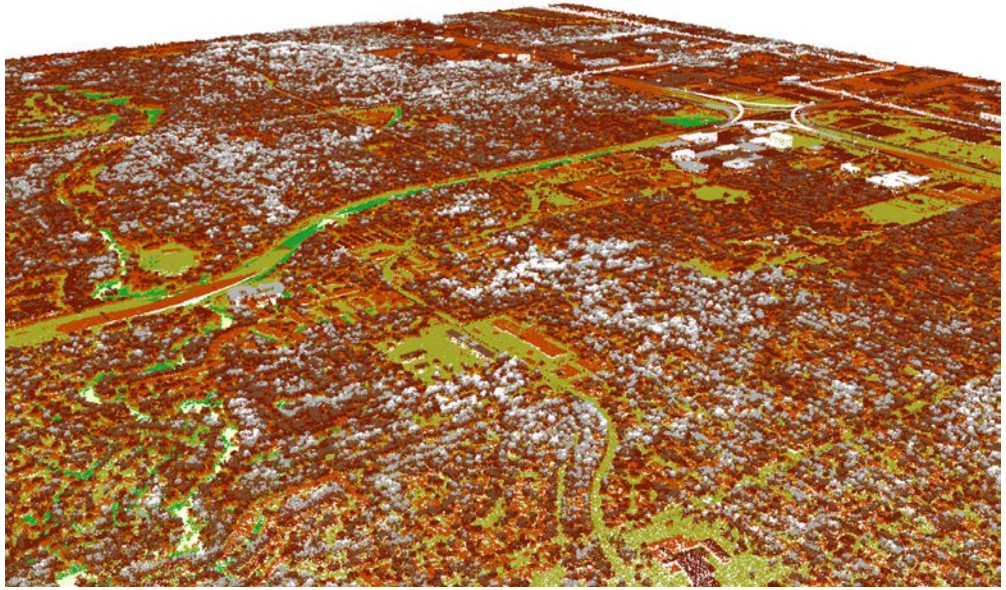
Exposure Assessment: Harvey Flooding

BW 8 at IH-10 South

Digital Surface Model (DSM) from 2018 LiDAR

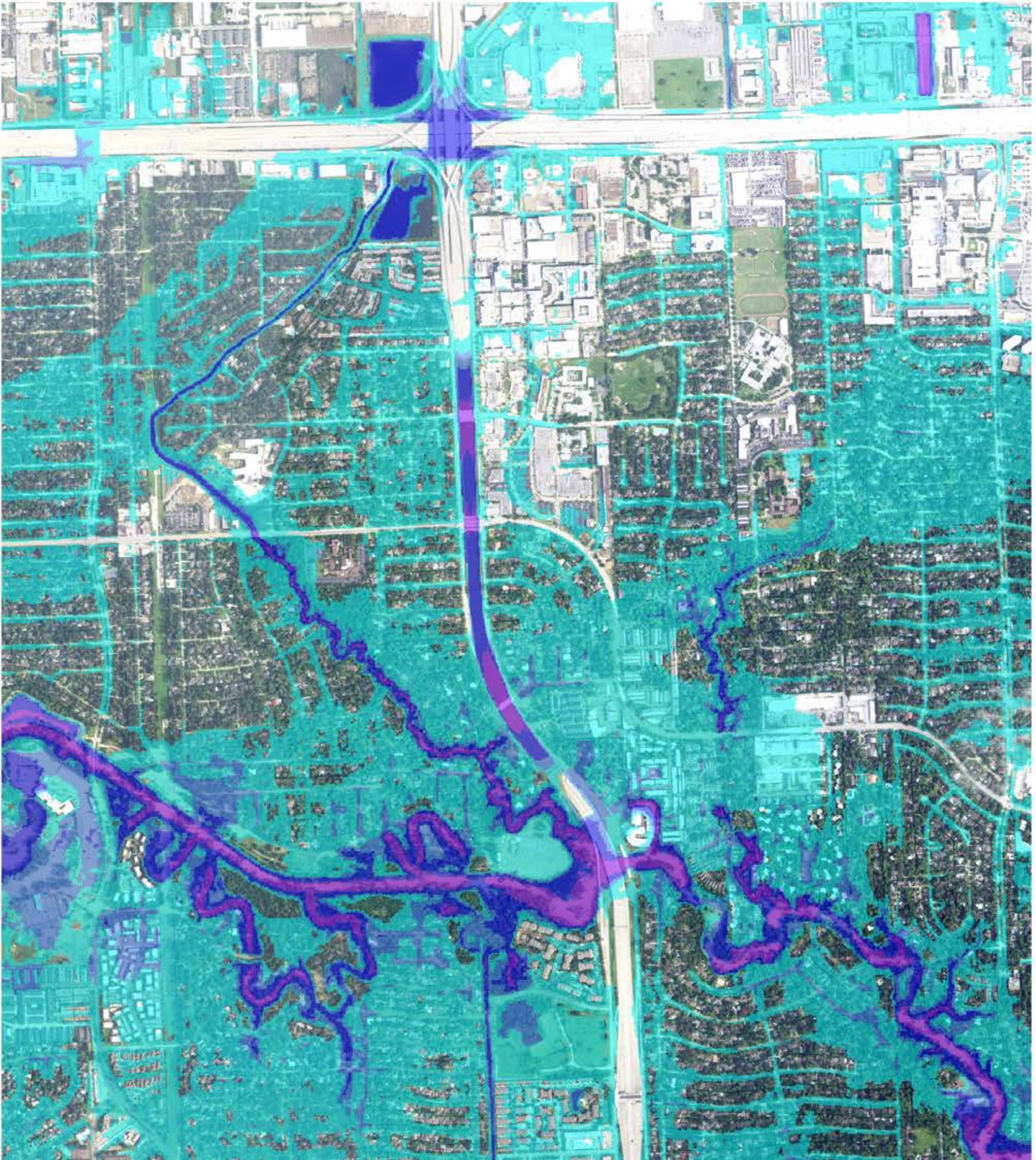
Digital Surface Model (DSM) represents the elevations of the reflective surfaces of **roadways** and **bridges** elevated above the ground.





LiDAR LAS image

METROPOLITAN PLANNING ORGANIZATION

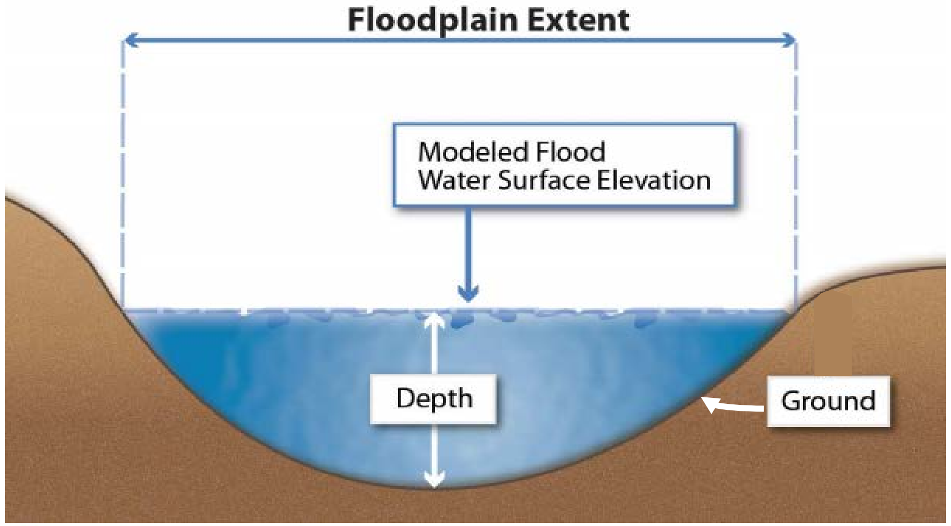


Exposure Assessment: Harvey Flooding

BW 8 at IH-10 South

FEMA Harvey Flood Model (2017)

Water Depth Grid =
Modeled Flood Water Surface Elevation – Ground Elevation (DEM)



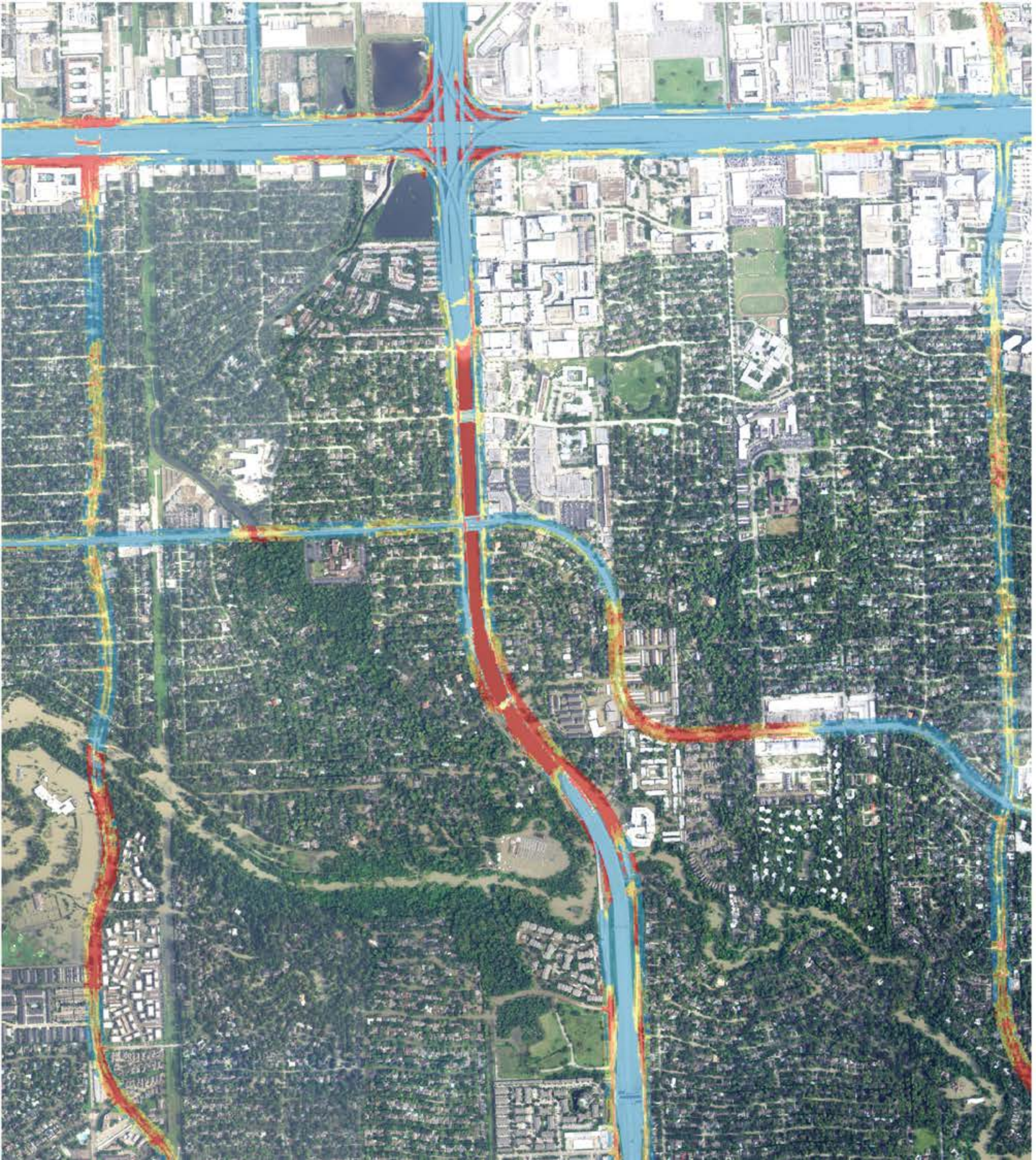
Harvey Depth Grid

Feet

- 0 - 5
- 6 - 10
- 11 - 20
- 21 - 40
- 41 +

0 0.25 0.5 Miles

METROPOLITAN PLANNING ORGANIZATION

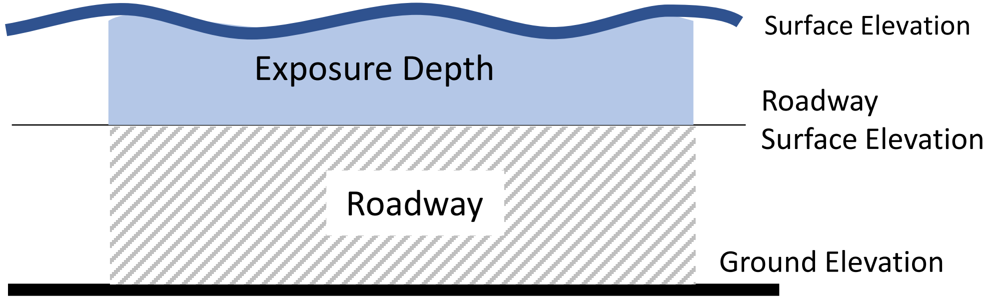


Exposure Assessment: Harvey Flooding

BW 8 at IH-10 South

Exposure Depth Grid

Exposure Depth =
Flood Water Surface Elevation – Digital Roadway Surface Elevation



Legend

Exposure Depth Grid

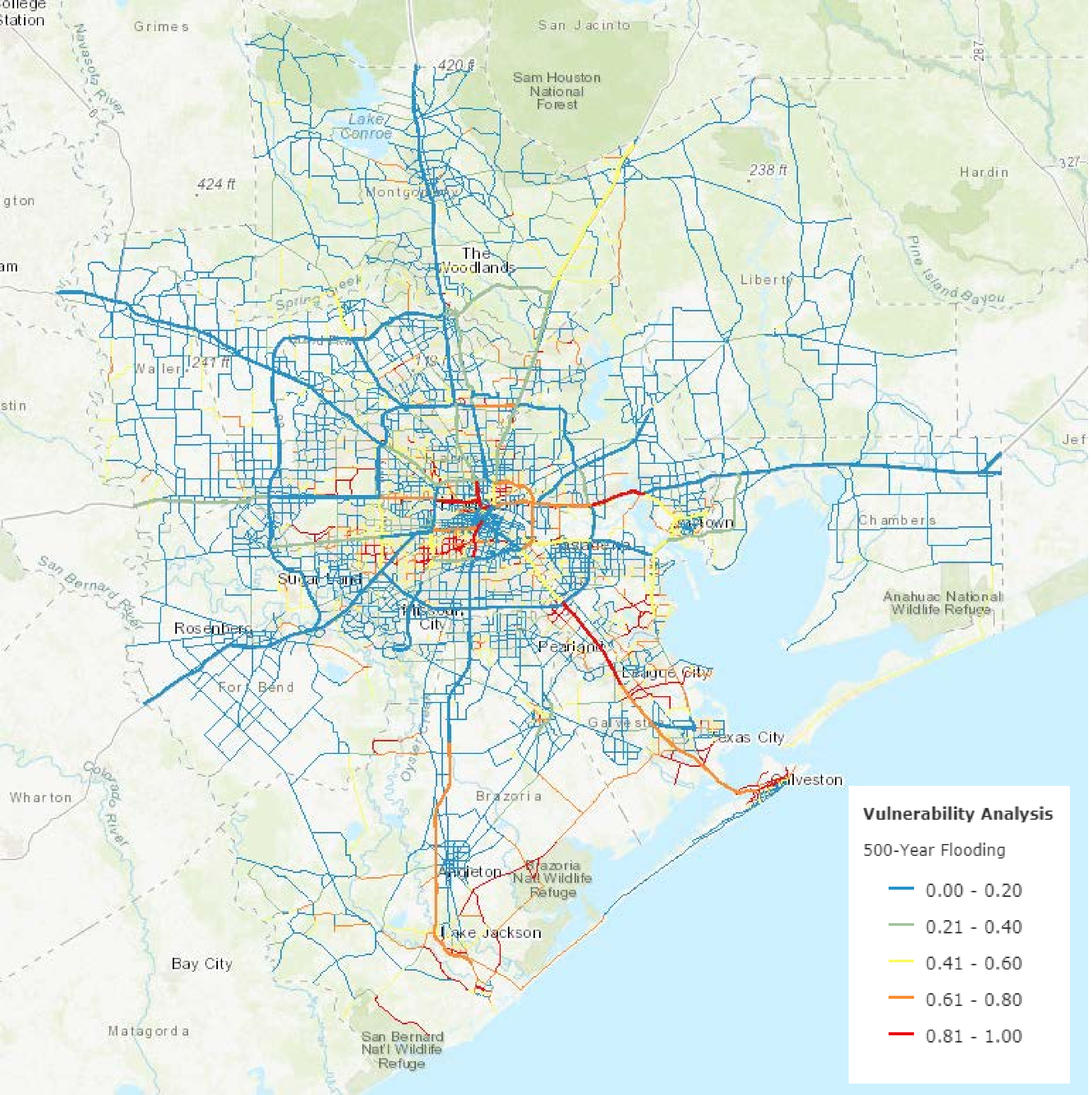
Exposure Level

- 🟦 No exposure or low risk
- 🟩 Medium-low risk
- 🟨 Medium risk
- 🟧 Medium-high risk
- 🟥 High risk

Exposure Description	Exposure Level
Not exposed/ Less than 0 foot of flood water	No exposure or low risk
0 - 1 foot of flood water	Medium-low risk
1 - 2 feet of flood water	Medium risk
2 - 3 feet of flood water	Medium-high risk
More than 3 feet of flood water	High risk

0 0.25 0.5 Miles

METROPOLITAN PLANNING ORGANIZATION



Vulnerability Assessment
VAST Tool

- **Exposure Assessment (70%)**
  Flooding (100-year, 500-year, & Harvey)
  Storm Surge (Hurricane Category 1 - 5 and Ike)
  Sea-Level Rise (4 & 5 feet)

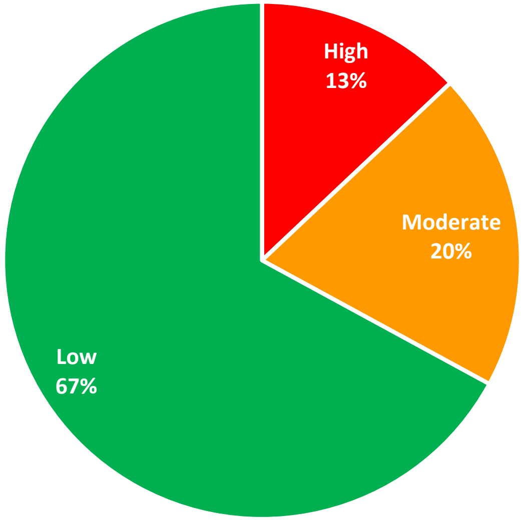
- **Sensitivity Assessment (20%)**
  Bridge Age
  Structural Evaluation
  Channel Conditions
  Scour Ratings
  Pavement Condition
  Past Closure

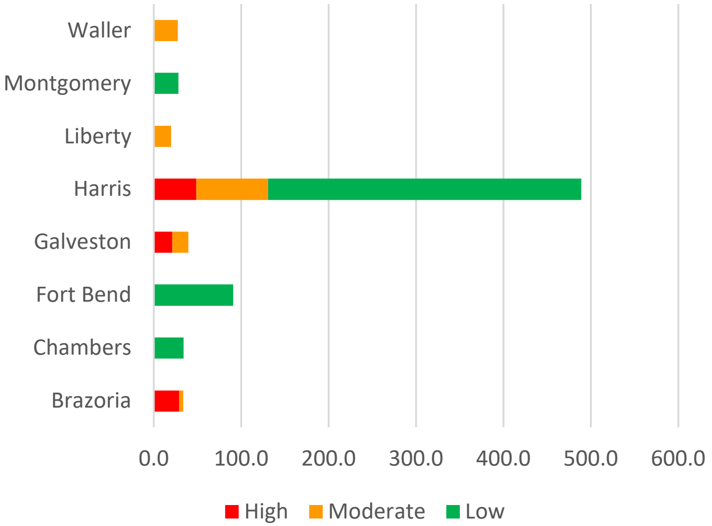
- **Adaptive Capacity Assessment (10%)**
  Detour Length
  Repair Cost

METROPOLITAN PLANNING ORGANIZATION

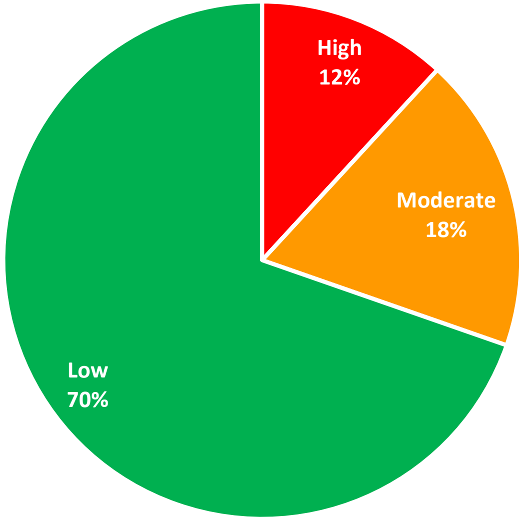
Vulnerability: Combined (Flooding 50% + Storm Surge 35% + Sea-Level Rise 15%)

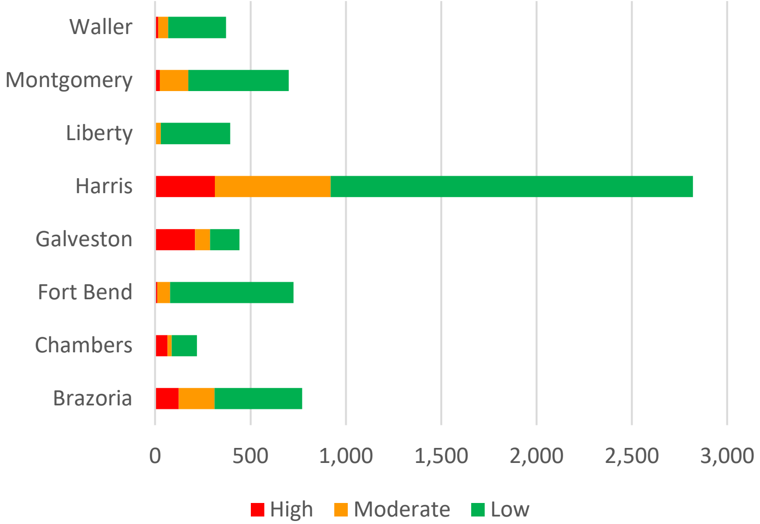
Freeways: 762 centerline miles

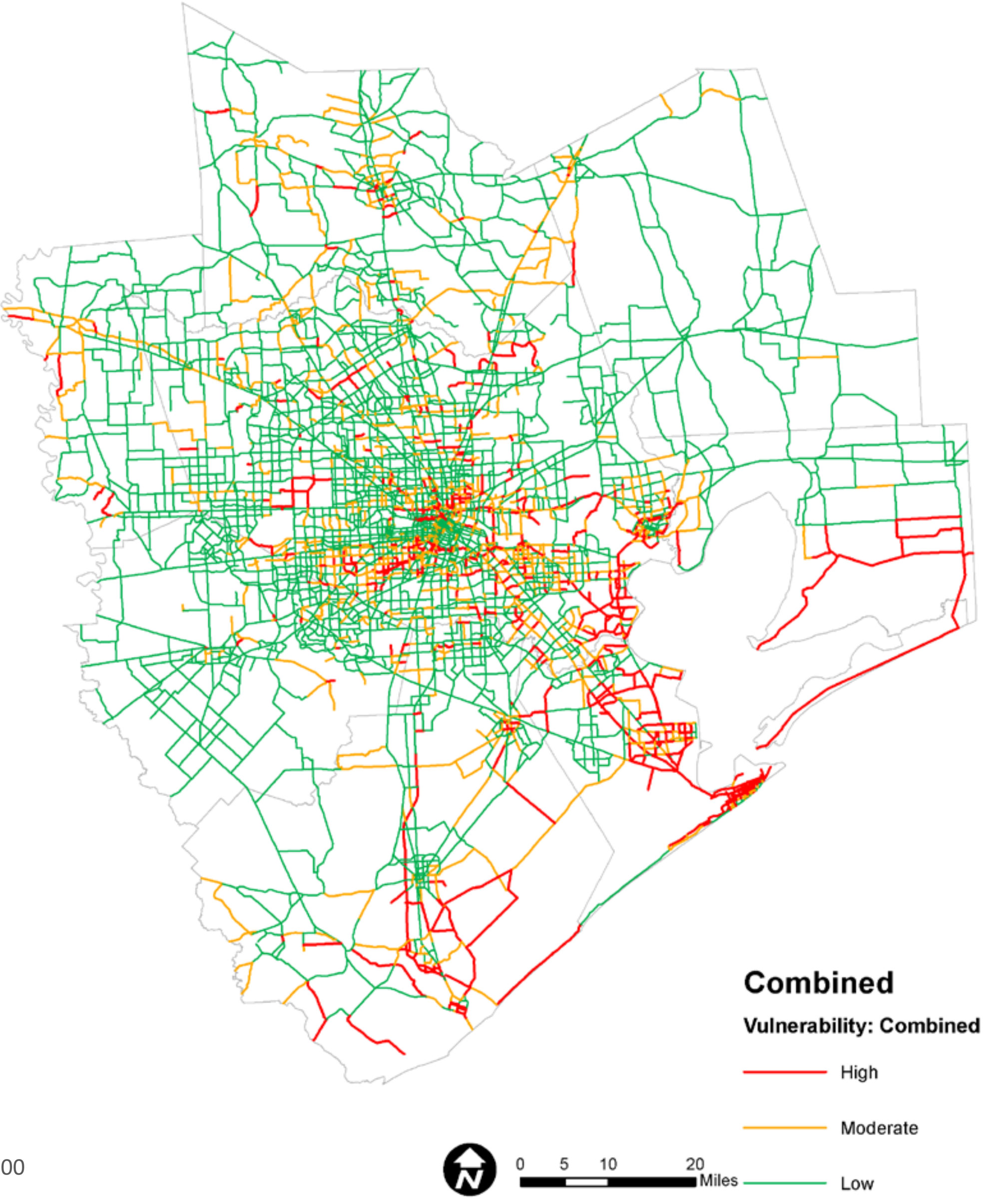




Major Streets: 6,442 centerline miles

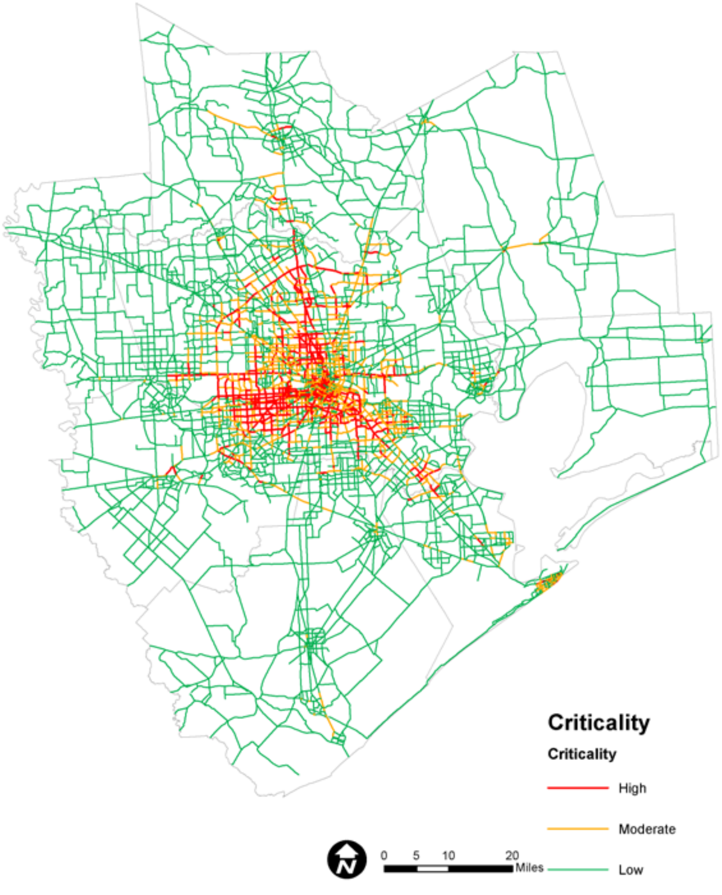






Vulnerability – Criticality Matrix

Criticality (3 types)



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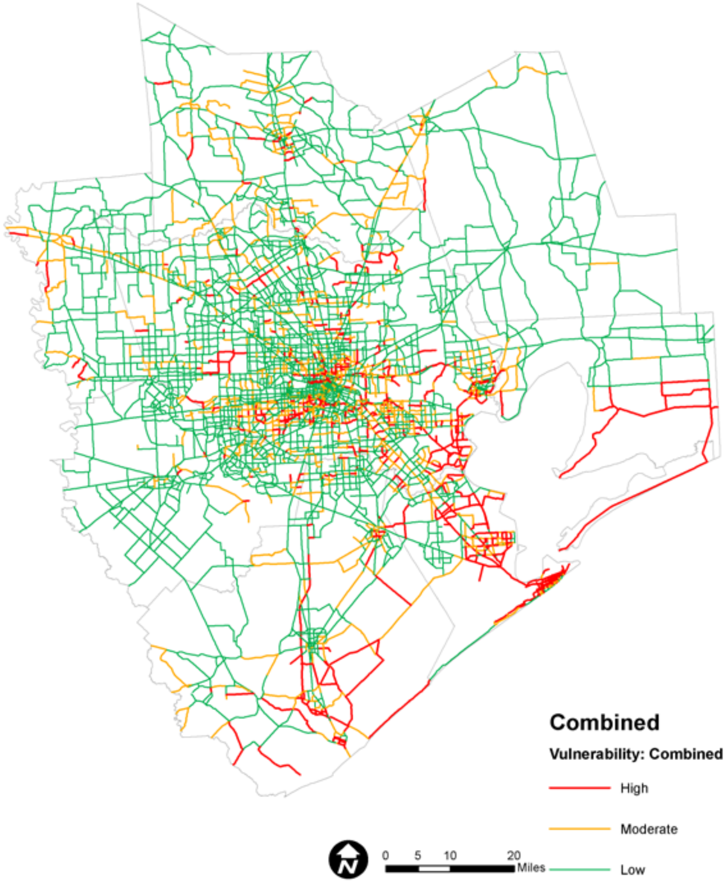
Vulnerability (3 types)



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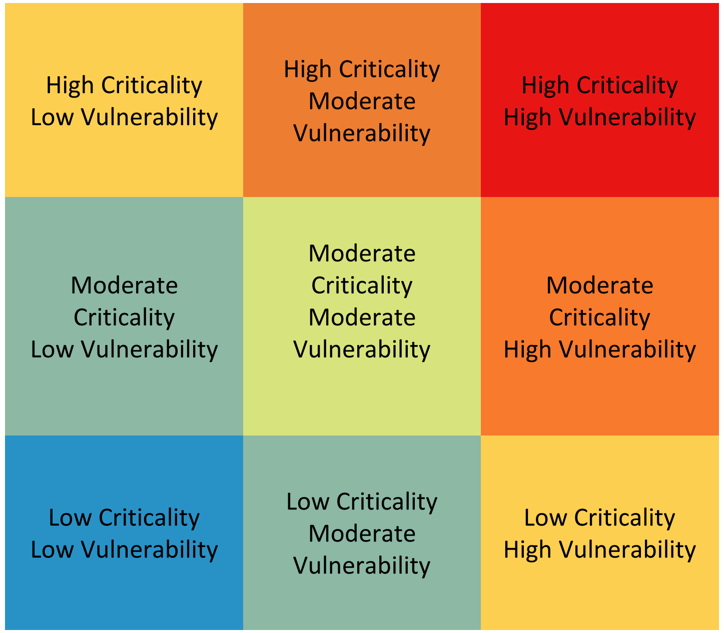
Criticality-Vulnerability Matrix (9 types)

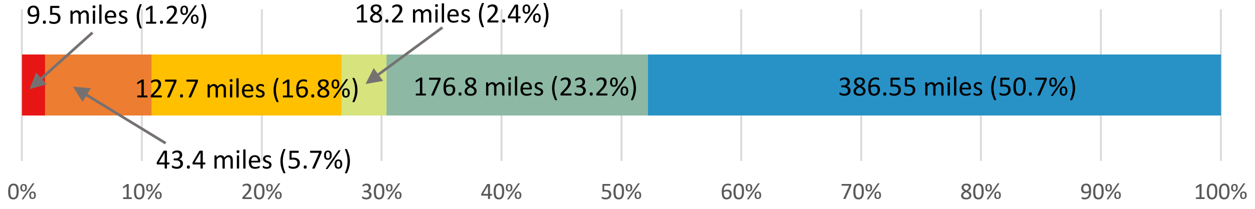


High Criticality Low Vulnerability	High Criticality Moderate Vulnerability	High Criticality High Vulnerability
Moderate Criticality Low Vulnerability	Moderate Criticality Moderate Vulnerability	Moderate Criticality High Vulnerability
Low Criticality Low Vulnerability	Low Criticality Moderate Vulnerability	Low Criticality High Vulnerability

METROPOLITAN PLANNING ORGANIZATION

Vulnerability – Criticality Matrix

Freeways: 762 centerline miles

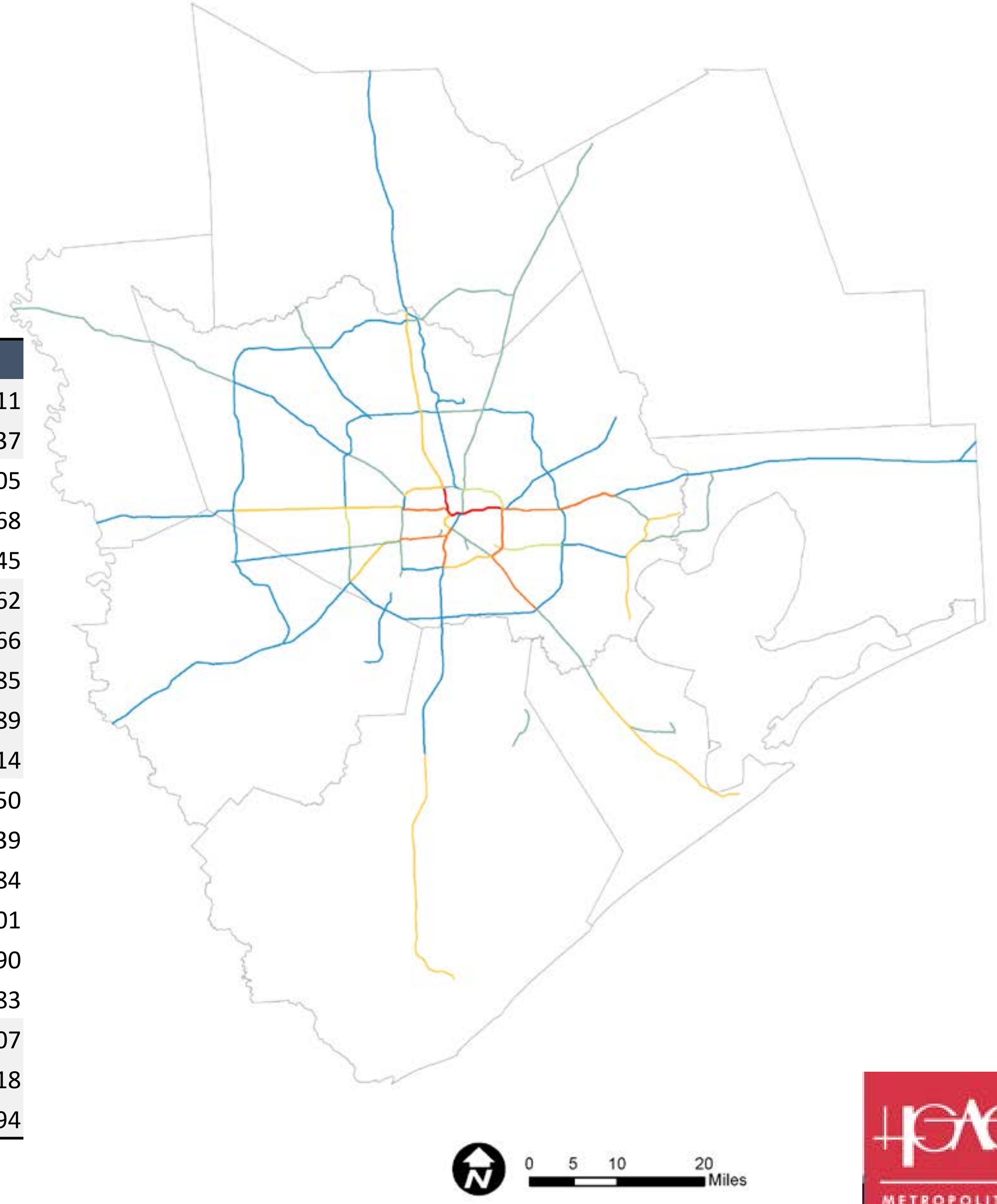


Matrix Summary

Matrix	Miles	%
Total	762.2	100.0%
High Criticality -High Vulnerability	9.5	1.2%
Moderate Criticality -High Vulnerability	23.2	3.0%
High Criticality -Moderate Vulnerability	20.2	2.6%
Low Criticality -High Vulnerability	66.2	8.7%
High Criticality -Low Vulnerability	61.5	8.1%
Moderate Criticality -Moderate Vulnerability	18.3	2.4%
Low Criticality -Moderate Vulnerability	113.7	14.9%
Moderate Criticality -Low Vulnerability	63.1	8.3%
Low Criticality -Low Vulnerability	386.5	50.7%

Freeways Details (excerpt)

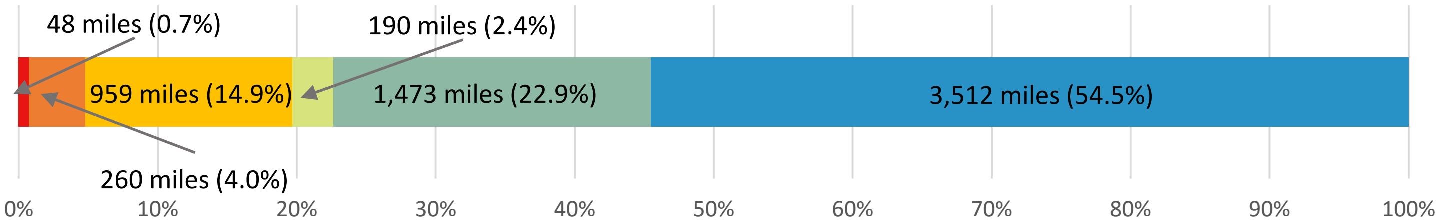
Matrix	Name	Miles
High Criticality – High Vulnerability	I-45	3.11
	IH 10 E	6.37
High Criticality -Moderate Vulnerability	GULF FWY/IH 45	8.05
	IH 10 E	6.68
	IH 69	5.45
Moderate Criticality -High Vulnerability	IH 10 E	6.62
	IH 10 W	5.66
	IH 69	0.85
	SOUTH FWY/SH 288	3.89
	SOUTH LOOP E	6.14
High Criticality – Low Vulnerability	IH 10 W	19.50
	IH 45	2.39
	IH 69	7.84
	NORTH FWY/IH 45	21.01
	NORTH LOOP	4.90
	SOUTH LOOP E	5.83
Low Criticality – High Vulnerability	GULF FWY/IH 45	21.07
	SH 146	16.18
	SH 288	28.94



METROPOLITAN PLANNING ORGANIZATION

Vulnerability – Criticality Matrix

Major Streets: 6,442 centerline miles

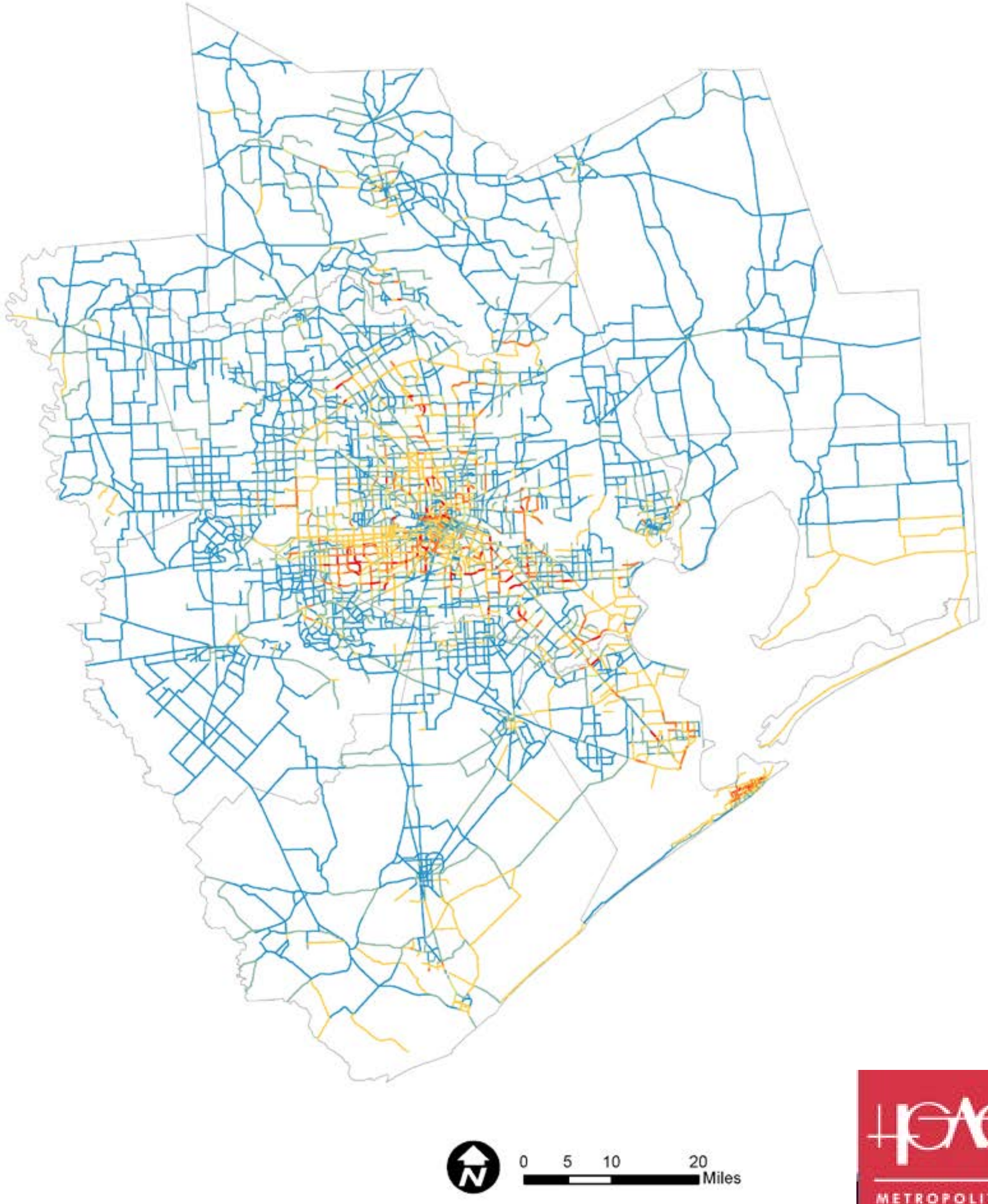


Matrix Summary

Matrix	Miles	%
Total	6,442.0	100.0%
High Criticality -High Vulnerability	48	0.7%
Moderate Criticality -High Vulnerability	119	1.9%
High Criticality -Moderate Vulnerability	140	2.2%
Low Criticality -High Vulnerability	595	9.2%
High Criticality -Low Vulnerability	364	5.7%
Moderate Criticality -Moderate Vulnerability	191	3.0%
Low Criticality -Moderate Vulnerability	861	13.4%
Moderate Criticality -Low Vulnerability	611	9.5%
Low Criticality -Low Vulnerability	3,512	54.5%

Principal Arterials Details (excerpt)

Matrix	Name	Miles
High Criticality -High Vulnerability	BROADWAY (Galveston)	2.617
	SH 3	1.537
	BROADWAY (Houston)	0.777
	COLLEGE	1.199
	CULLEN	0.735
	FAIRMONT PKWY	1.021
	FEDERAL	0.462
	FM 1960	0.142
	KIRBY DR	0.635
	LOCKWOOD DR	0.620
	MEMORIAL DR	0.637
	MONROE	0.134
	NASA RD 1	1.237
	OLD SPANISH TRAIL	0.102
	SH 35	0.794
	SH 146/LOOP 201	0.239
	SHAVER	0.437
	SPENCER HWY	0.463
	LOOP 336	0.119



METROPOLITAN PLANNING ORGANIZATION

Economic Impact Analysis

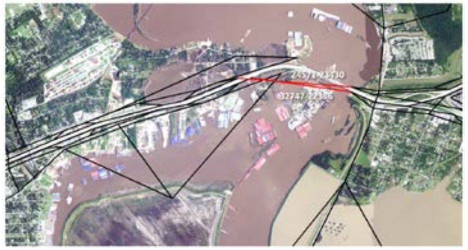
Scenario 5: US 59

Scenario 6: FM 723 & FM 359

Scenario 7: IH 10

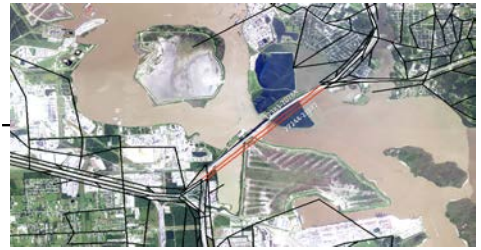
Scenario 8: North-South Connecters along Buffalo Bayou between Memorial Dr and Briar Forest

Scenario 1: IH 10 San Jacinto Bridge



Scenario 2: Gulf Freeway Galveston Causeway

Scenario 3: SH 146 Fred Hartman Bridge



Scenario 4: SH 225/Lawndale St.

Economic Impact Analysis

GDP Loss (Million of Fixed Dollars in 2020) by Scenarios

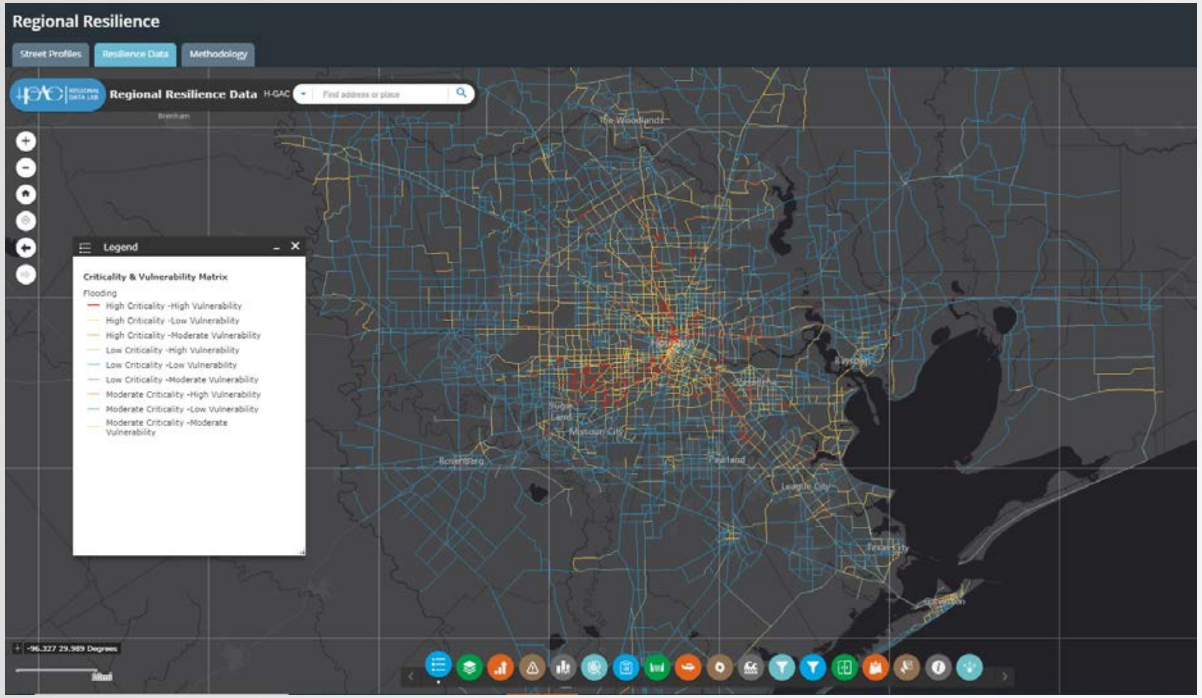
Scenario	Description	Annual	Month	Week	Day
Scenario 1	IH 10 San Jacinto Bridge	206.9	17.2	4.0	0.6
Scenario 2	Gulf Freeway Galveston Causeway	599.2	49.9	11.5	1.7
Scenario 3	SH 146 Fred Hartman Bridge	205.6	17.1	4.0	0.6
Scenario 4	SH 225/Lawndale St.	191.5	16.0	3.7	0.5
Scenario 5	US 59	182.5	15.2	3.5	0.5
Scenario 6	FM 723 & FM 359	173.6	14.5	3.3	0.5
Scenario 7	IH 10	215.3	17.9	4.1	0.6
Scenario 8	North-South Connecters along Buffalo Bayou between Memorial Dr and Briar Forest	494.8	41.2	9.5	1.4
Scenario 1+3+4		431.0	35.9	8.3	1.2
Scenario 1-8		1,407.5	117.3	27.1	4.0

Source- H-GAC Travel Demand Data and REMI Transight

Resiliency Adaptation Strategies

Resiliency Adaptation Strategies	Criticality			Vulnerability			Climate Stressor		
	Low	Moderate	High	Low	Moderate	High	Flooding	Storm Surge	Sea Level Rise
STORMWATER MANAGEMENT									
1. Increase Number of Swales & Ditches		X	X		X	X		X	X
2. Retention/Detention Basins		X			X		X		
3. Depressed/Raised Medians		X			X		X		
4. Bioswales	X			X			X		
5. Green Infrastructure	X	X		X	X		X		
MAINTENANCE									
1. Culvert Cleaning		X	X		X		X	X	
PLANNING/SOCIAL									
1. Stormwater Management Plan		X	X		X		X		
2. Land Use Planning / Climate Justice		X	X		X		X	X	X
3. Relocate/Abandon Roads	X					X	X		X
4. Shelter in place	X	X	X	X			X		
5. Evacuation/special Route Identification	X	X	X		X	X	X	X	X
6. Prohibiting Overweight/Oversize Vehicles			X	X	X	X	X		
7. Sensor Technologies and Monitoring Programs			X		X	X			
INFRASTRUCTURE									
1. Enhanced Road Surface		X	X	X			X		
2. Enhanced Sub Grade			X		X	X	X	X	
3. Hardened Shoulders		X	X	X	X		X	X	
4. Raised Road Profile			X		X	X	X	X	X
5. Geosynthetics/Geotextiles		X	X		X	X	X	X	
6. Permeable Pavement	X			X			X		
OTHER									
1. Maintain/Restore Wetlands	X	X	X		X	X	X		
2. Beach Nourishment/Dune Restoration		X	X		X	X		X	X
3. Vegetation for Erosion Control	X	X		X	X		X		
4. Swales/Ditches	X			X			X		
5. Wave Attenuation Devices		X	X		X	X		X	
6. Debris Deflectors for Bridge Protection		X	X		X	X			

Regional Resilience Tools

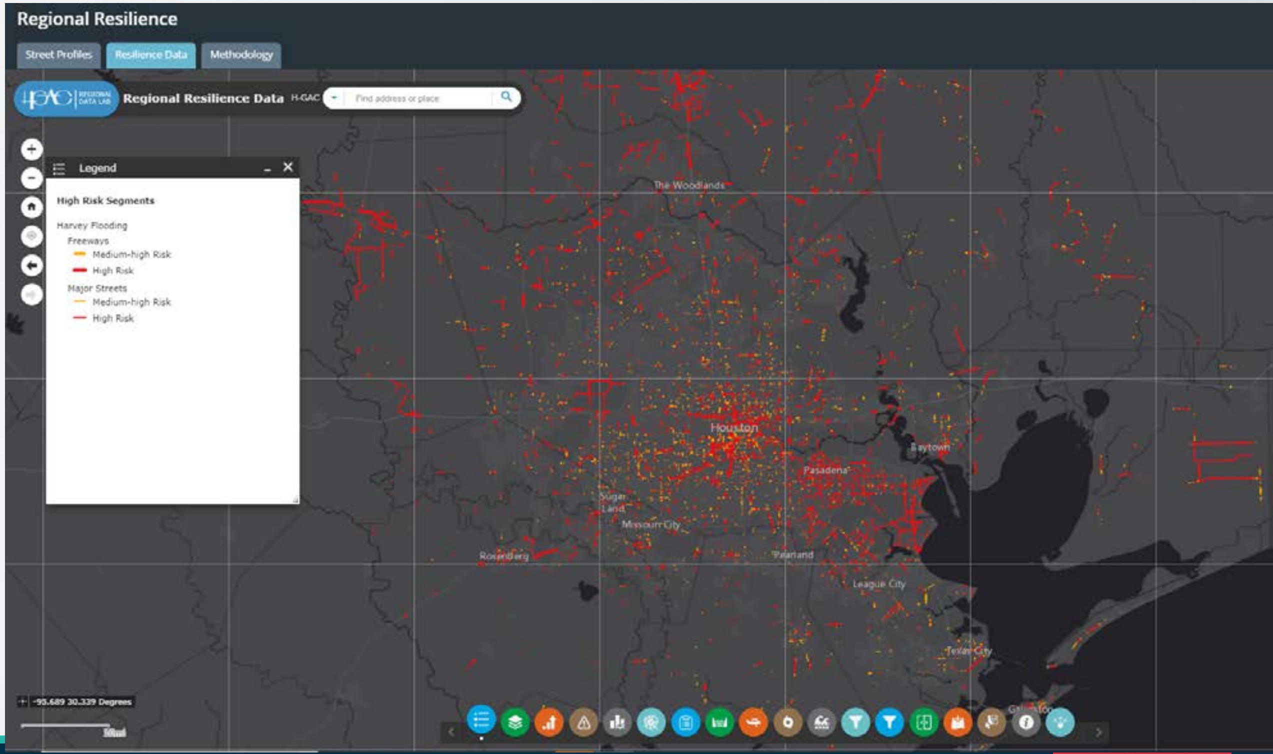


Legend

Criticality & Vulnerability Matrix

Flooding

- 🟥 High Criticality -High Vulnerability
- High Criticality -Low Vulnerability
- High Criticality -Moderate Vulnerability
- Low Criticality -High Vulnerability
- Low Criticality -Low Vulnerability
- Low Criticality -Moderate Vulnerability
- Moderate Criticality -High Vulnerability
- Moderate Criticality -Low Vulnerability
- Moderate Criticality -Moderate Vulnerability



Legend

High Risk Segments

Harvey Flooding

- Freeways
  - 🟧 Medium-high Risk
  - 🟥 High Risk
- Major Streets
  - 🟧 Medium-high Risk
  - 🟥 High Risk

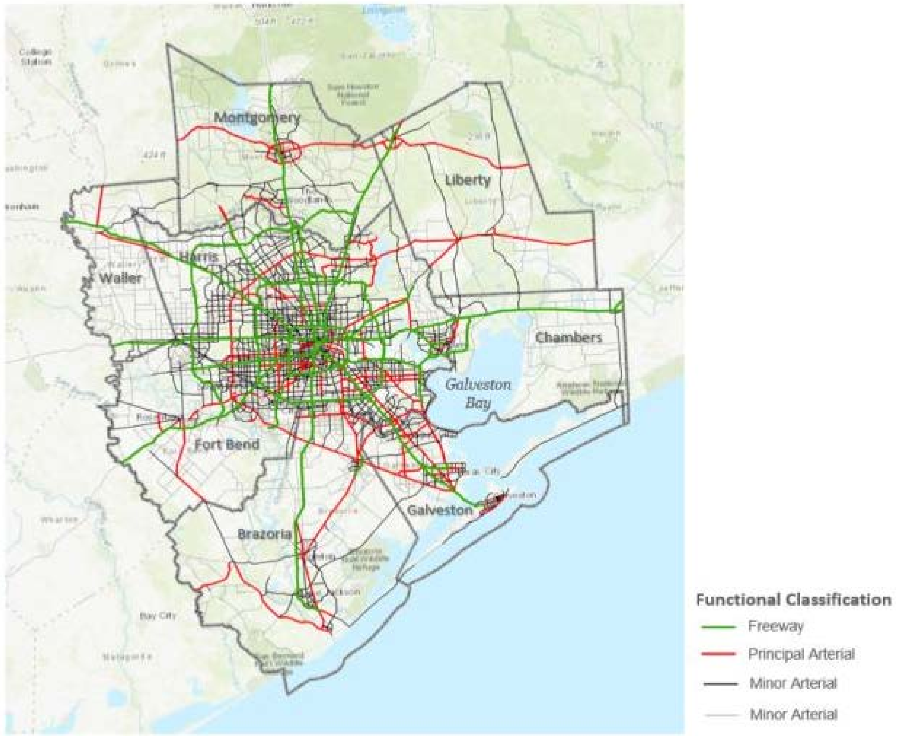
Next Steps- Resiliency Integration

- Regional Transportation Plan
  - Significant incorporation
    - Highly Vulnerable & Highly Critical transportation infrastructure locations
    - 25 Adaptive Mitigation Strategies
- Transportation Improvement Program
  - Increase resiliency & environmental factors for project scoring to address:
    - Water Quality
    - Cultural Resources/ Open Space
    - Wetlands/ Resource Areas
    - Wildlife Preservation/ Protected habitats

Next Steps-Resilient Design

- Livable Centers
- Transit Oriented Development
- Low Impact Development
- Complete Streets

Figure 9 – TxDOT Major Road Network in Pilot Program Area



Contact and Links

Resilience Tool

https://datalab.h-gac.com/resilience/

Contact Information

Pramod Sambidi, PhD- Pramod.Sambidi@h-gac.com

Kathryn Vo- Kathryn.Vo@h-gac.com

POLL EVERYWHERE QUESTION

- Which aspect of the Houston-Galveston Area Council’s approach would be most beneficial to your organization?

JENNIFER FOGLIANO, NJTPA

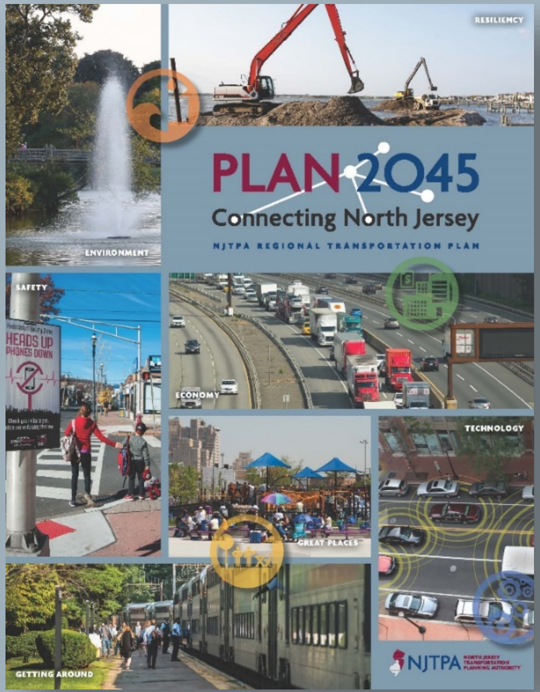
Jennifer Fogliano, AICP, is a principal environmental planner for the North Jersey Transportation Planning Authority (NJTPA), focused on issues of sustainability and resiliency, in particular climate change adaptation and mitigation in relation to the transportation system.

She previously worked as a planner for the Metropolitan Transportation Authority in New York City. For fifteen years, Jennifer has coordinated short and long term plans and projects with government agencies and organizations (at the federal, state, regional and local level), nonprofits, consultants and the public. She has a Bachelor of Science in Sociology from Saint Joseph's University in Philadelphia and a Masters of Urban Planning from Hunter College, CUNY in New York.

Using the MPO Planning Process to Increase Transportation System Resilience

Session 3: Peer Exchange – Resilience Investments

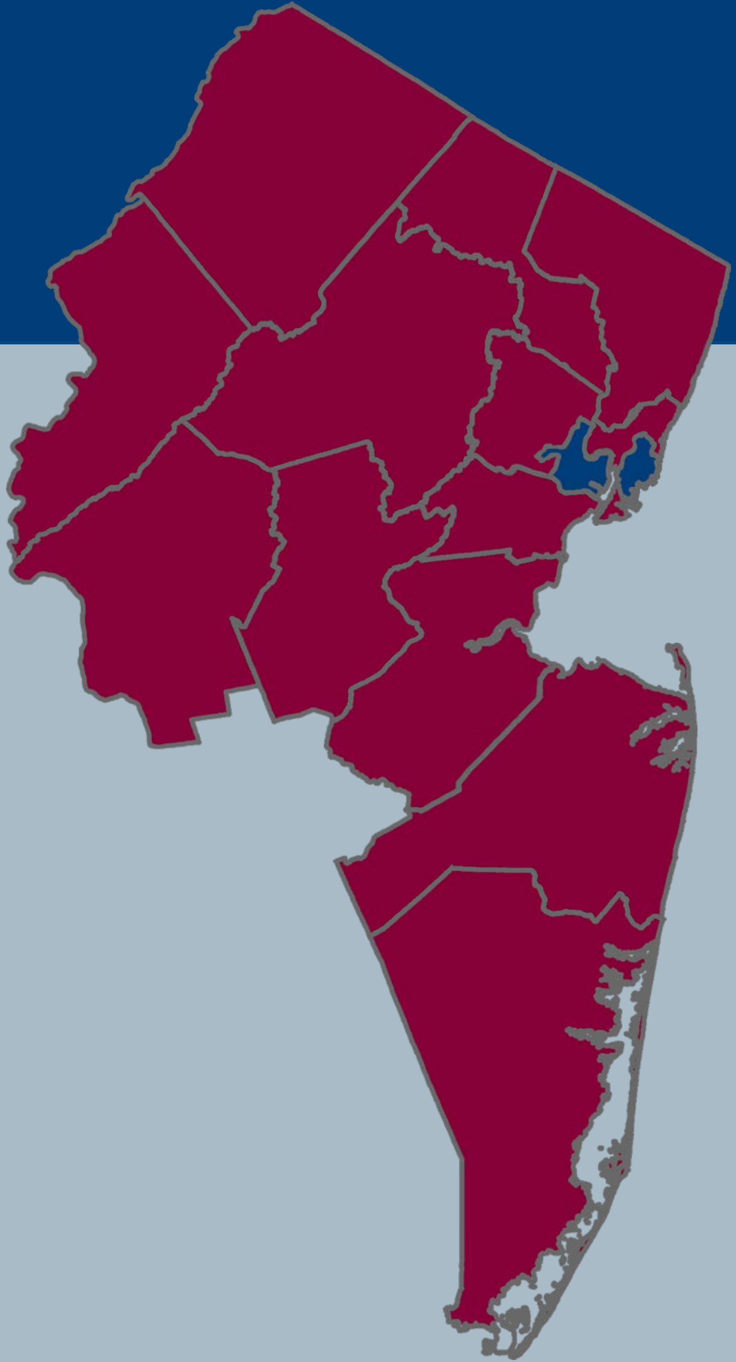
August 28, 2020



Jennifer Fogliano, Principal Planner
North Jersey Transportation Planning Authority

NJTPA Region

Bergen
Essex
Hudson
Hunterdon
Jersey City
Middlesex
Monmouth
Morris
Newark
Ocean
Passaic
Somerset
Sussex
Union
Warren



North Jersey Transportation Planning Authority

The Metropolitan Planning Organization for Northern New Jersey

Bergen	Essex	Hudson	Hunterdon	Middlesex
Monmouth	Morris	Ocean	Passaic	Jersey City
Somerset	Sussex	Union	Warren	Newark
NJDOT	Governor Rep.	Citizens’ Rep.	Port Authority	NJ Transit

STANDING COMMITTEES

Planning & Economic Development Committee

Project Prioritization Committee

Freight Initiatives Committee

Regional Transportation Advisory Committee

NJTPA

Planning Goals

- Protect the environment
- Provide affordable, accessible transportation
- Retain and increase economic activity
- Enhance system connectivity across all modes
- Maintain a reliable transportation system
- Create great places
- Improve safety

NJTPA

Regional Capital Investment Strategy (RCIS)

NJTPA

RCIS Investment Principles

- ✓ Help Northern New Jersey Grow Wisely
- ✓ Make Travel Safer
- ✓ Fix it First
- ✓ Expand Public Transit
- ✓ Improve Roads but Add Few
- ✓ Move Freight More Efficiently
- ✓ Manage Incidents and Apply Transportation Technology
- ✓ Support Walking and Bicycling
- ✓ Increase Regional Resiliency*

* New for Plan 2045

Increase Regional Resiliency Investment Guidelines

- Prioritize transportation investments that offer additional benefits for resiliency, for system preservation projects as well as upgrades and expansions.

- Incorporate vulnerability and risk assessments into project development.

- Scrutinize investments that are in places highly vulnerable to potential flooding/sea level rise.

NJTPA

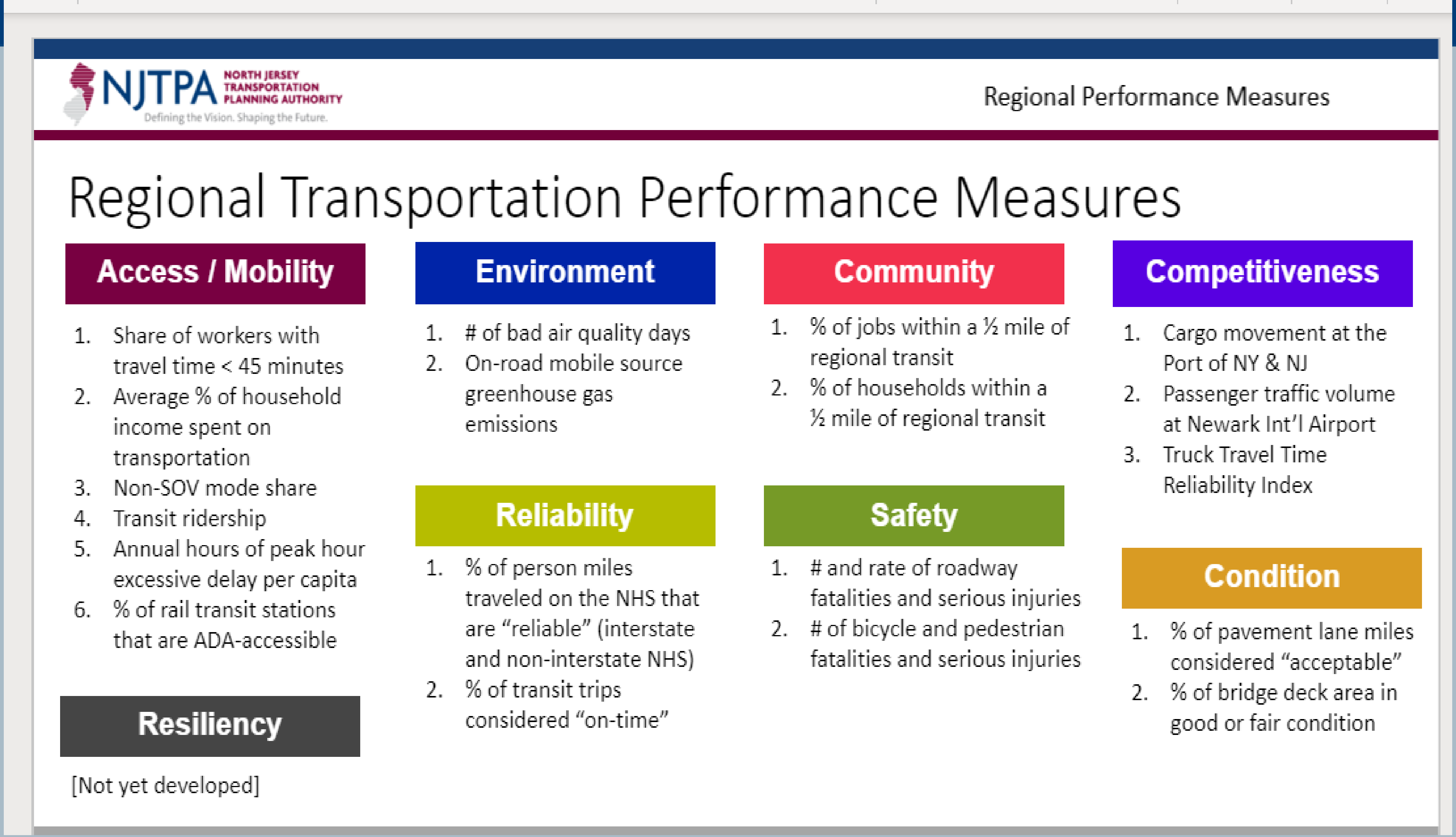
Increase Regional Resiliency Investment Guidelines continued…

- Invest in alternate fuel infrastructure in support of energy independence.

- Coordinate investments within and across modes to strengthen routes, enhance regional connectivity, increase mode options, and increase network redundancy.

- Make investments that support the targets of the Global Warming Response Act of 2007, addressing New Jersey's GHG reduction goals and NJ State Plan recommendations.

Performance Measures



NJTPA NORTH JERSEY TRANSPORTATION PLANNING AUTHORITY
Defining the Vision. Shaping the Future.

Regional Performance Measures

Regional Transportation Performance Measures

Access / Mobility

1. Share of workers with travel time < 45 minutes
2. Average % of household income spent on transportation
3. Non-SOV mode share
4. Transit ridership
5. Annual hours of peak hour excessive delay per capita
6. % of rail transit stations that are ADA-accessible

Resiliency

[Not yet developed]

Environment

1. # of bad air quality days
2. On-road mobile source greenhouse gas emissions

Reliability

1. % of person miles traveled on the NHS that are “reliable” (interstate and non-interstate NHS)
2. % of transit trips considered “on-time”

Community

1. % of jobs within a ½ mile of regional transit
2. % of households within a ½ mile of regional transit

Safety

1. # and rate of roadway fatalities and serious injuries
2. # of bicycle and pedestrian fatalities and serious injuries

Competitiveness

1. Cargo movement at the Port of NY & NJ
2. Passenger traffic volume at Newark Int’l Airport
3. Truck Travel Time Reliability Index

Condition

1. % of pavement lane miles considered “acceptable”
2. % of bridge deck area in good or fair condition

TOGETHER
NORTH
JERSEY.

The Together North Jersey Plan

5 Priority Goals.


TOGETHER
NORTH
JERSEY.
THE PLAN.
2015

- Grow a strong regional economy.
- Create great places.
- Increase access to opportunity.
- Protect the environment.
- Work together.

COMPETITIVE.
- *Countywide Economic System Evaluation and Future Growth Analysis for Sussex County*

EFFICIENT.
- *Monmouth County Bus Rapid Transit Opportunities Study*

LIVABLE.
- *Essex County Complete Streets Implementation Action Plan*

RESILIENT.
- *Newark Greenstreets Initiative*

Resilient Strategies

- Adapt infrastructure
- Identify vulnerabilities
- Improve management and mitigate impacts

storms, more frequent lesser storms and sea level rise will make inundated roads and nuisance flooding more common in the future, leading to regular road closures and ongoing damage and disruption.

The NJTPA will continue to work with partner agencies to assess vulnerabilities and prepare investments and emergency plans to ensure resiliency. Coordinating across state and regional lines is particularly important given the potential for widespread impacts. One notable effort is NJTPA's participation in FHWA's Post Hurricane Sandy Transportation Resilience Study in NY, NJ and CT conducted through a partnership with agencies in the three states, including NJ TRANSIT and the Port Authority of New York & New Jersey. Recommendations of this study must be addressed in ongoing planning and investments. Example strategies include climate-risk-adjusted benefit-cost analyses during the planning phases for adaptation strategies and programming adaptation strategies at appropriate time frames given the possible pace of climate change.

Study of vulnerabilities and resiliency strategies within the region are also important. For example, the NJTPA is coordinating a study to **develop a climate resilience and adaptation plan** for the New Jersey portion of the Passaic River Basin. Other study and planning efforts have been undertaken along

Resilient●

◂ Identify the region's vulnerabilities to extreme weather and climate change (Strategy 10.1)

NJTPA Regional Transportation Plan for Northern New Jersey 101

Plan 2050

- Background paper on climate change
- Planning for electric vehicles
- Coordinating with state and local partners

NJTPA LONG RANGE TRANSPORTATION

PLAN 2050

Transportation ▸ People ▸ Opportunity

Thank You!

Jennifer Fogliano, AICP
Principal Planner

Defining the Vision. Shaping the Future.

NJTPA

NORTH JERSEY
TRANSPORTATION
PLANNING AUTHORITY

Contact:
jfogliano@njtpa.org

Find us on Facebook!

follow us on twitter

Find Us On Instagram

You Tube SUBSCRIBE TO OUR CHANNEL

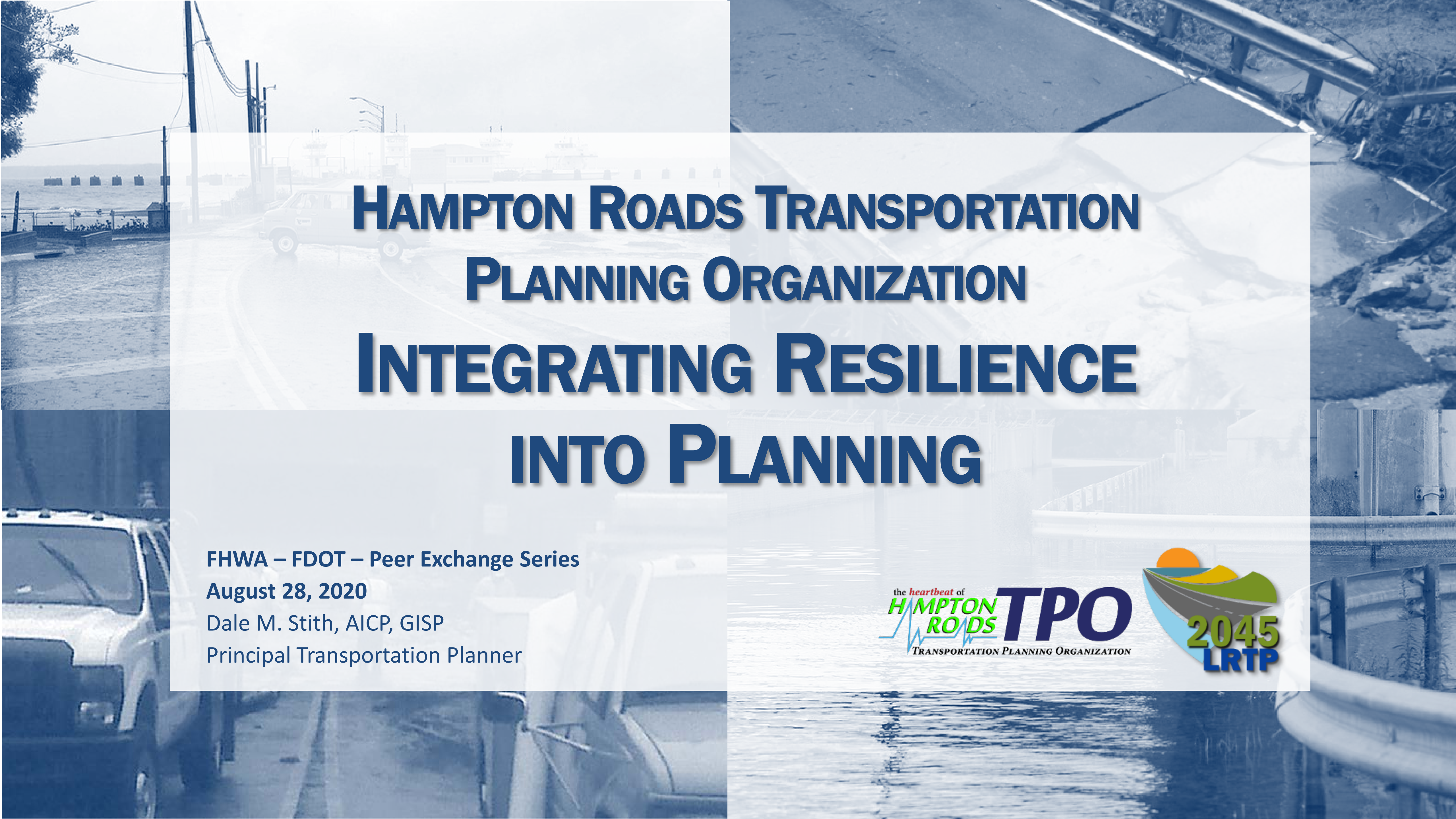
POLL EVERYWHERE QUESTION

- Which aspect of the North Jersey Transportation Planning Authority's approach would be most beneficial to your organization?

DALE STITH, HRTPO

Dale Stith is a Principal Transportation Planner with the Hampton Roads Transportation Planning Organization (HRTPO) and has been with the agency since 2006. At the HRTPO, Dale manages the development of the Long-Range Transportation Plan for Hampton Roads, which includes coordinating long-range planning efforts with regional stakeholders and other agency initiatives, overseeing the application and maintenance of the HRTPO Project Prioritization Tool as well as the Regional Travel Demand Model.

Dale has a Bachelor of Science from Old Dominion University, with a double emphasis in Geography and Geographic Information Systems, and a Masters in Transportation and Urban Systems from North Dakota State University.



HAMPTON ROADS TRANSPORTATION PLANNING ORGANIZATION

INTEGRATING RESILIENCE INTO PLANNING

FHWA – FDOT – Peer Exchange Series
August 28, 2020
Dale M. Stith, AICP, GISP
Principal Transportation Planner

the heartbeat of HAMPTON ROADS TPO
TRANSPORTATION PLANNING ORGANIZATION

2045 LRTP

Background on Hampton Roads

HRTPO/HRPDC Resiliency Studies and Planning Efforts

Resiliency in our LRTP Process

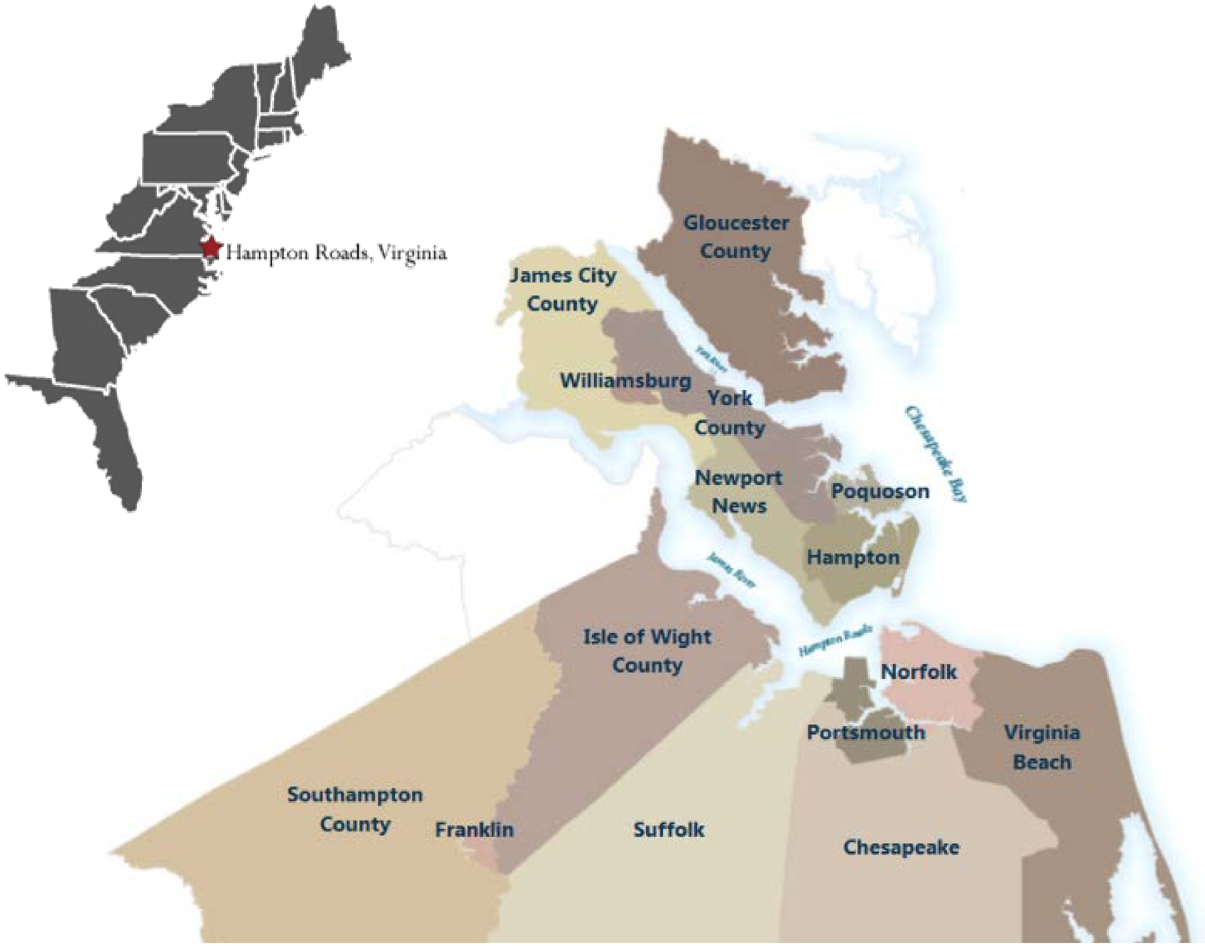
- Project Prioritization
- Scenario Planning

Inclusion of Volpe Resilience and Disaster Recovery Metamodel

- LRTP/Project Prioritization
- Other Applications

HAMPTON ROADS

- The HRTPO is the Metropolitan Planning Organization for Hampton Roads
  - Comprised of 15 Localities
  - 3 Transit Agencies
  - Federal and State Agencies
  - 4 Virginia General Assembly Members
- Home to 1.7 Million People
- Strategic location for Foreign Trade, Military Facilities, and Tourism

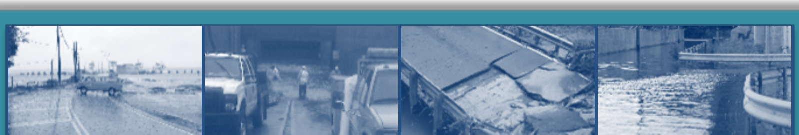


SEA LEVEL RISE IN HAMPTON ROADS

- Hampton Roads is experiencing the highest rate of relative Sea Level Rise on the East Coast
- Sea Level Rise is expected to accelerate
- 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)

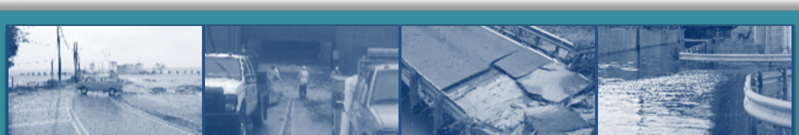
Source: National Climate Assessment via EPA, data from Hammar-Klose and Thieler 2001



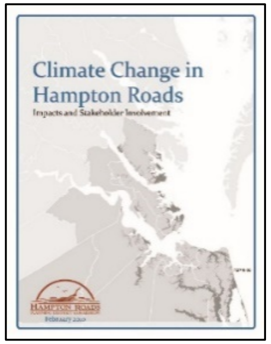
REGIONAL INVOLVEMENT IN PLANNING FOR SEA LEVEL RISE

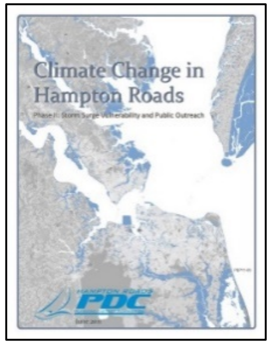
HRTPO and HRPDC Partnership

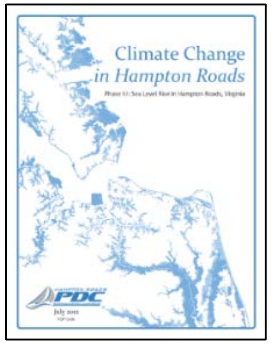
- Environmental Sustainability Best Practices for Transportation symposium
- Partnerships with other stakeholders
  - HRPDC Coastal Resiliency Committee
  - University Efforts (ODU, UVA, W&M, VT)
  - Virginia Institute of Marine Science (VIMS)
- Hampton Roads SLR Intergovernmental Planning Pilot Project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

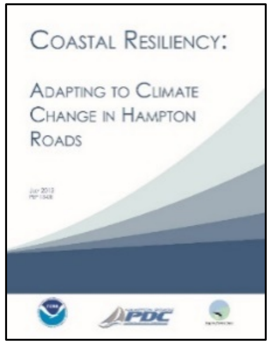


HRPDC – RESILIENCY PLANNING EFFORTS

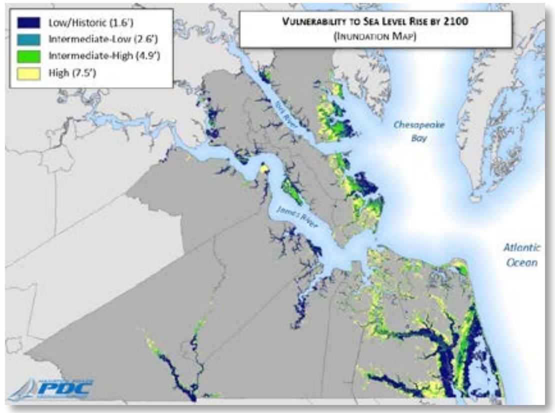

Climate Change in Hampton Roads
Impacts and Stakeholder Involvement
February 2010

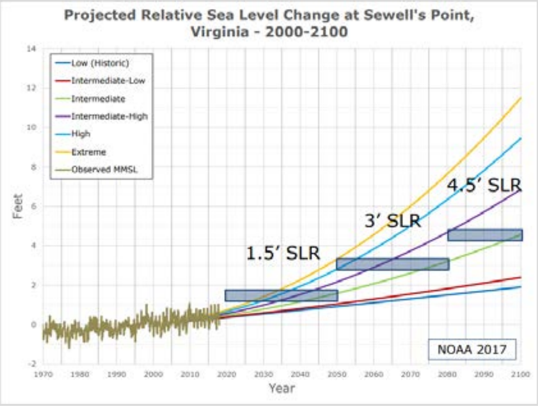

Climate Change in Hampton Roads
Phase II: Storm Surge Vulnerability and Public Outreach

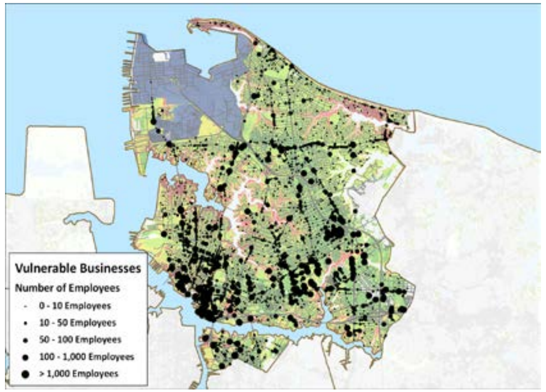

Climate Change in Hampton Roads
Phase III: Sea Level Rise in Hampton Roads, Virginia


COASTAL RESILIENCY:
ADAPTING TO CLIMATE CHANGE IN HAMPTON ROADS

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

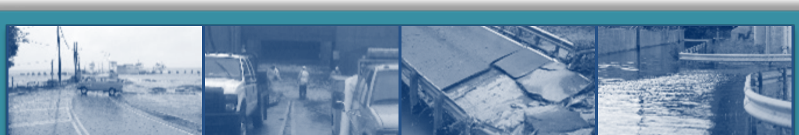




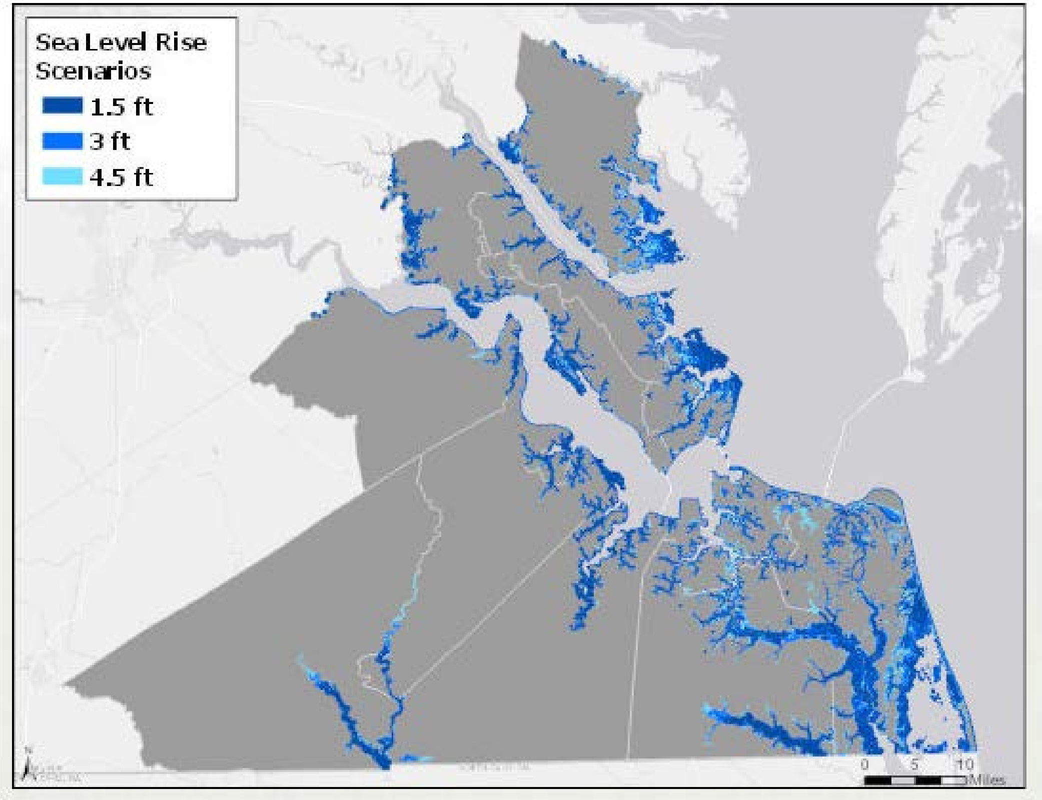


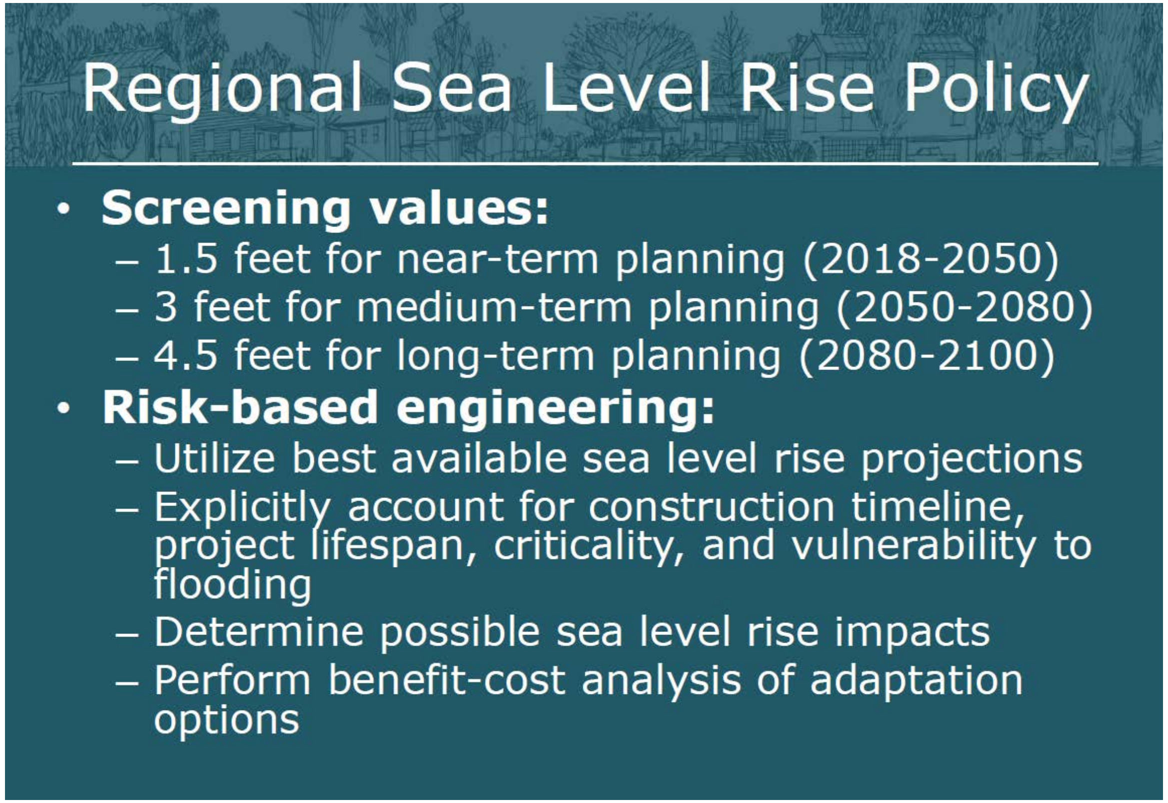
Storm Surge Analysis – Norfolk, Virginia


Resilience Projects Dashboard



REGIONAL SEA LEVEL RISE POLICY

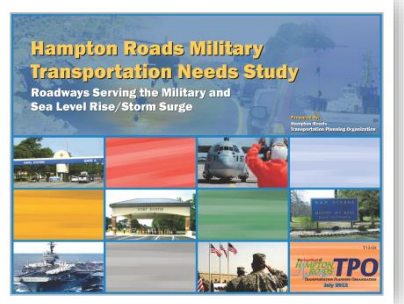




Regional Sea Level Rise Policy

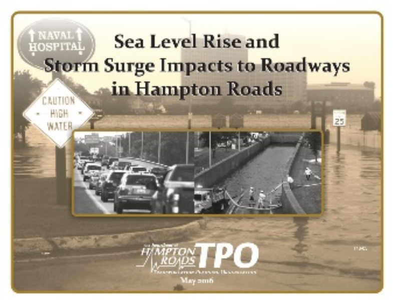
- **Screening values:**
  - – 1.5 feet for near-term planning (2018-2050)
  - – 3 feet for medium-term planning (2050-2080)
  - – 4.5 feet for long-term planning (2080-2100)
- **Risk-based engineering:**
  - – Utilize best available sea level rise projections
  - – Explicitly account for construction 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

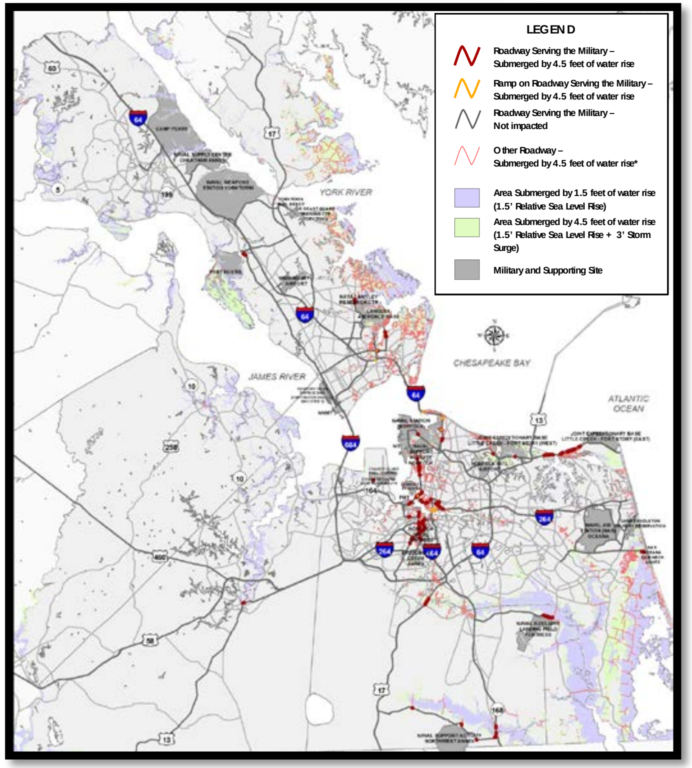


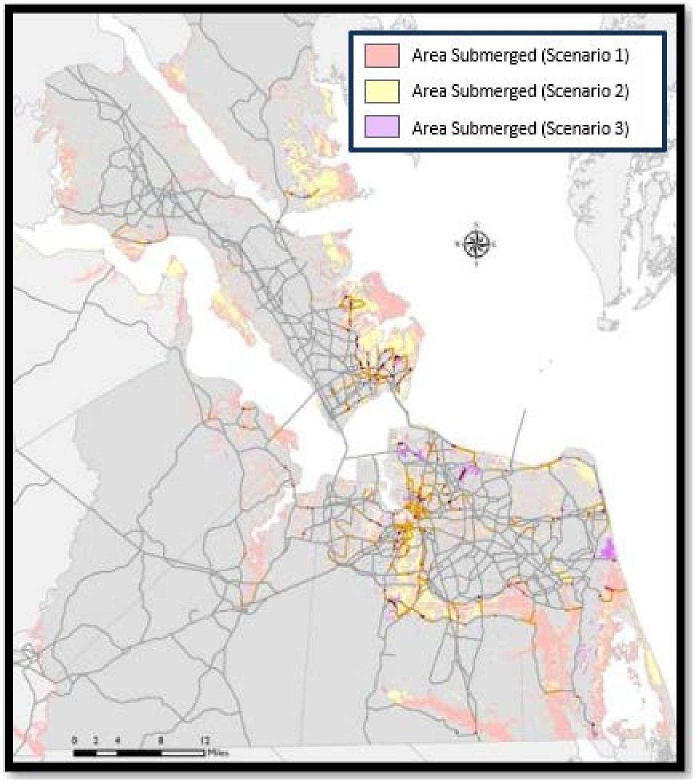
Hampton Roads Military Transportation Needs Study

Roadways Serving the Military and Sea Level Rise/Storm Surge



Sea Level Rise and Storm Surge Impacts to Roadways in Hampton Roads





Identify Vulnerabilities and Develop Adaptation Strategies

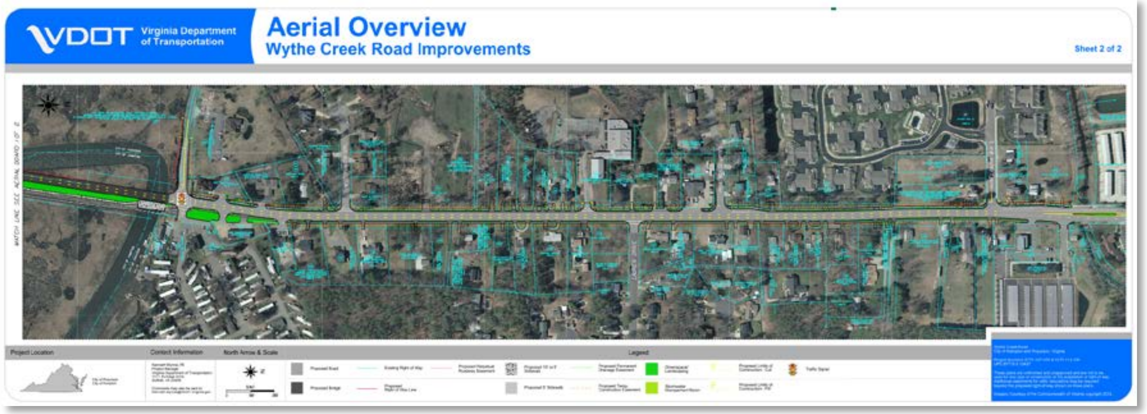
- Identify roadway segments vulnerable to flooding to develop adaptation strategies
- Raise awareness of potential flood locations to consider during design

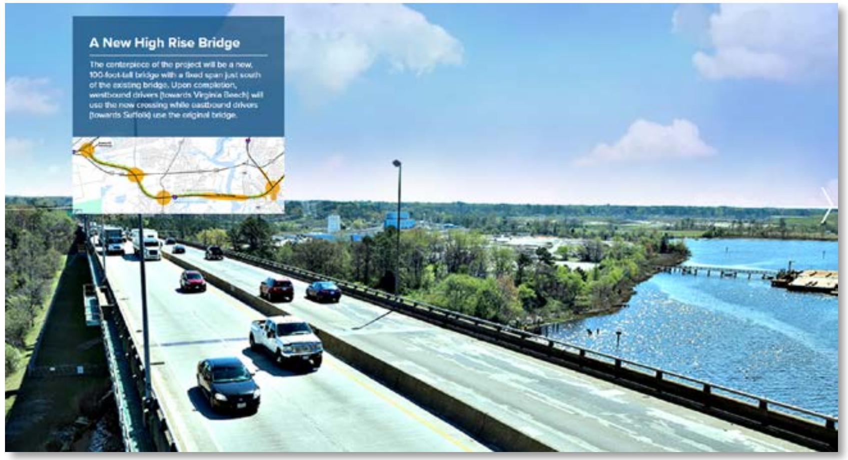
Project Evaluation and Prioritization

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

INTEGRATING ADAPTION STRATEGIES

- Adaptation strategies reduce potential impacts to ensure transportation system reliability and resiliency




A New High Rise Bridge

The centerpiece of the project will be a new, 100-foot-tall bridge with a fixed span just south of the existing bridge. Upon completion, westbound drivers (towards Virginia Beach) will use the new crossing while eastbound drivers (towards Suffolk) use the original bridge.

- **Wythe Creek Road widening project**
  - Coordination between Poquoson, Hampton, and NASA
  - Used inundation mapping tool and modeling to make design modifications
- **I-64 Southside High Rise Bridge project**
  - As a result of sea level rise planning efforts, VDOT increased bridge design height by 5-feet to account for future sea level rise

HAMPTON ROADS LONG-RANGE TRANSPORTATION PLAN


HAMPTON ROADS TPO

2040

Hampton Roads
2040 Long-Range
Transportation Plan

- Adopted July 2016
- Effective until June 2021

2045 LRTP

<u>Update</u>
HRTPO Project Prioritization Tool

Need for Scenario Planning

HRTPO PROJECT PRIORITIZATION

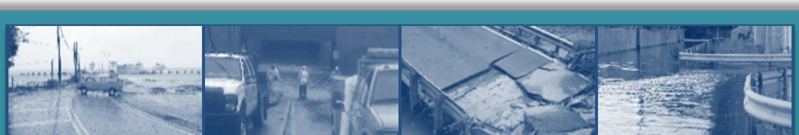
HRTPO
Project Prioritization Tool

Project Utility:
Ability to solve a problem

Economic Vitality:
Potential for economic gain

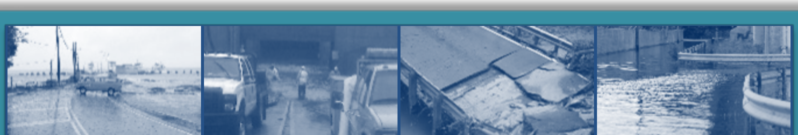
Project Viability:
Project readiness

- The HRTPO Project Prioritization Tool has been used in the past 2 LRTP cycles as well as in the identification and prioritization of (“mega”) Regional Priority Projects
- Designed to be a **dynamic tool that can be updated** to reflect current regional priorities, new data sources, etc.



SUMMARY OF SUGGESTED PRIORITIZATION MODIFICATIONS

Suggested Modifications Received from Stakeholders	
Improved alignment with Federal Performance Measures	• Include Federal Performance Measures
Improved alignment with state prioritization process (SMART SCALE)	• Include measures from SMART SCALE • Align data where possible • Establish a Filter/Factor (to gauge how projects might score/rank in SMART SCALE)
Environmental Considerations	• **Climate Change/SLR/Storm Surge/Resiliency** • **Environmental considerations**
Transit	• Refine transit criteria based on findings of Transit Benchmarking and/or future Transit Vision Plan • Smaller scope transit projects (bus routes, bus replacement) • Passenger Rail
Active Transportation	• Refine current Bike/Ped criteria based on findings of Regional Active Transportation Plan and Gaps Analysis • Add Economic Vitality
RSTP/CMAQ Coordination	• Refine Systems Mgmt/TDM/OpImp criteria to allow more RSTP/CMAQ projects to be scored using Tool • Separate rehabilitation/replacement projects from capacity improvements • Add Economic Vitality
Economic Vitality	• Refine Economic Vitality criteria/scoring
Social Equity	• Incorporate Environmental Justice/Title VI measures • Access: housing, essential services, higher education/tech centers
Balance Components	• Balance scoring components (Economic Vitality and Project Viability were not originally developed to be equally weighted with Project Utility)
Technology	• Include criteria to award points for projects that incorporate technology (i.e. smart roads)



RESILIENCY/FLOODING VULNERABILITY MEASURES

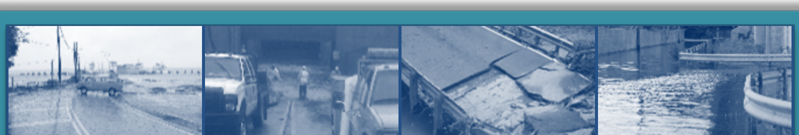
Candidate project is in a vulnerable area for sea level rise/storm surge/recurrent flooding (Yes/No)

- Vulnerable Area – Developed planned improvements or adaptation strategies to address future sea level rise/storm surge/recurrent flooding and the project includes design features that make it resilient to flooding
  - Yes – points awarded
  - No – no points awarded
- Not in Vulnerable Area – points awarded (due to no vulnerability)

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

- High, Medium Low (sliding scale of points)

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



SCENARIO PLANNING CONSIDERATIONS

Regional Economic Drivers

- Military
- Port
- Tourism
- New Industries

Multimodal Connectivity and Technology

- High Capacity Transit Corridors
- Passenger Rail
- Active Transportation
- Connected and Automated Vehicles
- TNC/Ride Sharing

Resiliency/ Geographic Considerations

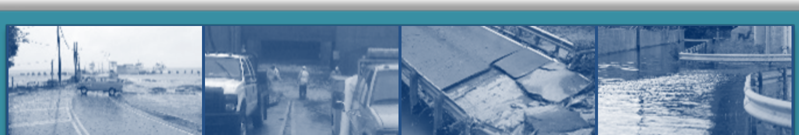
- Sea Level Rise and Storm Surge
- Coastal Resiliency
- Flooding Resiliency

Demographic Considerations

- Aging Population
- Millennials
- Alternative Growth Scenarios

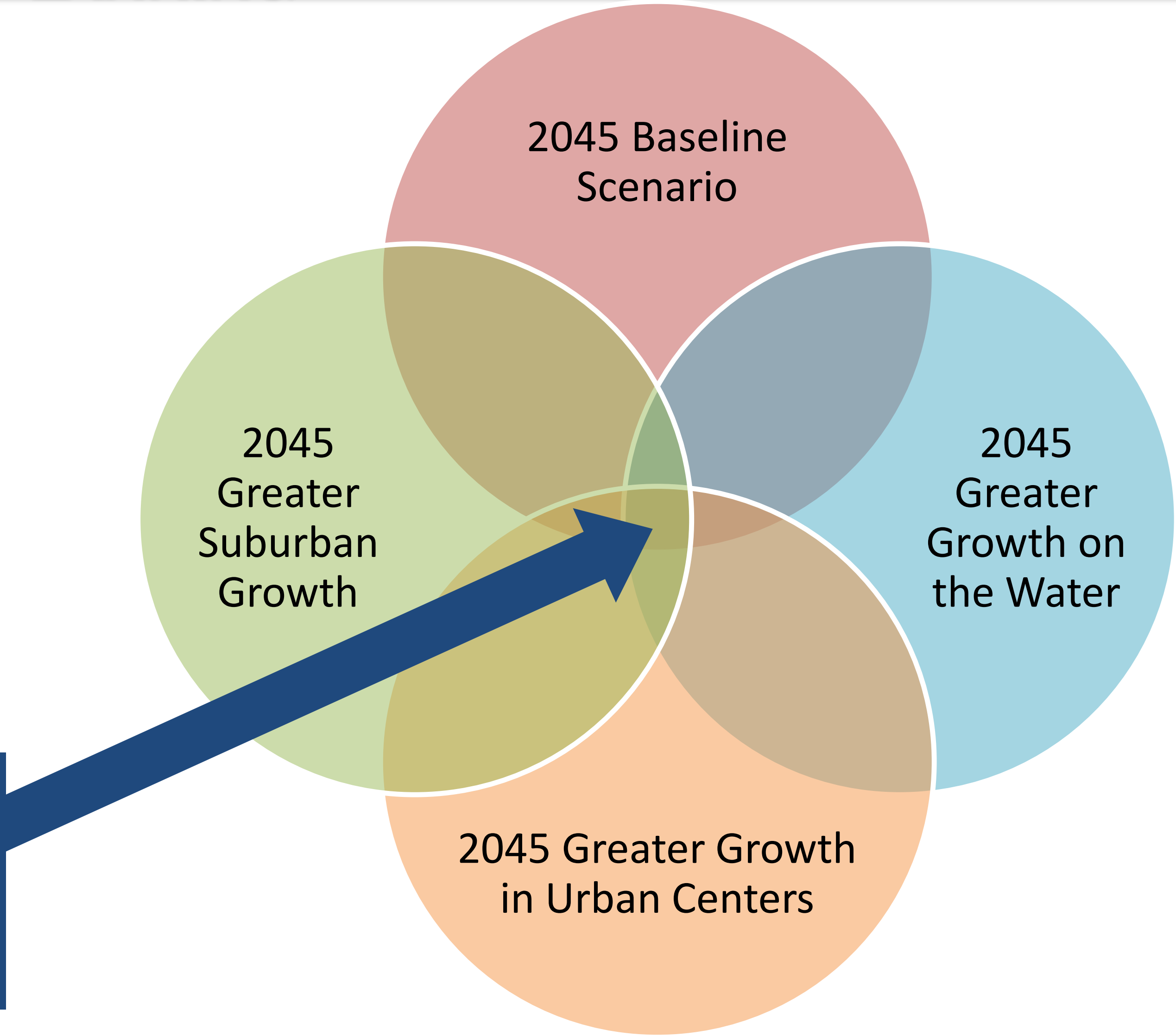
Funding

- Hampton Roads Transportation Fund
- Transportation Revenues
  - SMART SCALE



HRTPO REGIONAL SCENARIO PLANNING

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



2045 Baseline Scenario

2045 Greater Suburban Growth

2045 Greater Growth on the Water

2045 Greater Growth in Urban Centers

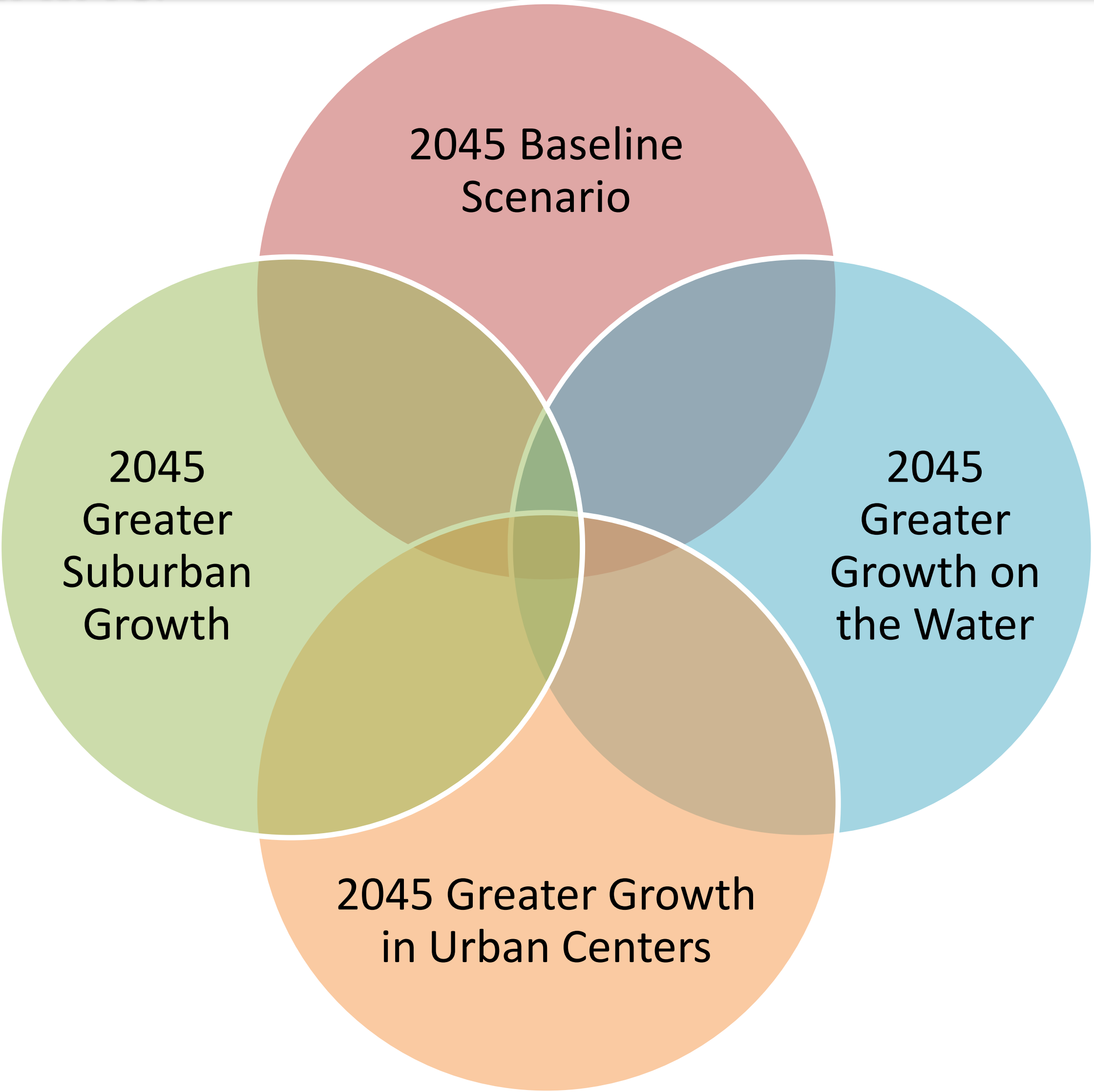
Evaluate and Rank Projects Across All Scenarios:

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**



2045 Baseline Scenario

2045 Greater Suburban Growth

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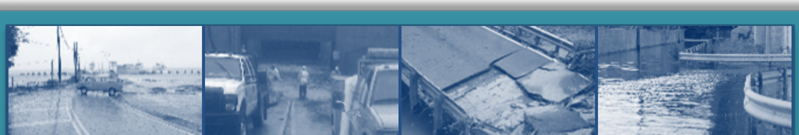
2045 Greater Growth in Urban Centers

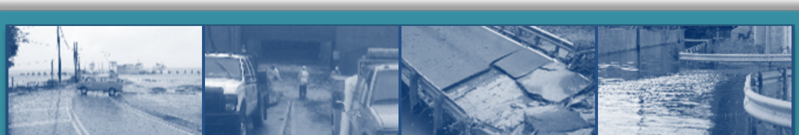


RESILIENCE AND DISASTER RECOVERY METAMODEL (RDRM)

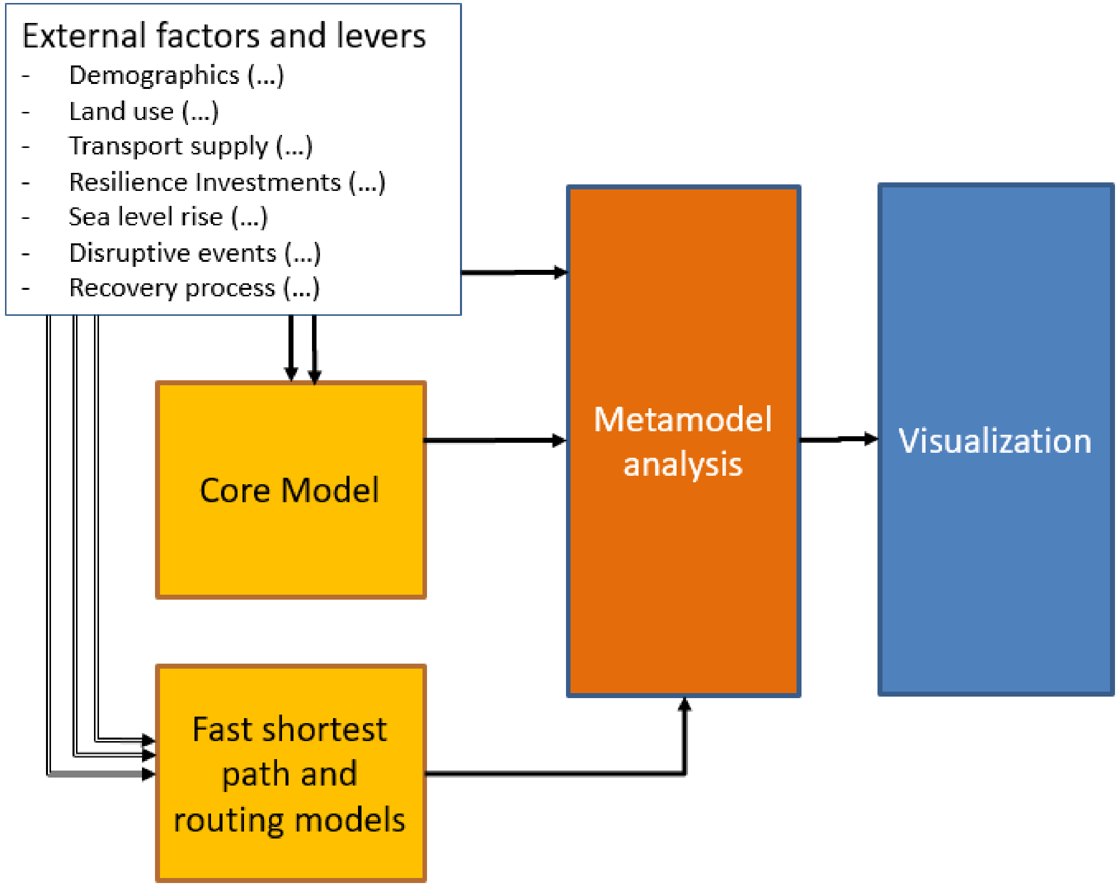
- USDOT/Volpe partnership with HRTPO/HRPDC
  - **May 2016 – Hampton Roads Climate Impact Quantification Initiative**
    - Goal: cost tool that considers financial impacts in infrastructure planning due to climate change and severe weather
  - **April 2017 – Hampton Roads Infrastructure Resiliency Quantification 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 (RDRM)**

HRTPO Objectives with RDRM:

- **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



RESILIENCE AND DISASTER RECOVERY METAMODEL (RDRM)



External factors and levers
- Demographics (…)
- Land use (…)
- Transport supply (…)
- Resilience Investments (…)
- Sea level rise (…)
- Disruptive events (…)
- Recovery process (…)

Core Model

Fast shortest path and routing models

Metamodel analysis

Visualization

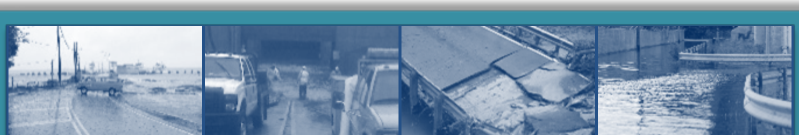
LRTP Planning Process

- 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

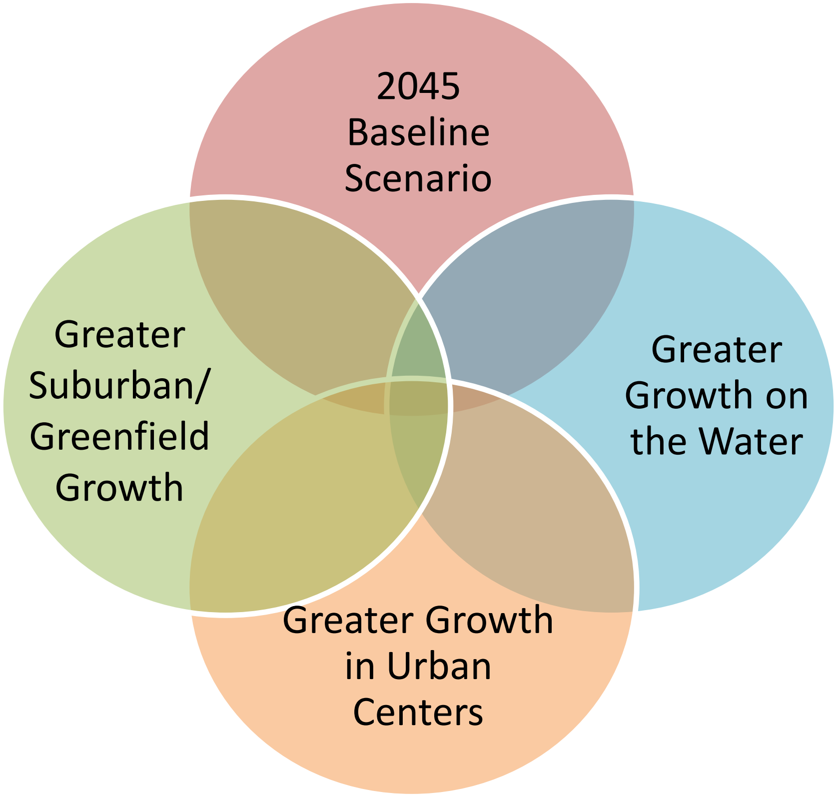
- Project design/cost refinement
- Other regional studies

50 YEARS U.S. Department of Transportation Volpe Center 1970 – 2020



CURRENT LRTP SCENARIO PLANNING PROCESS

Evaluate and Rank Project Across ALL Scenarios



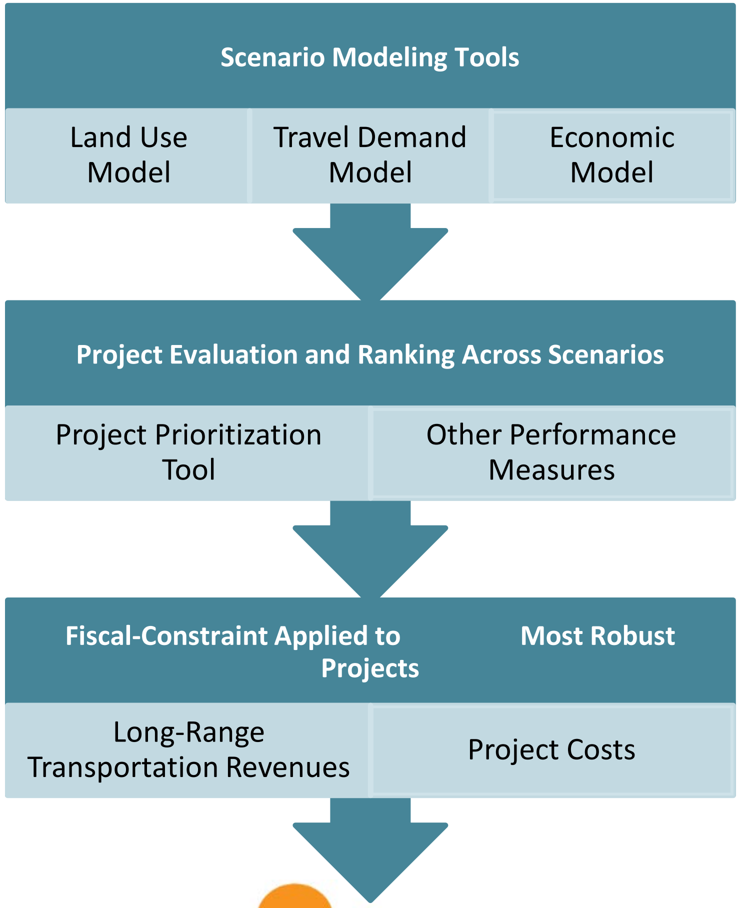
2045 Baseline Scenario

Greater Suburban/ Greenfield Growth

Greater Growth on the Water

Greater Growth in Urban Centers

Most Robust Projects



Scenario Modeling Tools

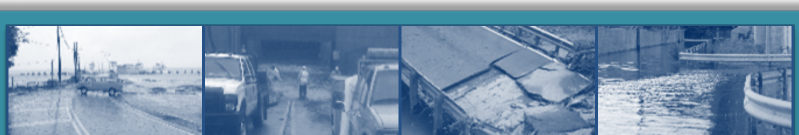
- Land Use Model
- Travel Demand Model
- Economic Model

Project Evaluation and Ranking Across Scenarios

- Project Prioritization Tool
- Other Performance Measures

Fiscal-Constraint Applied to Most Robust Projects

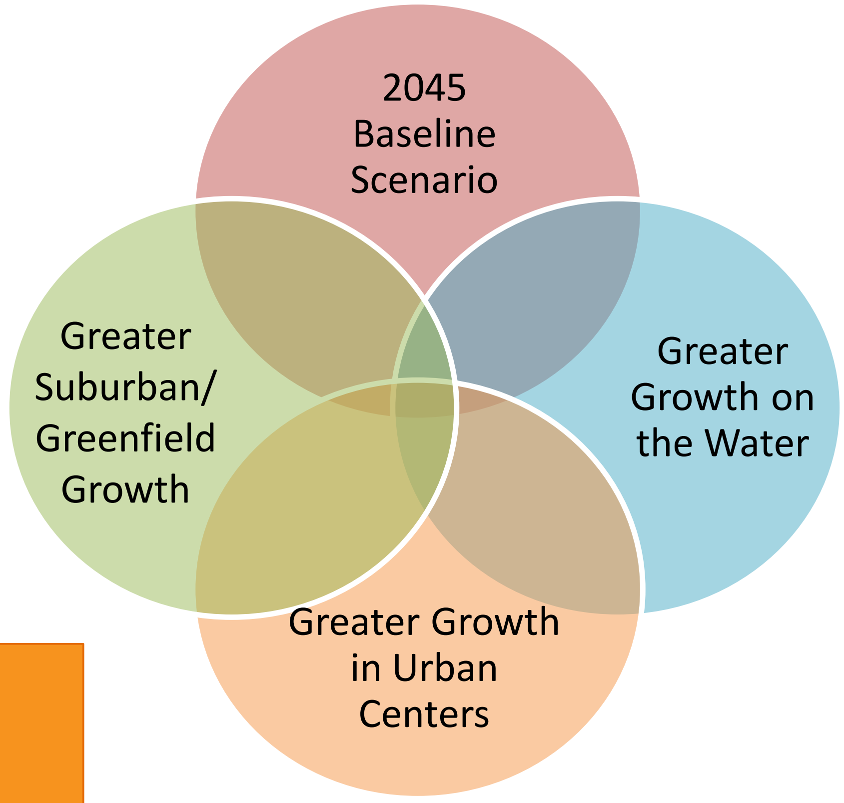
- Long-Range Transportation Revenues
- Project Costs



LRTP Scenario Planning Process with RDRM

EXPLORE IMPACTS OF MORE THAN ONE SLR/FLOODING SCENARIO

Evaluate and Rank Project Across ALL Scenarios

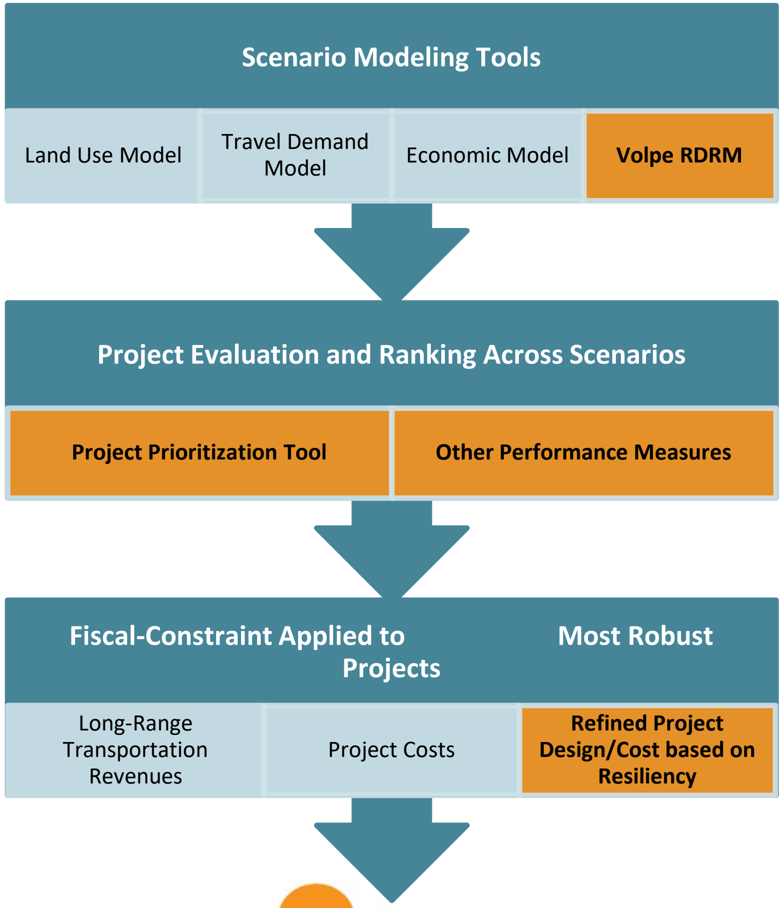

2045 Baseline Scenario

Greater Suburban/ Greenfield Growth

Greater Growth on the Water

Greater Growth in Urban Centers

Most Robust Projects


Scenario Modeling Tools

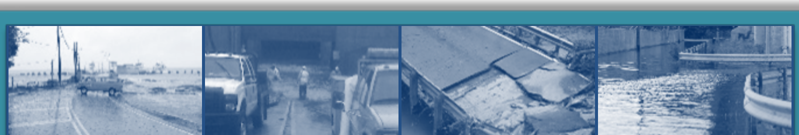
Land Use Model	Travel Demand Model	Economic Model	**Volpe RDRM**

Project Evaluation and Ranking Across Scenarios

Project Prioritization Tool	**Other Performance Measures**

Fiscal-Constraint Applied to Projects **Most Robust**

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



THANK YOU!

Dale M. Stith, AICP, GISP
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the heartbeat of HAMPTON ROADS TPO
TRANSPORTATION PLANNING ORGANIZATION

POLL EVERYWHERE QUESTION

- Which aspect of the Hampton Roads TPO’s approach would be most beneficial to your organization?

SCOTT SMITH, VOLPE CENTER

Scott Smith is a senior level operations research analyst with over 25 years of experience in applying technology to improve transportation operations and safety across all modes. At the Volpe Center, his project sponsors have included most of the modal administrations in U.S. DOT and local agencies. He is the travel demand modeling lead for our resilience and disaster recovery project with US DOT. In 2019, he organized and documented a peer review on an MPO’s use of robust decision-making.

Before joining the Volpe Center, Dr. Smith worked in private industry developing decision support tools to assist motor carriers and railroads with operations, and shippers with transportation procurement.

Dr. Smith holds Project Management Professional (PMP), Certified Analytics Professional (CAP) certification and is a member of the Institute for Operations Research and the Management Sciences (INFORMS) and the Project Management Institute. He is a member of the Standing Committee on Transportation Planning Analysis and Application of the Transportation Research Board. Dr. Smith holds a doctorate in Civil Engineering from MIT.

Resilience and Disaster Recovery Metamodel Overview

FHWA/FDOT peer exchange

Scott Smith, Volpe Center, US DOT
scott.smith@dot.gov

August 28, 2020

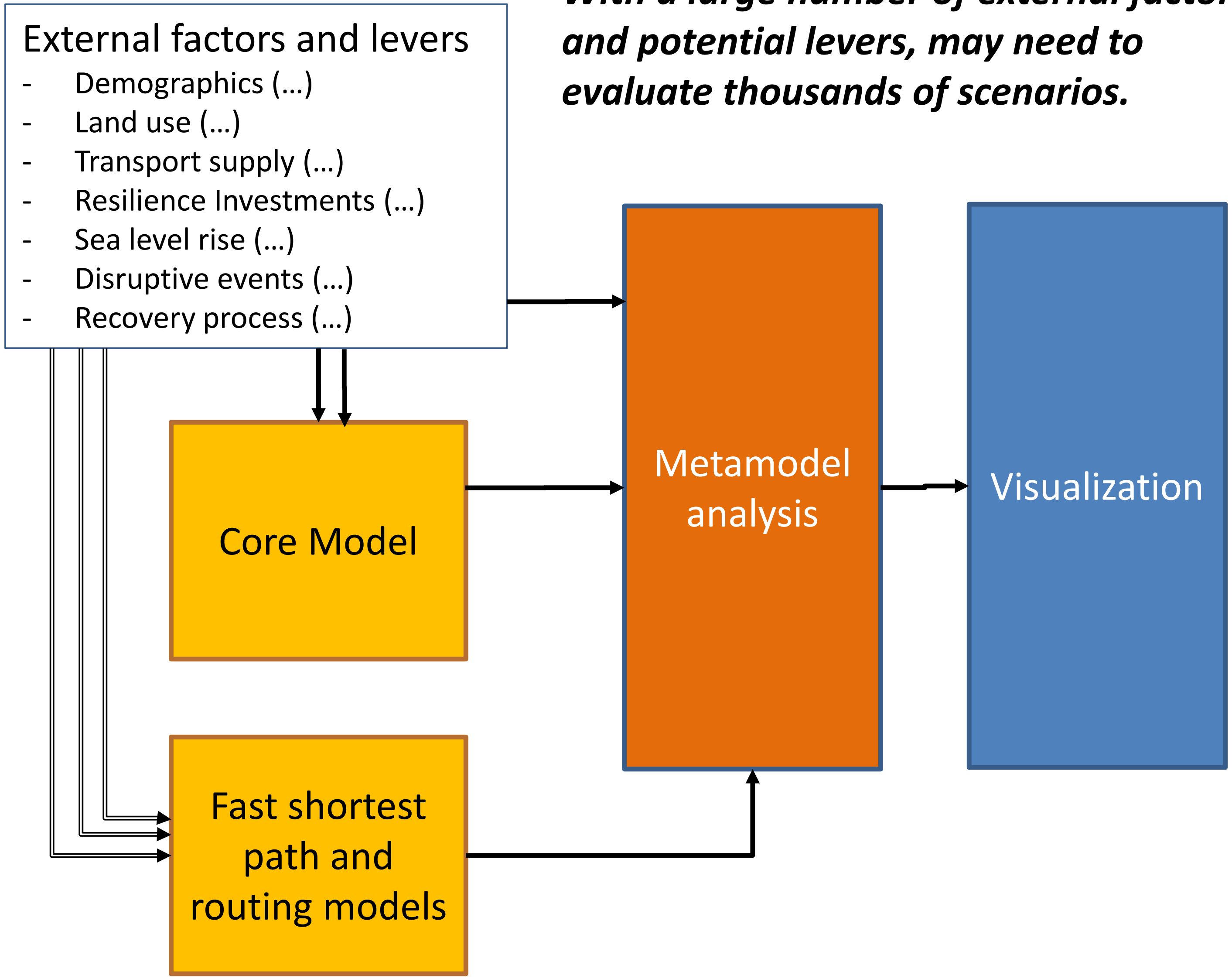
Resilience and Disaster Recovery (RDR) Project

- ☐ Objective - develop a tool that:
  - Is nationally replicable.
  - Addresses a variety of hazard conditions that affect transportation.
  - Enables State DOTs and Metropolitan/Regional Planning Organizations to incorporate the costs and benefits of resilience into the project prioritizing process.
- ☐ Concept:
  - Geospatially explicit tool.
  - Leverage existing tools as appropriate.
  - Enable scenario comparisons for resilience investment return.
- ☐ Outcome: Help DOTs, MPOs and others make informed infrastructure investments.

RDR Process

Exploratory modeling approach, based on TMIP-EMAT (1)

- Core models
  - TDM: The full MPO travel demand model, which takes hours to run.
  - Faster shortest path and routing model to explore disruption scenarios
- RDR Meta-model
  - A much faster model that uses a few results from the core model to explore the range of uncertainty by running many scenarios



External factors and levers
- Demographics (…)
- Land use (…)
- Transport supply (…)
- Resilience Investments (…)
- Sea level rise (…)
- Disruptive events (…)
- Recovery process (…)

With a large number of external factors and potential levers, may need to evaluate thousands of scenarios.

1. Travel Model Improvement Program, Exploratory Modeling and Analysis Tool (see 2018 Innovations in Travel Modeling conference presentation)

Overall Framework

eXternal factors
- Land use changes (patterns of growth in the region)
- Sea level rise
- Frequency / severity of inundation events
- New technology
- Changes in user attitudes: travel and mode choice
- Fuel prices

policy Levers
- Transportation investments
- Resilience investments
- Financial incentives
- Land use policies

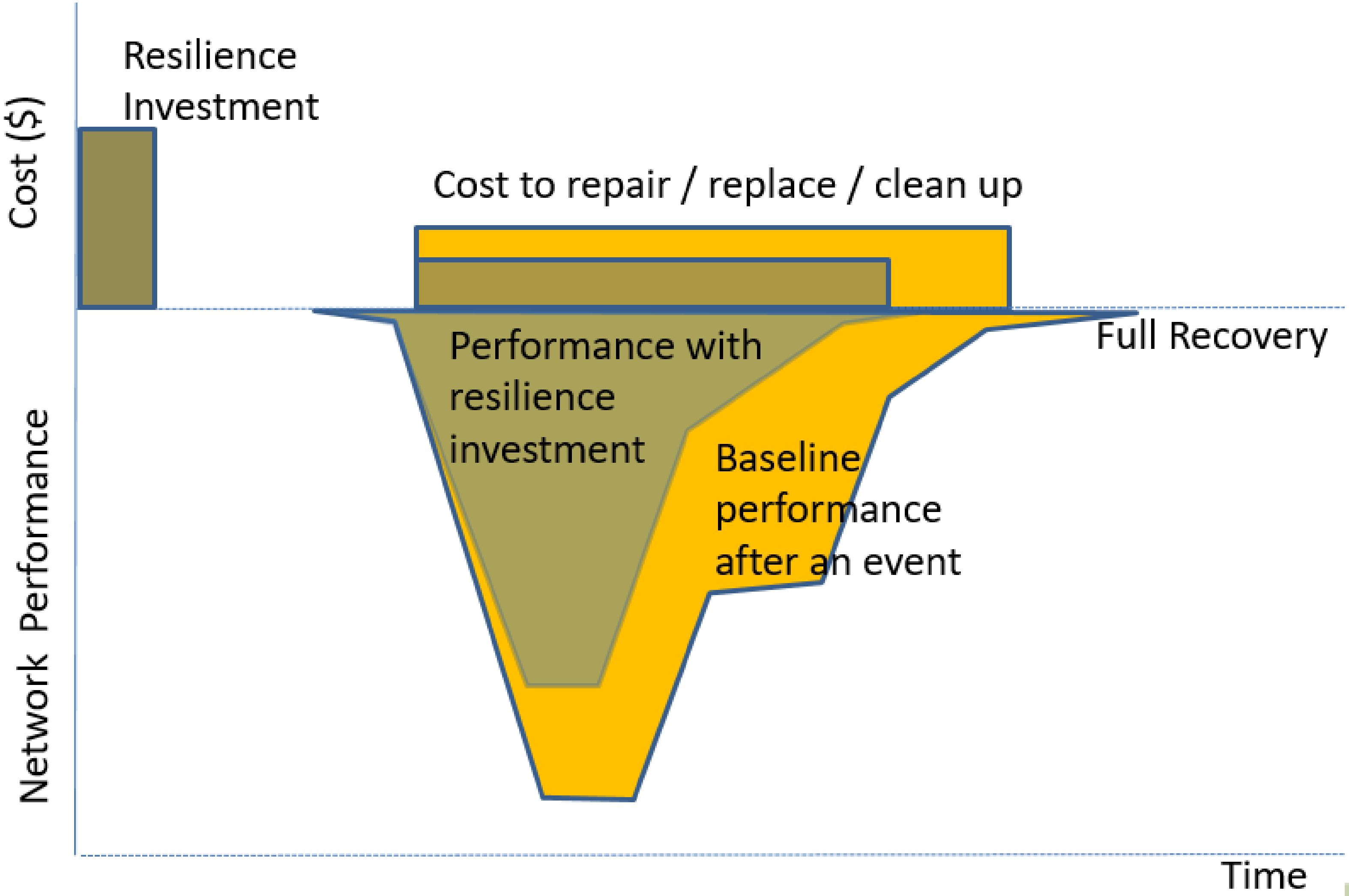
Relationships
- Baseline trips, network flows, travel times
- Inundation recovery times and effects on the network
- Effect of network disruptions on trips, flows and travel times
- Monetization: recovery cost, lost trips, extra travel time and distance
- Comparison of many scenarios

Metrics
- Trips
- Person Hours Traveled (PHT)
- Person and Vehicle Miles Traveled
- Increase in PHT, PMT, VMT
- Monetized value of the scenario
- Regret

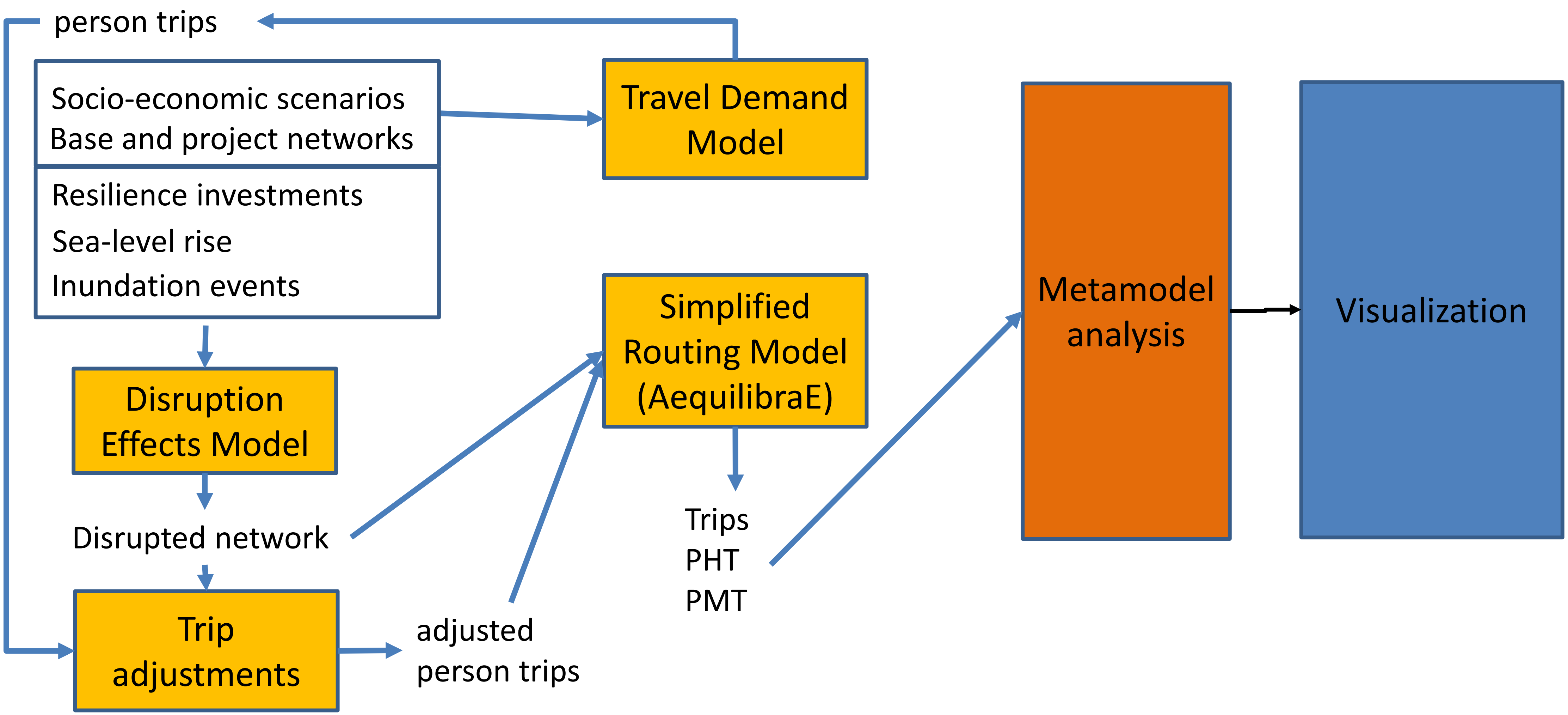
This is the XLRM framework from Robust Decision-Making under Deep Uncertainty, used in TMIP-EMAT

Modeling a single event / resilience investment

- ❑ Costs
  - Direct cost to repair / replace / clean up
  - Degradation in network performance
    - Lost trips
    - Circuitous travel
- ❑ A recovery process has a time dimension
- ❑ Full recovery
  - Hazard has receded
  - Asset is repaired



Toolbox



person trips

Socio-economic scenarios
Base and project networks

Resilience investments
Sea-level rise
Inundation events

Travel Demand Model

Disruption Effects Model

Disrupted network

Trip adjustments

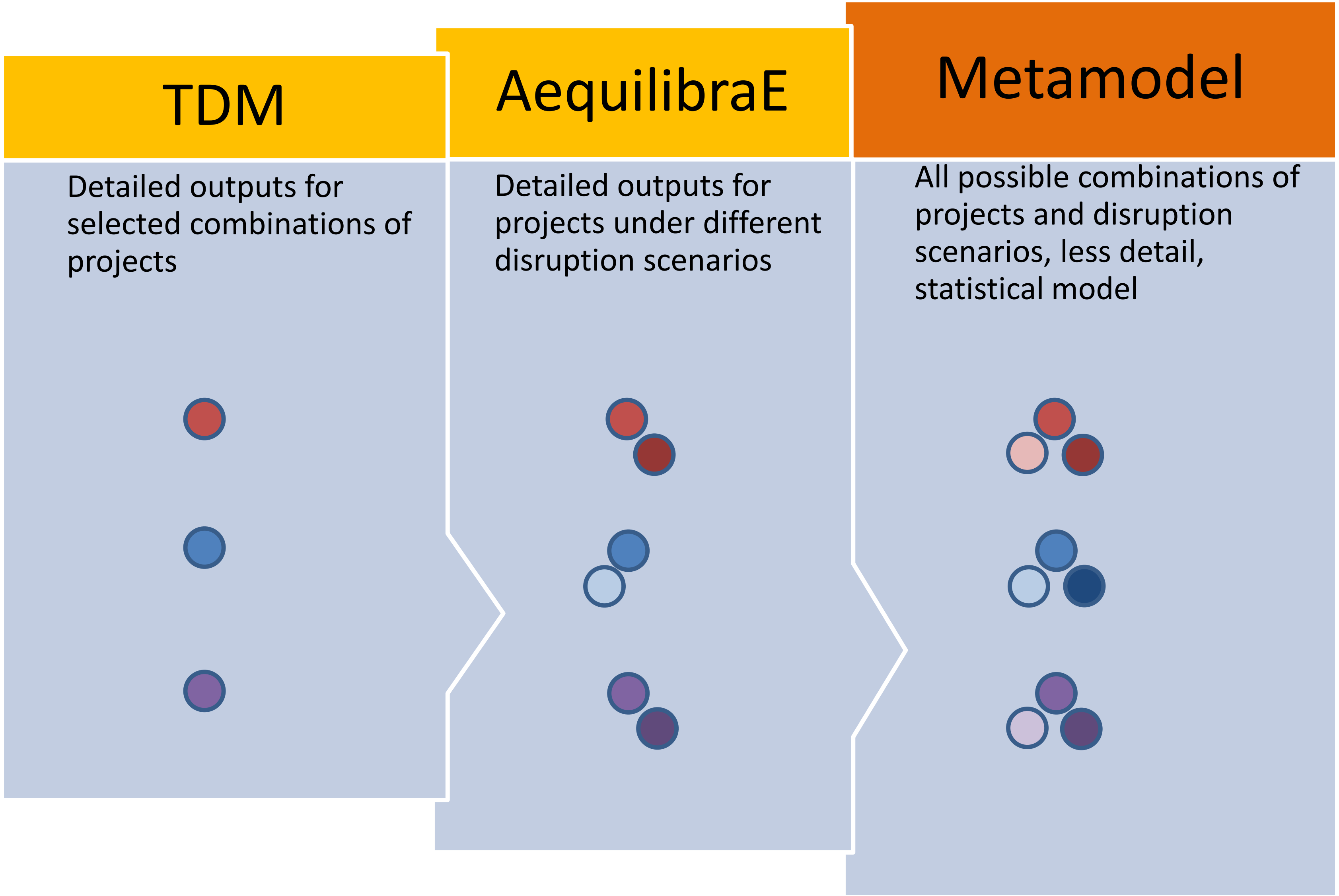
adjusted person trips

Simplified Routing Model (AequilibraE)

Trips
PHT
PMT

Metamodel analysis

Visualization



TDM

Detailed outputs for selected combinations of projects

AequilibraE

Detailed outputs for projects under different disruption scenarios

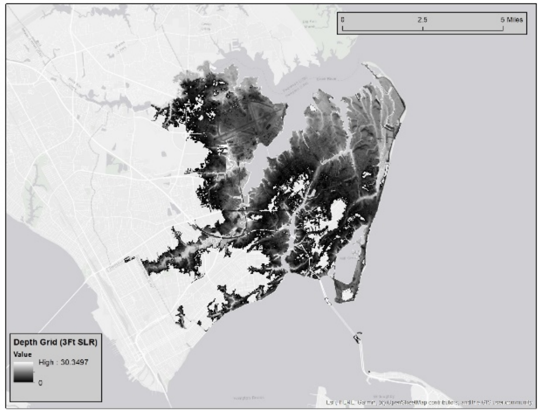
Metamodel

All possible combinations of projects and disruption scenarios, less detail, statistical model

Disruption Effects

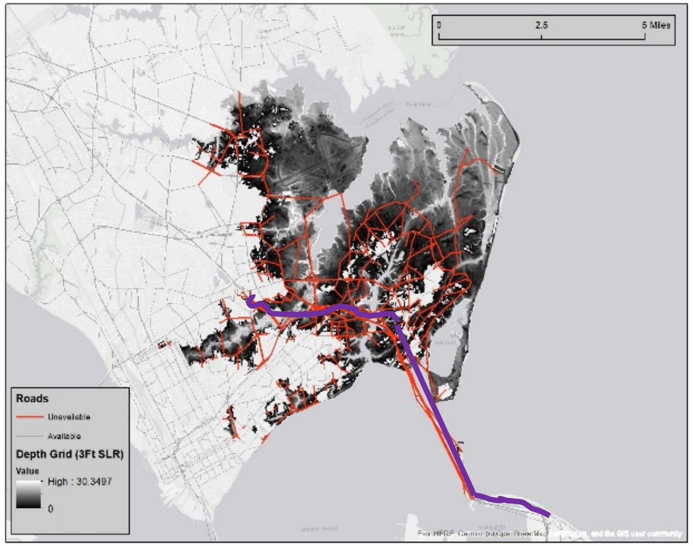
Network with resilience investments

+



Flood with a 3-ft sea level rise

=



Disrupted network with removed or degraded links

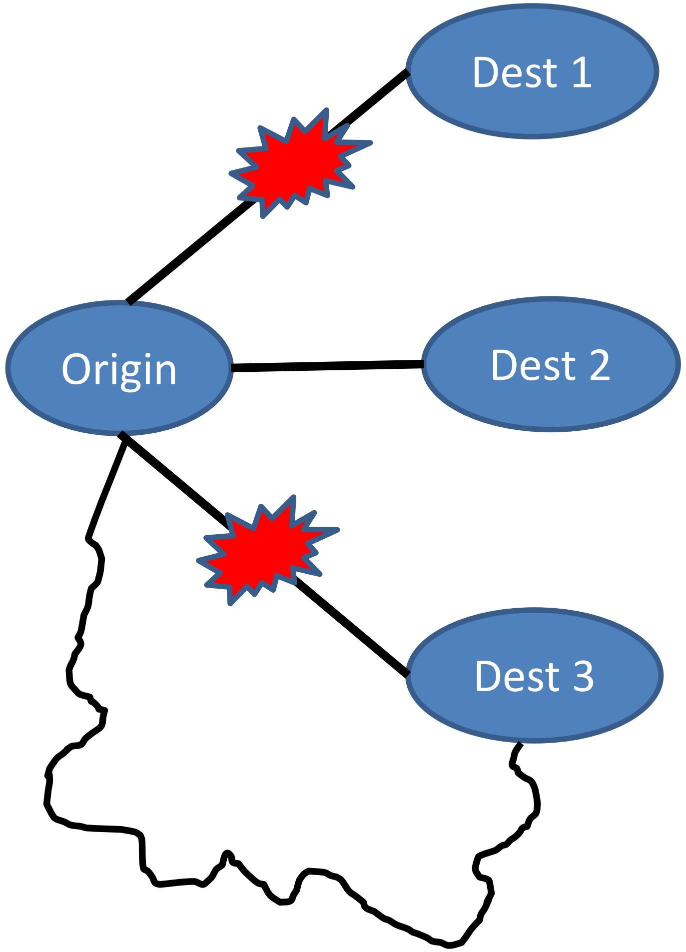
- ❑ Inputs
  - GIS-formatted version of the network
    - Resilience investments: links exempt from inundation
  - GIS-formatted flood inundation depth grid.

- ❑ Outputs
  - Maximum inundation depth on each link
  - Binned option: Exposure of 0 = link available, depth up to x = a% capacity, depth up to y = b% capacity.
  - Binary option: Exposure > 0, link unavailable
  - Exposure-disruption curve: equation defines capacity based on hazard exposure.

The script is a starting point: it is important to review individual assets

Trip Adjustments

elasticity <= 0



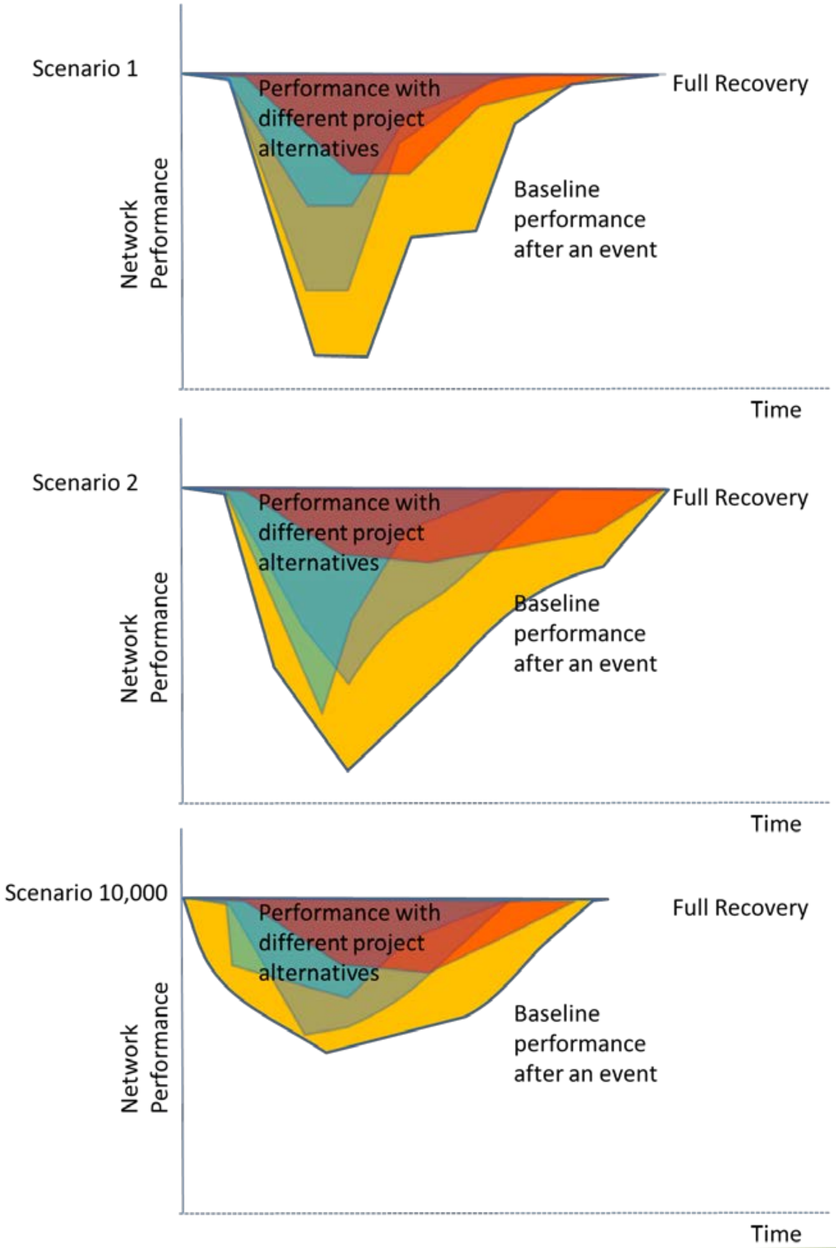
- ❑ If *new_travel_time* = ∞
  - *new_demand = 0*
- ❑ else if *new_travel_time* ≤ *old_travel_time* (within a tolerance)
  - *new_demand = old_demand*
    (Includes the case where travel_time = 0)
- ❑ else
  - *new_demand = old_demand x* $(new\_travel\_time\ /\ old\_travel\_time)^{elasticity}$

Core Models

- ❑ Travel Demand Model
    - Standard four-step model
    - Typically takes hours to run end-to-end
- ❑ Simplified Routing Model
    - Open-source code to provide simple shortest-path and user equilibrium routing capability
    - http://aequilibrae.com/python/latest/
    - Running time is typically measured in minutes
        - o using demand for one time period

Project Prioritization

- **Baseline Scenarios:** these are defined by the parameters of uncertainty
  - Demographics (…)
  - Land use (…)
  - Transport supply (…)
  - Hazard Features (…)
  - Recovery process (…)
- **Project Alternatives:** any resiliency project alternatives that will be tested in the baseline scenarios, includes the no-action baseline
- **Project Alternative Scenario/Outcomes**: network performance of project alternative tested in a given baseline scenario, includes:
  - Person Hours Traveled (PHT),
  - Vehicle Miles Traveled (VMT),
  - Trips,
  - and Asset Damage.



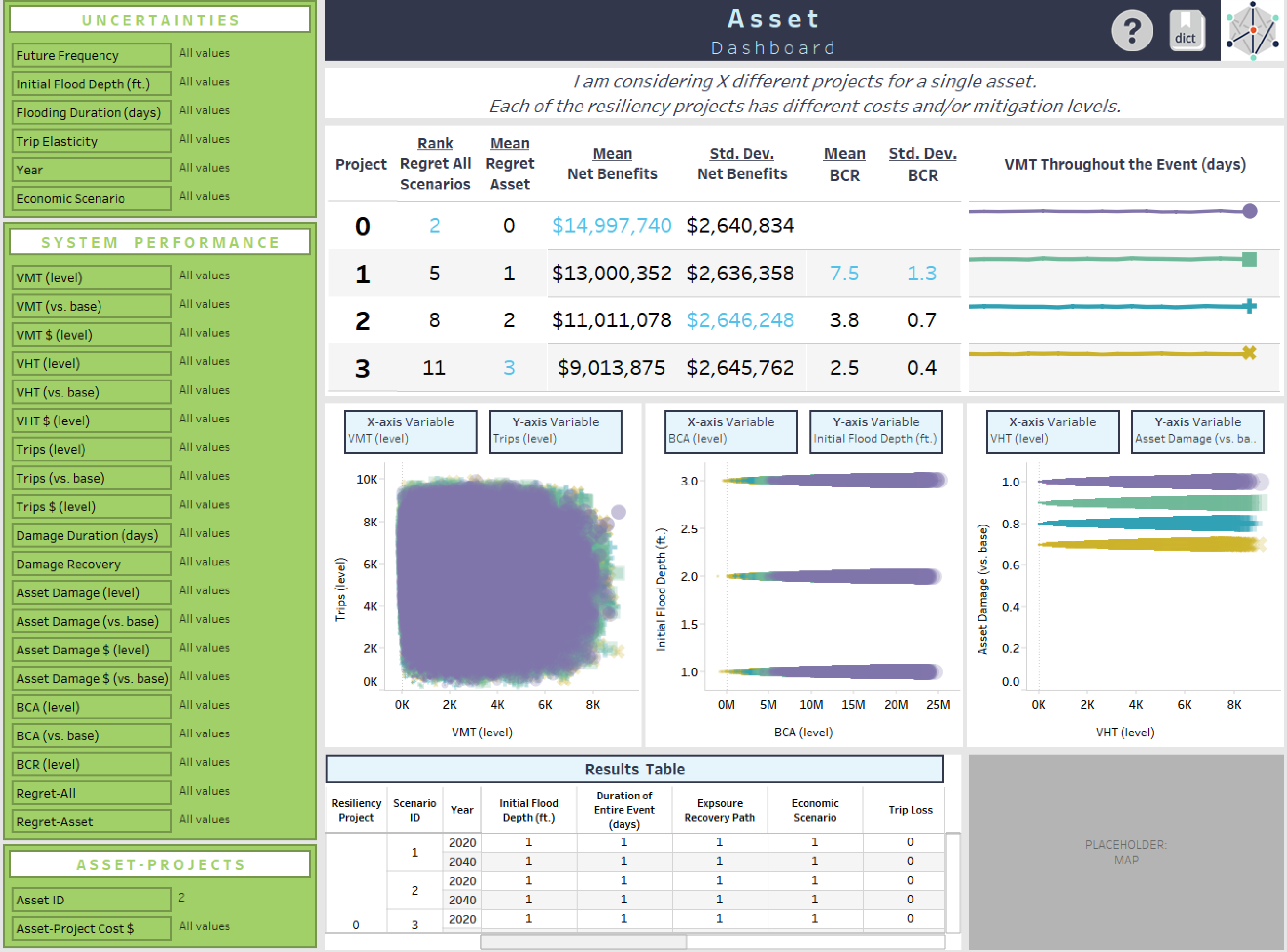
Project Prioritization: Analysis Approaches

- **Breakeven Analysis**:
  - Computes the highest theoretical cost reduction that could be achieved if a hazard were fully mitigated
  - Requires: performance and repair costs for each baseline scenario
- **Benefit Cost Analysis**:
  - Standard BCA approach to compare projects using the sum of discounted net of benefits across all scenarios
  - Requires: annual hazard frequency, cost of project, and the difference of the performance and repair costs between the project alternative outcome and the baseline scenario
- **Regret Analysis**:
  - Regret measures “what you would rather have done” for a given scenario
  - Compares a project against the project with the highest net benefit, for a given scenario
  - Requires: net benefits of each project in the given scenario

Output Visualization Dashboard (Tableau)

- ❑ Current dashboard screenshots use notional data to expand the results of the test run to demonstrate the scale of the metamodel results

- ❑ Three levels of dashboard:
  - Asset (multiple projects for a given asset)
  - Asset-project (a specific project option at an asset)
  - All assets (comparing projects and assets)



UNCERTAINTIES

Future Frequency	All values
Initial Flood Depth (ft.)	All values
Flooding Duration (days)	All values
Trip Elasticity	All values
Year	All values
Economic Scenario	All values

SYSTEM PERFORMANCE

VMT (level)	All values
VMT (vs. base)	All values
VMT $ (level)	All values
VHT (level)	All values
VHT (vs. base)	All values
VHT $ (level)	All values
Trips (level)	All values
Trips (vs. base)	All values
Trips $ (level)	All values
Damage Duration (days)	All values
Damage Recovery	All values
Asset Damage (level)	All values
Asset Damage (vs. base)	All values
Asset Damage $ (level)	All values
Asset Damage $ (vs. base)	All values
BCA (level)	All values
BCA (vs. base)	All values
BCR (level)	All values
Regret-All	All values
Regret-Asset	All values

ASSET-PROJECTS

Asset ID	2
Asset-Project Cost $	All values

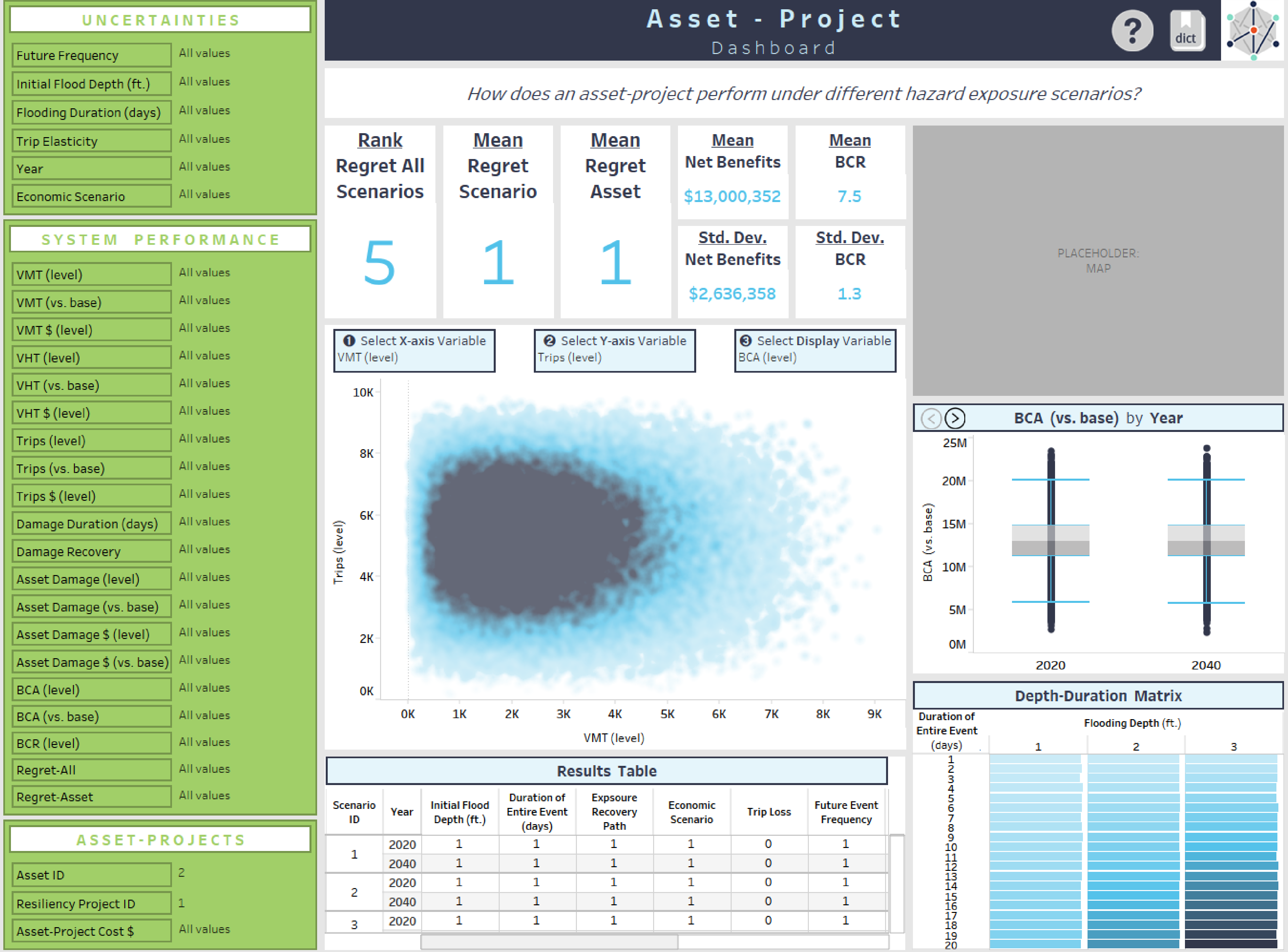
Asset
Dashboard

I am considering X different projects for a single asset.
Each of the resiliency projects has different costs and/or mitigation levels.

Project	Rank Regret All Scenarios	Mean Regret Asset	Mean Net Benefits	Std. Dev. Net Benefits	Mean BCR	Std. Dev. BCR	VMT Throughout the Event (days)
0	2	0	$14,997,740	$2,640,834			
1	5	1	$13,000,352	$2,636,358	7.5	1.3	
2	8	2	$11,011,078	$2,646,248	3.8	0.7	
3	11	3	$9,013,875	$2,645,762	2.5	0.4	

Results Table

Resiliency Project	Scenario ID	Year	Initial Flood Depth (ft.)	Duration of Entire Event (days)	Expsoure Recovery Path	Economic Scenario	Trip Loss
0	1	2020	1	1	1	1	0
		2040	1	1	1	1	0
	2	2020	1	1	1	1	0
		2040	1	1	1	1	0
	3	2020	1	1	1	1	0



Asset - Project
Dashboard

How does an asset-project perform under different hazard exposure scenarios?

UNCERTAINTIES

Future Frequency	All values
Initial Flood Depth (ft.)	All values
Flooding Duration (days)	All values
Trip Elasticity	All values
Year	All values
Economic Scenario	All values

SYSTEM PERFORMANCE

VMT (level)	All values
VMT (vs. base)	All values
VMT $ (level)	All values
VHT (level)	All values
VHT (vs. base)	All values
VHT $ (level)	All values
Trips (level)	All values
Trips (vs. base)	All values
Trips $ (level)	All values
Damage Duration (days)	All values
Damage Recovery	All values
Asset Damage (level)	All values
Asset Damage (vs. base)	All values
Asset Damage $ (level)	All values
Asset Damage $ (vs. base)	All values
BCA (level)	All values
BCA (vs. base)	All values
BCR (level)	All values
Regret-All	All values
Regret-Asset	All values

ASSET-PROJECTS

Asset ID	2
Resiliency Project ID	1
Asset-Project Cost $	All values

Rank Regret All Scenarios	Mean Regret Scenario	Mean Regret Asset	Mean Net Benefits	Mean BCR
5	1	1	$13,000,352	7.5
			Std. Dev. Net Benefits	**Std. Dev. BCR**
			$2,636,358	1.3

PLACEHOLDER: MAP

❶ Select X-axis Variable
VMT (level)

❷ Select Y-axis Variable
Trips (level)

❸ Select Display Variable
BCA (level)

Results Table

Scenario ID	Year	Initial Flood Depth (ft.)	Duration of Entire Event (days)	Expsoure Recovery Path	Economic Scenario	Trip Loss	Future Event Frequency
1	2020	1	1	1	1	0	1
	2040	1	1	1	1	0	1
2	2020	1	1	1	1	0	1
	2040	1	1	1	1	0	1
3	2020	1	1	1	1	0	1

Near Term Modeling Next Steps

- ❑ Pilot with HRTPO/HRPDC/VDOT
  - Test model components using HRTPO TDM outputs.
  - Gather input/feedback on metamodel functions for refinement/enhancement.
- ❑ Finalize RDRM development, integration of components, testing
  - Currently working on regression function to expand/interpolate among sampled scenarios, recovery/repair cost components, final Tableau dashboard, among others.
- ❑ Technical feedback group
  - Several MPOs to provide breadth of feedback/input on tool.
- ❑ Dissemination and outreach
  - Release targeted for early 2021.

RDR Team

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OST-R PM:
Shawn Johnson

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Kevin Zhang (Recovery Module)

Advising:
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Sari Radin, Julianne Schwarzer

POLL EVERYWHERE QUESTION

- Which aspect of the Volpe Center’s approach would be most beneficial to your organization?

Panel Discussion: Challenges and Opportunities

WRAP UP

- **Monday: Session 4 - Lessons Learned**
    - Equity and economic development
    - Synthesis of lessons learned
    - Available resources from FHWA
    - Remaining needs and next steps