CAMBRIDGE SYSTEMATICS

Think Forward

Memorandum

TO: North Florida TPO

FROM: Cambridge Systematics, RS&H

DATE: August 8, 2018

RE: Transportation and Resilience Background and LRTP Recommendations

---

This memorandum provides an overview of Federal and state guidance, a state of the practice analysis, and recommendations on a goal, objectives, and related measures to be considered for the North Florida Transportation Planning Organization's (TPO) 2045 Long Range Transportation Plan (LRTP) on the topic of resilience.

The National Academy of Sciences and the American Association of State Highway and Transportation Officials (AASHTO) describe resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. For this task, as with many organizations across the United States, the term resilience is associated with transportation infrastructure impacts from weather events and climate trends. However, resilience also incorporates a broader set of chronic and acute stressors, such as human-made safety and security risks, long-term congestion and mobility impacts, and community and economic resilience due to disruptions or constraints.

Federal and State Requirements

The following sections identify Federal and state requirements and guidance for resilient and adaptive planning practices.

FAST Act and Related Federal Guidance

Federal guidance on climate resilience has been shaped by laws and executive action[1] over the years that catalyzed adaptation planning at the Federal level. Much of the overarching Federal work in the field of climate trends adaption has been undertaken by the U.S. Global Change Research Program (USGCRP), which was established by Presidential initiative in 1989 and mandated by Congress in the Global Change Research Act (GCRA) of 1990, which comprises of 13 Federal agencies – including the USDOT, to conduct research to examine potential climate impacts on transportation. One product of the USGCRP is the National Climate Assessment

[1] Executive Order 13653, (which replaced EO 13514) has led to agency action on adaptation planning across the Federal level. It has been rescinded by the current administration. FHWA's Order 5520 is based on EO 13653. Among other executive action which stands revoked/rescinded is the EO 13690, related to the flood risk management standard.

(NCA), which "integrates scientific information from multiple sources and sectors to highlight key findings and significant gaps in our knowledge; establishes consistent methods for evaluating climate impacts in the US."

USDOT's policy statement on climate adaptation states that "DOT shall integrate consideration of climate impacts and adaptation into the planning, operations, policies, and programs of DOT in order to ensure that taxpayer resources are invested wisely and that transportation infrastructure, services and operations remain effective in current and future climate conditions."[2] The Fixing America's Surface Transportation (FAST) Act, signed into law in December 2015, included a number of provisions addressing the resilience of the nation's transportation system. It requires agencies to take resiliency into consideration during transportation planning processes. The FAST Act expands[3] the scope of the planning process for state Departments of Transportation and Metropolitan Planning Organizations to include the following:

Adaptation makes changes to prepare for and mitigate the *effects of climate trends*, thereby reducing the vulnerability of communities and systems. By adapting to cope with the effects, communities, enterprises and institutions can build their **resilience.**

- Consideration for implementation of a new planning factor for states and metropolitan planning organizations (MPOs): improving the resiliency and reliability of the transportation system (23 CFR 450.206(a)(9) and 23 CFR 450.306(b)(9)).
- During the course of development of a metropolitan transportation plan and the transportation improvement program, consult with agencies and officials responsible for natural disaster risk reduction (23 CFR 450.316(b)).
- Assess capital investment and other strategies as part of the transportation planning process to reduce the vulnerability of the existing transportation infrastructure to natural disasters (23 CFR 450.324(g)(7)).

FHWA provides guidance on eligibility of activities[4] to adapt to climate change and extreme weather events under the Federal-Aid and Federal Lands Highway programs. As part of this guidance, it notified that activities that "plan, design, and construct highways to adapt to current and future climate change and extreme weather events are eligible for reimbursement under the Federal-aid program". Eligible activities include vulnerability and risk assessments of highways that are eligible for Federal aid, among other activities. Among the funding programs listed for conducting vulnerability or risk assessments are Statewide Planning (SPR) and Surface Transportation Program (STP).

The US Army Corps of Engineers' (USACE) sea level change (SLC) scenarios[5], which have been used to conduct screening level assessments of vulnerability of USACE projects to coastal

[2]Policy Statement on Climate Change Adaptation, USDOT. https://www.transportation.gov/sites/dot.gov/files/docs/Policy_on_Aaptation2011.pdf

[3] Resilience and Transportation Planning, FHWA Office of Planning, Environment and Realty (HEP) https://www.fhwa.dot.gov/environment/sustainability/resilience/publications/ratp/index.cfm

[4] Eligibility of Activities To Adapt To Climate Change and Extreme Weather Events Under the Federal-Aid and Federal Lands Highway Program https://www.fhwa.dot.gov/federalaid/120924.cfm

[5] Comprehensive Evaluation of Projects with Respect to Sea-Level Change,

flooding has been adopted by various agencies across the US and in Florida in projecting sea level change, while considering local effects like subsidence.

Florida Transportation Plan

The Florida Transportation Plan (FTP) is the long-range transportation plan for all of Florida. The FTP has a long-range goal that envisions an "agile, resilient, and quality infrastructure", with continued preparation for "extreme weather events such as more frequent or severe tropical storms; flood risks in coastal areas resulting from high-tide events, storm surge, flash floods, stormwater runoff, and related impacts; changes in precipitation patterns and temperatures; and other environmental conditions that could impact transportation infrastructure"[6]. The plan also calls for preparing and ensuring that the State's transportation system be resilient to extreme weather and other risks and identifies the role of research, collaboration, and development of creative solutions to support that effort. Two key relevant objectives[7] that are identified under this planning goal are:

- Adapt transportation infrastructure and technologies to meet changing customer needs; and
- Increase the resiliency of infrastructure to risks, including extreme weather and other environmental conditions.

Florida Statutes

At the State level, Florida passed the Community Planning Act (CPA) in 2011, which designated Adaptation Action Areas to address coastal hazards and potential impacts to sea level rise and eventually prioritizing funding for infrastructure improvements and adaptation planning. In 2015, Florida Senate Bill 1094, "An Act relating to the peril of flood", also became law, which required planning considerations for potential coastal future flood risk due to sea level rise and storm surge, as part of local area comprehensive plans. It also mandated several changes related to flood insurance and promoting strategies that mitigate risk. While not applicable to the North Florida TPO's mission, these requirements are encouraging local government partners to address coastal flooding issues.

County Comprehensive Plans

Comprehensive plans contain a Conservation Element as required by Section 163.3177, F.S. which relates to conservation, use, and protection of natural resources such as air, water, wetlands, soil, fisheries, and wildlife. Additionally, units of government abutting the Atlantic Ocean, the Gulf of Mexico, or certain waters of the state must include a Coastal Management Element. Local governments[8] in the North Florida TPO region have incorporated resiliency principles into their comprehensive plans in the following goal statements:

---

http://www.corpsclimate.us/ccaceslcurves.cfm

[6] Florida Transportation Plan, Policy Element, Agile, Resilient, and Quality Infrastructure (pp.10) http://floridatransportationplan.com/pdf/FDOT_FTP-SIS_PolicyElement.pdf

[7] Ibid., pp.11

[8] Municipalities in the region also have similar policy language in their comprehensive plans.

- The Clay County 2025 Comprehensive Plan Evaluation and Appraisal Report Conservation Goal 1: “to preserve, conserve and appropriately manage the natural resources of Clay County and provide protection of environmentally sensitive lands, life and property from natural and man-made hazards.”

- The Nassau County 2030 Coastal Management Element Coastal Hazard Mitigation Sub-Element Goal: “Promote the responsible management of its coastal area, balancing the provision of water-dependent and water-related uses with the protection of life and property from natural disasters and the preservation of natural resources.”

- St. John’s County 2025 Comprehensive Plan Coastal/Conservation Management Element Goal E.1: “The County shall manage, use, conserve, protect and enhance coastal resources, along with protecting human life from natural disasters.”

- City of Jacksonville 2030 Comprehensive Plan Evaluation and Appraisal Report (2018) “Goal 7: The City shall make every reasonable effort to ensure the public safety, health, and welfare of people and property from the effects of coastal storm and hurricane damage.”

State of the Practice

The state of the practice analysis identified national best practices in vulnerability assessments and resiliency planning and examples of their implementation at the MPO level.

FHWA Adaptation Framework

Transportation agencies and practitioners have researched and refined approaches to assessing impacts of climate variability on transportation infrastructure both at the national and State levels through Federal and State funded or sponsored projects. Most noteworthy and prominent of these efforts are the two rounds of FHWA Vulnerability Assessment Pilot Case Studies, which have tested and refined the FHWA’s Climate Change and Extreme Weather Vulnerability Assessment Framework. This framework has been geared towards state DOT’s and MPOs across the country to design and implement climate vulnerability assessment of a given region’s transportation infrastructure.

A visual representation of the FHWA Adaptation Framework is shown in **Figure 1**. Major components of this framework include:

- Defining objectives and scope;
- Assessing vulnerability; and
- Integrating vulnerability into decision-making

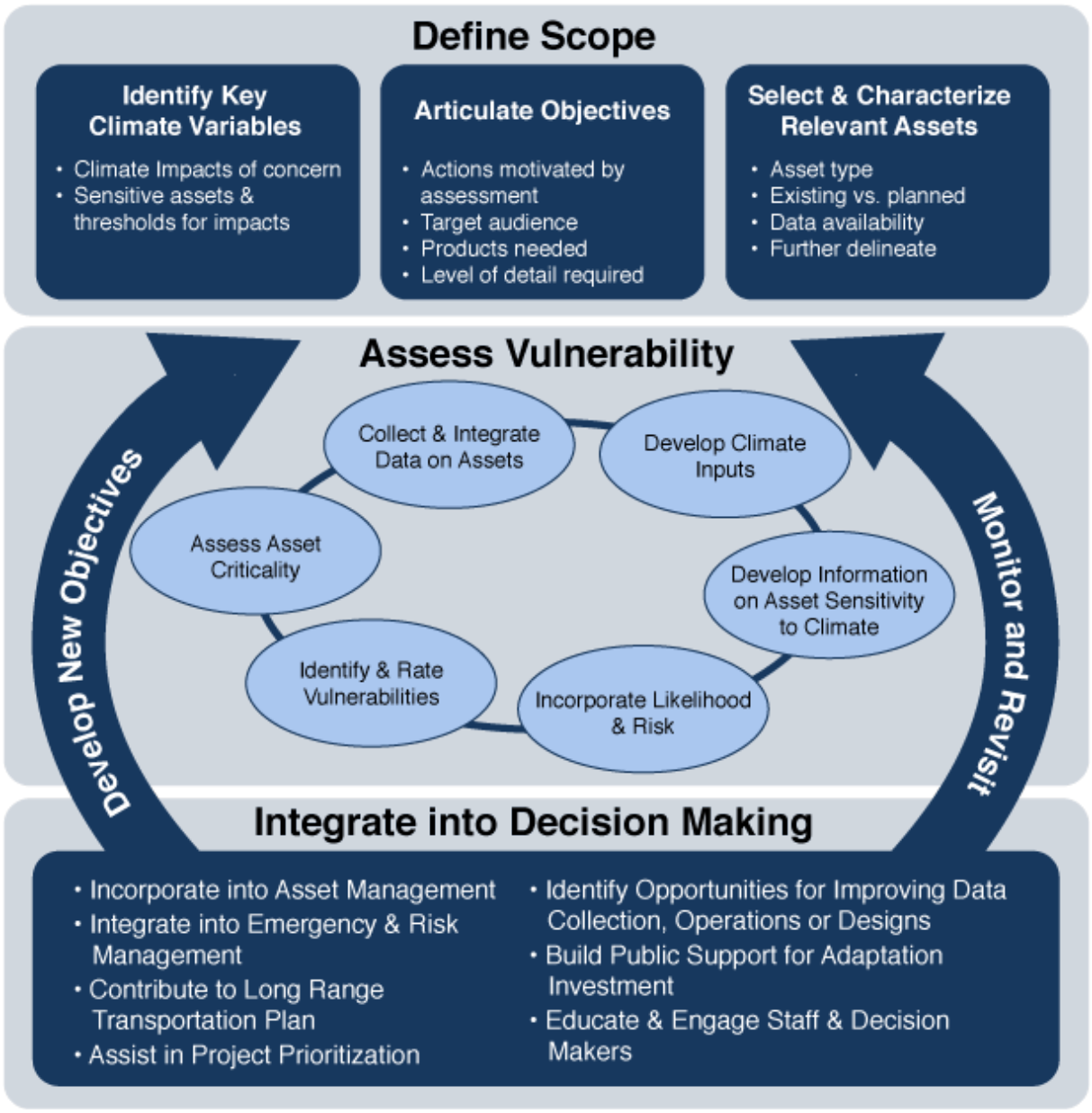

Figure 1: FHWA's Climate Change and Extreme Weather Vulnerability Assessment Framework (Source: FHWA)

MPO Best Practices

State and local jurisdictions in Florida have been involved in developing consensus climate projections and methodologies for assessing potential impacts on transportation infrastructure for several years. Some of this work has been funded by FDOT, which resulted in creating tools and processes that help undertake a vulnerability and risk assessment. Among the notable efforts is

the continued development of sketch planning tools for undertaking statewide and regional assessments of transportation facilities, initially by Florida Atlantic University (FAU) and thereafter by the University of Florida GeoPlan Center.

Other key efforts are the FHWA-sponsored vulnerability and risk assessment pilots that supported the work to develop and pilot approaches for assessing the vulnerability of transportation systems to climate change and develop strategies for building resilience in the transportation sector. Nineteen pilot projects were funded in 2013-2015 and the two in Florida were:

- Hillsborough County MPO Vulnerability Assessment and Adaptation Pilot
- South Florida Climate Change Vulnerability Assessment and Adaptation Pilot Project

Hillsborough County MPO Vulnerability Assessment and Adaptation Pilot:

The scope of Hillsborough County MPO's assessment was to evaluate and identify the economic impact of sea level rise, storm surge and inland flooding to the multi-modal transportation assets across the County and targeted analysis on critical assets identified during the process. The study was undertaken in three phases:

- Assemble climate and asset data and screen assets for criticality (See **Figure 2** for asset screening process);
- Assess vulnerability of critical assets; and
- Estimate general economic losses associated with climate impacts.

This assessment and resulting findings have been incorporated into the Hillsborough MPO's 2040 LRTP as an objective to increase the security and resiliency of the multimodal transportation system. The associated performance measure of this objective is recovery time and economic impact of a major storm.

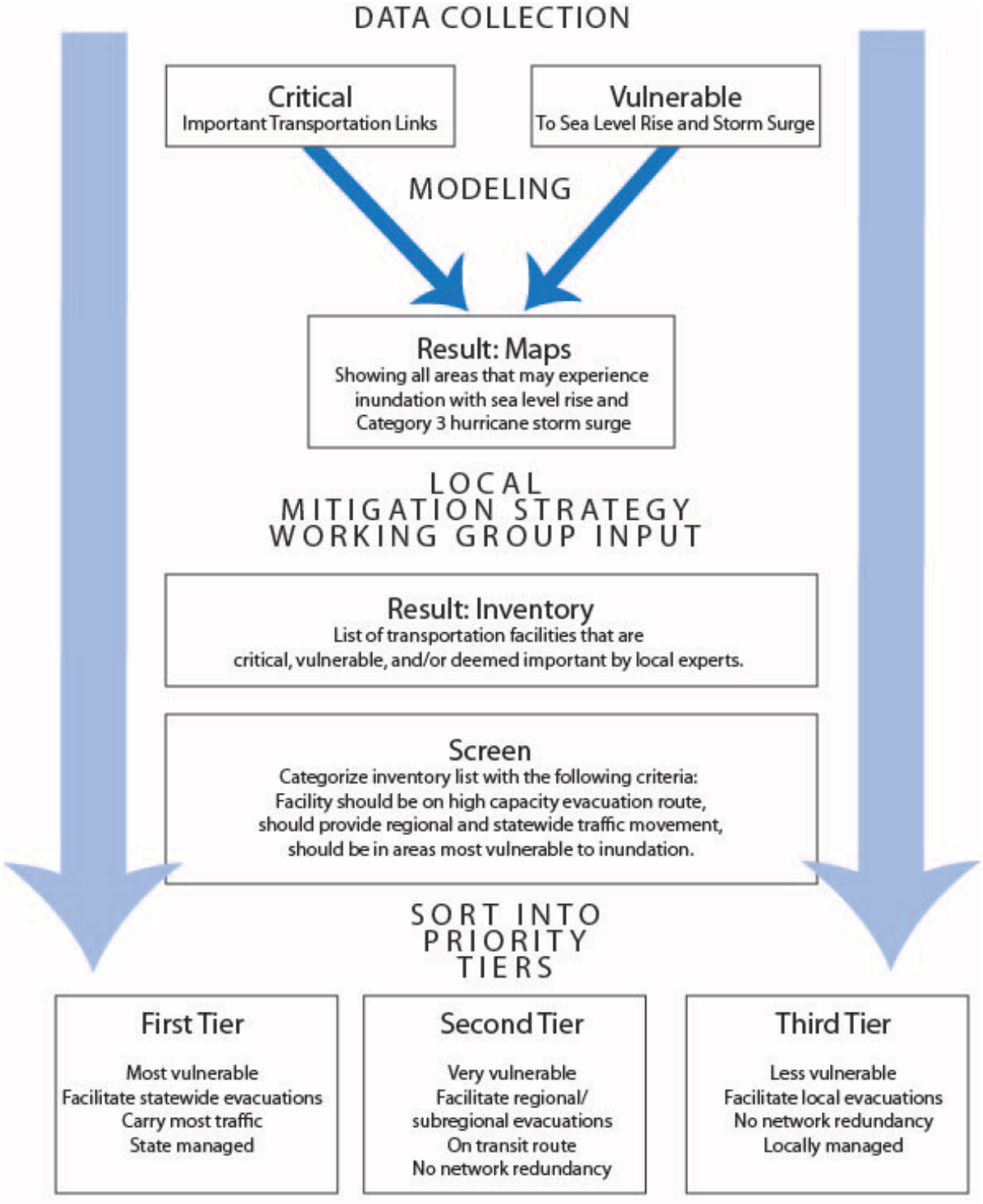

Figure 2: Hillsborough MPO Adaptation Pilot Asset Screening Process

CAMBRIDGE SYSTEMATICS

South Florida Climate Change Vulnerability Assessment and Adaptation Pilot Project:

Partnering agencies in the pilot included Palm Beach MPO, Miami-Dade MPO, the Monroe County Planning and Environmental Resources Department, and Broward Metropolitan Planning Organization (MPO), which conducted the assessment (**Figure 3**) in the four Southeast Counties of the State. Similar to the Hillsborough County MPO pilot, the South Florida pilot also considered the effects of sea level rise, storm surge, and rain driven inundation as the climate stressors for consideration.

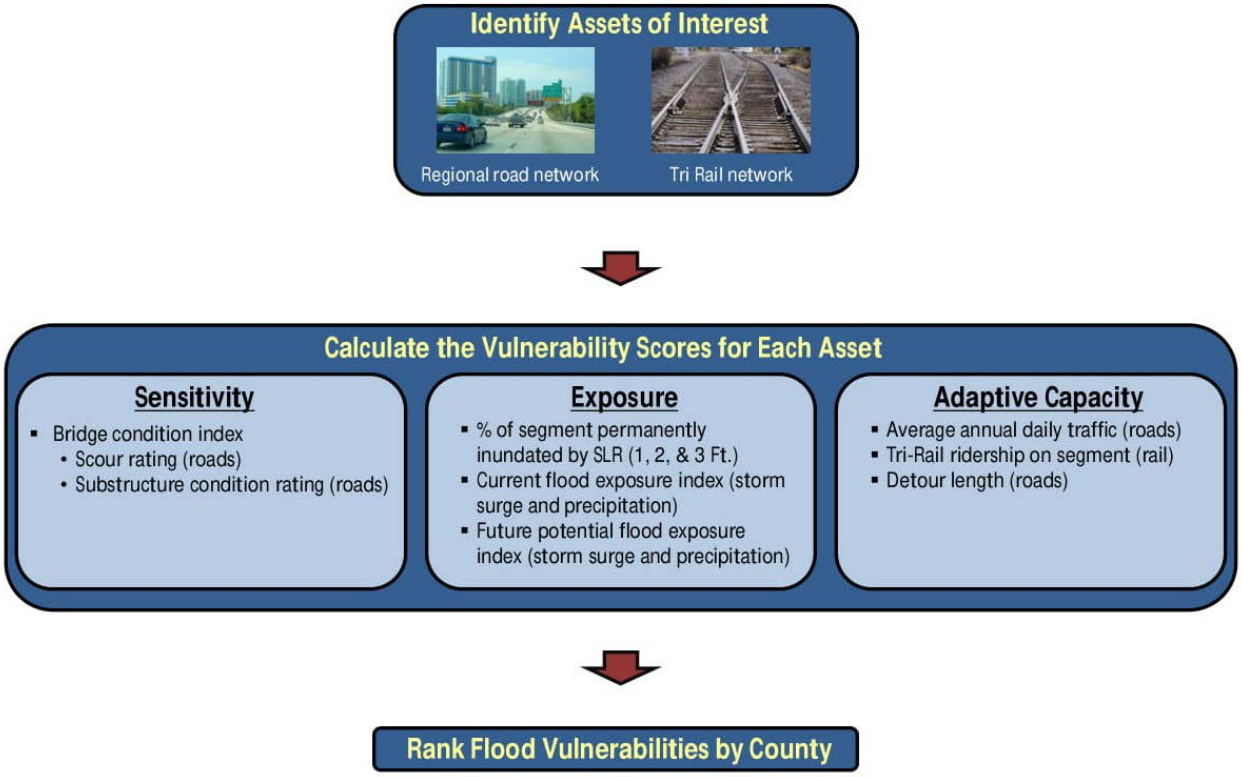

Figure 3: South Florida Climate Adaptation Pilot Vulnerability Assessment Approach

The result of the assessment was a vulnerability score for each regionally significant roadway asset in the study area. Along with identification of vulnerable assets, the study recommended policy directions in the following areas of decision-making:

- Transportation Policy, Planning and Project Prioritization;
- Rehabilitation or Reconstruction of Existing Facilities in High Risk Areas;
- New Facility on New ROW in High Risk Areas;
- Operations; and
- Maintenance.

Subsequent studies that built upon the vulnerability assessments were a local-roads vulnerability assessment for Broward County and a South Florida storm surge evaluation to assess the compounding effects of storm surge with sea level change for the modeled 2040 network.

Local Efforts

Within the North Florida TPO region, at least two cities are already undertaking hazard and resiliency studies and workshops. The City of Jacksonville is conducting a Peril of Flood update and has a coastal high flood hazard area dataset that could support the North Florida TPO's effort. This data was created using the Surge Inundation Model (SIM) which incorporates a Digital Elevation Model created from the most recently flown LiDAR data (from FDEM); water features and the newly updated Jacksonville SLOSH basin from the National Hurricane Center (2012). The City of Augustine conducted a resiliency workshop in May 2018. The City is one of three pilot communities to study vulnerability to coastal flooding and development of a strategic adaptation plan by Florida Department of Economic Opportunity (DEO). These local efforts will inform the development of a regional framework.

Recommendations for LRTP

The following goal, objectives, and related measures are recommended to be considered for the North Florida TPO's 2045 Long Range Transportation Plan (LRTP). The recommendations are based on discussions held at a resilience scoping meeting with regional stakeholders[9] held on June 12, 2018. In particular, a "planning factor" approach for incorporating resilience in the LRTP was applied. There is a single goal, four objectives, and one measure for each objective, which are below. The measures listed are easy to evaluate and apply system-wide.

Goal – Reliable and Resilient Multimodal Infrastructure

Objectives and Measures

O1. Incorporate climate risk in project planning, system preservation and maintenance.

M1: Number of existing and planned projects screened for vulnerability to weather and climate impacts as defined by the total planned investment in dollars.

O2. Provide reliable mobility access and minimize impact of disruptions to regional mobility.

M2: Reducing system-wide travel time delay due to disruption, where disruption is characterized as a representation of maximum storm surge heights for a hypothetical Category 3 storm surge event at each location. The baseline is overall system delay and a target is reduction in the percentage of delay over time.

[9] Agencies represented were: the Cities of Jacksonville, Jacksonville Beach, and St. Augustine; Clay County; Northeast Florida Regional Council, JAXPORT, Jacksonville Transportation Authority, the Florida Department of Transportation, and North Florida TPO.

O3. Support regional evacuation needs as reflected in County emergency management plans.

M3: Evacuation clearance times based on evacuation studies, with a target that clearance times under a regional/county standard(s) are maintained.

O4. Address social equity in adaptation/resilience strategy implementation.

M4: Resiliency investments in areas with a higher share of historically disadvantaged, traditionally underserved, or mobility constrained population groups as determined by the North Florida TPO (i.e., areas with low-income and minority populations). The target would be that investment in these areas remains proportional or better to total investment, e.g., if the population benefitting from resilience investments is N percent of the total regional population, then at least N percent of the resiliency investments are planned/programmed in the specified areas.

Enhanced measures associated with asset-level or detailed assessments and refinements are provided in Table 1. This table provides the same objectives and measures shown above and adds more detailed descriptions in the Description and Measures columns. The Enhanced Measures column identified other measures the North Florida TPO may consider for the 2045 LRTP or later planning processes.

Table 1: Reliable and Resilient Multimodal Infrastructure - Objectives and Measures

Objective	Description	Measure	Enhanced Measures
O1. Incorporate climate risk in project planning, system preservation and maintenance.	Number of existing and planned projects screened for vulnerability to weather and climate impacts (Total planned investment in $$.) Identify existing and planned infrastructure at risk. Transportation assets identified for implementing potential adaptation measures to cope with vulnerability.	Screening and Vulnerability Assessment	Comprehensive vulnerability assessment by considering asset sensitivity and adaptive capacity, that could lead to: • Selection/Identification of Adaptation Measures • Adaptation Measures for representative project(s) – Needs or adaptation-only projects
O2. Provide reliable mobility access and minimize impact of disruptions to regional mobility.	Reduce travel time delay due to disruption, where disruption is characterized as a hypothetical Category 3 storm surge event.	System-wide delay measure with all facilities affected by disruption considered "out of service"	• Asset-level recovery times (i.e., time required to restore service) for critical assets • Detour Planning (based on Disruption Impact Mitigation Planning)
O3. Support regional evacuation needs as reflected in County emergency management plans.	Ability to evacuate regional residents as appropriate during emergencies.	Evacuation clearance times (depends on evacuation studies)	Scenario modeling and potential simulation runs to evaluate strategies that could lower or maintain existing clearance times
O4. Address social equity in adaptation/resilience strategy implementation.	Resiliency investment in areas with higher share of identified population groups (i.e., low-income and minority populations).	Evaluation of disadvantaged communities vulnerable to weather and climate risk	Expand low-income and minority populations to include mobility-disadvantaged groups (zero-car households, seniors/youth), transit dependent populations Investment in areas with higher share of identified population groups as proportion of total resilience investments Policy or program enhancements (as needed) to address population needs, such as evacuation assistance

Next Steps

The next step for the North Florida TPO is to conduct an evaluation of key transportation infrastructure (roads and railroads) to identify potentially vulnerable facilities. This evaluation will use readily available sketch-level planning tools; more detailed assessments can be performed at a later phase. Based on the results of the analyses, the information can be used to inform LRTP project needs development; project prioritization, including assessment of recommended performance measures; and funding decisions. The results also can assist in transportation operations and maintenance considerations and emergency management.