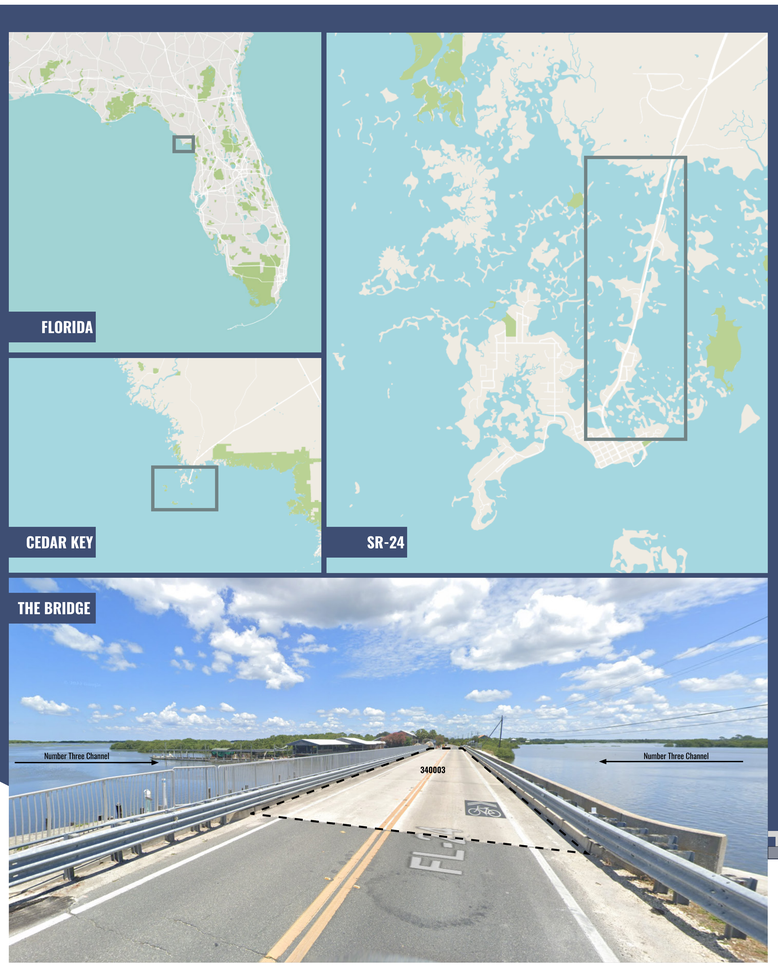
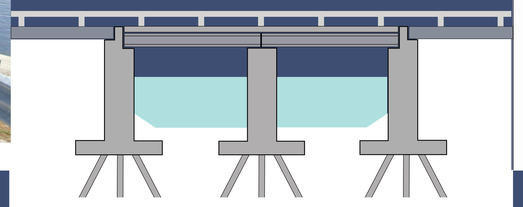
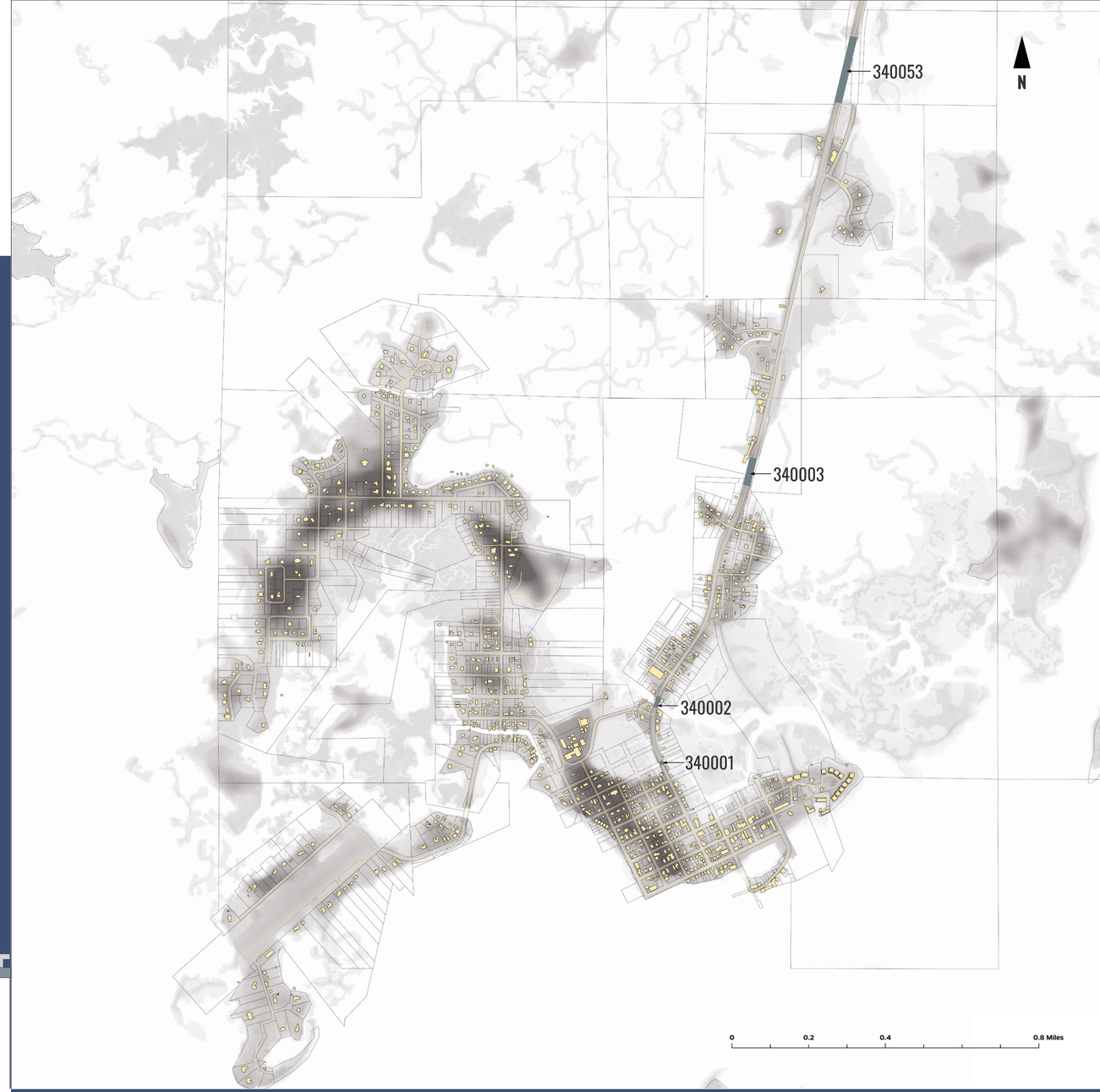
BRIDGES IN VULNERABILITY ASSESSMENTS: THE CASE OF CEDAR KEY



Ana Tricarico Orosco, University of Florida
Jeffrey Carney, University of Florida
Christian Calle, University of Florida

Bridges are a familiar component of the built coastal environment. Hydrologic features are in constant flux, requiring bridge engineers to follow strict design guidelines and monitor frequently. City officials and planners are concerned with various policy and funding matters that affect evacuation routes, maintenance, and public perception. In addition, abundant ecological issues intersect with all of these matters. When it comes to vulnerability assessments and the role of bridges through these same landscapes, the challenges are inherently interdisciplinary. This poster presents a case study of how bridges are treated in a vulnerability assessment in Cedar Key, Florida. This vulnerability assessment was issued to support policy makers as they made decisions about adaptation strategies. In particular, the unique conditions in Cedar Key provide the basis for understanding the possibilities of broadening the framework for bridge assessments beyond what is typically issued by the state's Standardized Vulnerability Assessment. A combination of the Florida Department of Transportation bridge inspection reports, historical hurricane data, topographic Lidar survey, sea-level rise projections, and flood risk mapping are used as a guide to analyze existing processes and identify gaps. The current definitions adopted and requirements for exposure assessment leave potentially critical data out of the equation, which could hinder funding and planning efforts. This investigation aims to provide a deeper insight into the role of bridges in vulnerability assessments and encourage more significant cross-pollination between the different fields that overlap where a bridge stands.





MAIN QUEST

Vulnerability assessments in Florida are still on their first wave of planning and delivery. This is a significant step towards equipping communities with resources that will prepare them to protect and respond to disasters in a more effective way. The ramifications and impact of vulnerability assessments will need to be further studied as more communities join in the effort to produce this document and implement strategies through their comprehensive plans, policies, and projects.

VULNERABILITY ASSESSMENT
FEMA/Disaster Mitigation Act 30 Oct 2000
Assess vulnerabilities as it relates to Sea Level Rise

ADAPTATION PLAN
Proposed adaptation measures based on VA findings

COMPREHENSIVE PLAN
Ties together adaptation planning, county planning, and municipality needs

VULNERABILITY ASSESSMENT

The Vulnerability Assessment is a requirement outlined on Florida statute s. 380.093, F.S., enacted May 12, 2021 under bill 1954. This statute created the Resilient Florida Program.

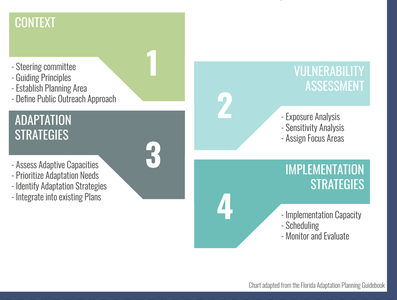


Chart adapted from the Florida Adaptation Planning Guidebook

STEERING COMMITTEE + COMMUNITY OUTREACH	Documentation of steering committee make up and outreach meetings
BACKGROUND DATA	1. Critical/regionally significant assets 2. Topographic data 3. Flood scenario-related data
EXPOSURE ANALYSIS	Comparison of different flood scenarios, including tidal, rainfall, sea level rise, and compound (as applicable)
SENSITIVITY ANALYSIS	Impact of flooding (from exposure analysis) on inventoried assets (from background data)
FINAL REPORT	Compiles all of the findings and identifies priorities based on immediate need (FOCUS AREA).

ADAPTATION & FOCUS AREA

Adaptation strategies for each item identified in the focus area are compared in the FEMA STAPLEE Method.

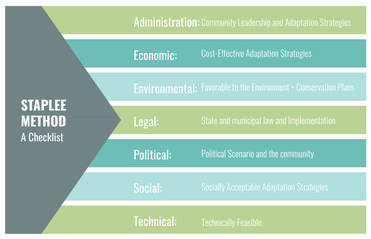
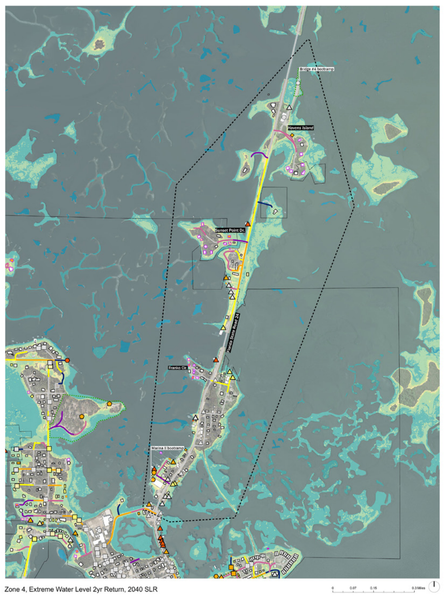


Chart adapted from the Florida Adaptation Planning Guidebook

PROTECTION	"Protection strategies are structurally defensive measures that directly protect vulnerable structures,allowing them to be left largely unaltered."
ACCOMMODATION	"Accommodation strategies alter physical design of vulnerable structures to allow the structure or land use to stay in place with modification."
RETREAT	"Retreat from areas or infrastructure where protection or accommodation will not be efficient or effective can be voluntary, incentivized, or done gradually."
AVOIDANCE	"Avoidance involves guiding new development away from areas that are subject to coastal hazards and can be done by implementing policy and/or offering incentives."

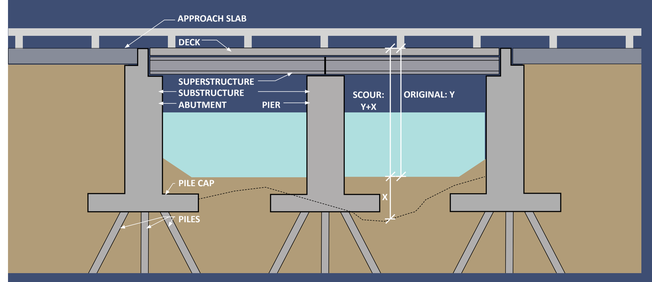


SIDE QUEST

A separate data analysis including additional layers flagged bridge 34003 due to age, sufficiency rating, and being scour critical (Phase IV). While the official assessment may not prioritize the bridges solely based of flood elevations, their age and condition interact with risk associated with sea level rise and flooding. Adding those parameters in a VA can open for the opportunity to have more interdisciplinary discussions through the adaptation planning, as well as potentially unlocking other funding possibilities.

BRIDGE	340001	340002	340003	340053
STRUCTURE TYPE	5 Prestressed Concrete - 02 Stringer/Girder	5 Prestressed Concrete - 02 Stringer/Girder	5 Prestressed Concrete - 02 Stringer/Girder	5 Prestressed Concrete - 02 Stringer/Girder
YEAR	1967	1967	1967	1974
SCOUR CRITICAL	No	No	Yes	No
UTILITIES ATTACHED TO THE STRUCTURE	No	No	Yes (Fiber Optic)	Yes (Fiber Optic)
SUFFICIENCY RATING	59.6	68.6	60.9	78.6

Table adapted from FDOT data



INTERSECTING LAYERS

Maps from Florida Natural Areas Inventory

FURTHER INVESTIGATION

This study highlights the need for improved bridge vulnerability assessments, especially for evacuation routes. It proposes a new method that considers past assessments from different areas and funding strategies for bridges. The successful application of this method in Cedar Key suggests its potential, but further case studies are needed to refine it for diverse communities facing rising sea levels and floods.

--

References:
FDOT. (2022). Bridge Scour Manual. https://www.fdot.gov/docs/default-source/roadway/drainage/bridgescour/FDOT-Scour-Manual.pdf

FDOT. (2023, October 2). Florida Bridge Information. https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/maintenance/str/bi/oom_20231002_floridabridgeinformation_4thqtr.pdf?sfvrsn=71d32110_1

Florida Adaptation Planning Guidebook. (2018). Florida DEP. https://floridadep.gov/sites/default/files/AdaptationPlanningGuidebook.pdf

Sea Level Trends—NOAA Tides & Currents. (n.d.). Retrieved November 12, 2023, from https://tidesandcurrents.noaa.gov/sltrends/

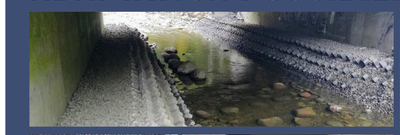
Standardized Vulnerability Assessment: Scope of Work Guidance. (2022, May). https://floridadep.gov/sites/default/files/VA%20Scope%20FINAL%202_0.pdf

State of Florida. (n.d.). Statute 380.093. Statutes & Constitution. Retrieved November 13, 2023, from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0380/Sections/0380.093.html

von Meding, J., & Chmutina, K. (2023). From labelling weakness to liberatory praxis: A new theory of vulnerability for disaster studies.

Disaster Prevention and Management: An International Journal, 32(2), 364–378. https://doi.org/10.1108/DPM-10-2022-0208

ADAPTATION POSSIBILITIES

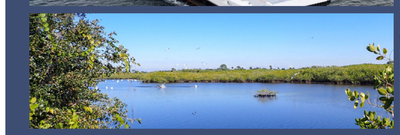


PROTECTION
Scour Treatment + deck anchors + remote monitoring

ACCOMMODATION
Elevate roadway and bridge

ACCOMMODATION PLUS
New causeway

RETREAT
Timeline to phase out roadway/bridge use; transition to ferry



AVOIDANCE
Offer incentives for relocation, Cedar Key becomes a conservation area in 50+ years