Addressing Climate Change Vulnerabilities to Transportation Infrastructure

Lessons from Michigan DOT

presented to

Adaptation in the Great Lakes Region Conference

presented by

Cambridge Systematics, Inc.

Jason Hyde and

Michigan DOT, Niles Annelin

Transportation leadership you can trust.

CAMBRIDGE SYSTEMATICS

MDOT Michigan Department of Transportation

Michigan's Climate and Transportation

- Over 3,000 Miles of Shoreline – 2nd only to Alaska
- Over 100,000 Miles of Roadway
- Over 10,000 Bridges
- 98 Islands
- Over 11,000 Inland Lakes
- At any point in Michigan you are never more than 85 Miles away from one of the Great Lakes

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Michigan's Climate and Transportation

- 35% of US/Canada Trade flows through Michigan
- $520 Billion in Freight is Moved each year on Michigan's Highways, Rail and Water Ports
- Trucking Accounts for 67% of all Freight Tonnage Moved in Michigan

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Climate Risks

- More Frequent and Intense Rain Events
  - » Washout of Transportation Infrastructure
- Increased Frequency of Freeze Thaw Cycle
- Increased and Prolonged Summer Temperatures Extremes
  - » Both will Deteriorate Roads more Rapidly
- Changes to Maintenance Needs

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Climate Risks

Winter Melt/Spring Rains - More Flooding

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Climate Risks

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

What to Do

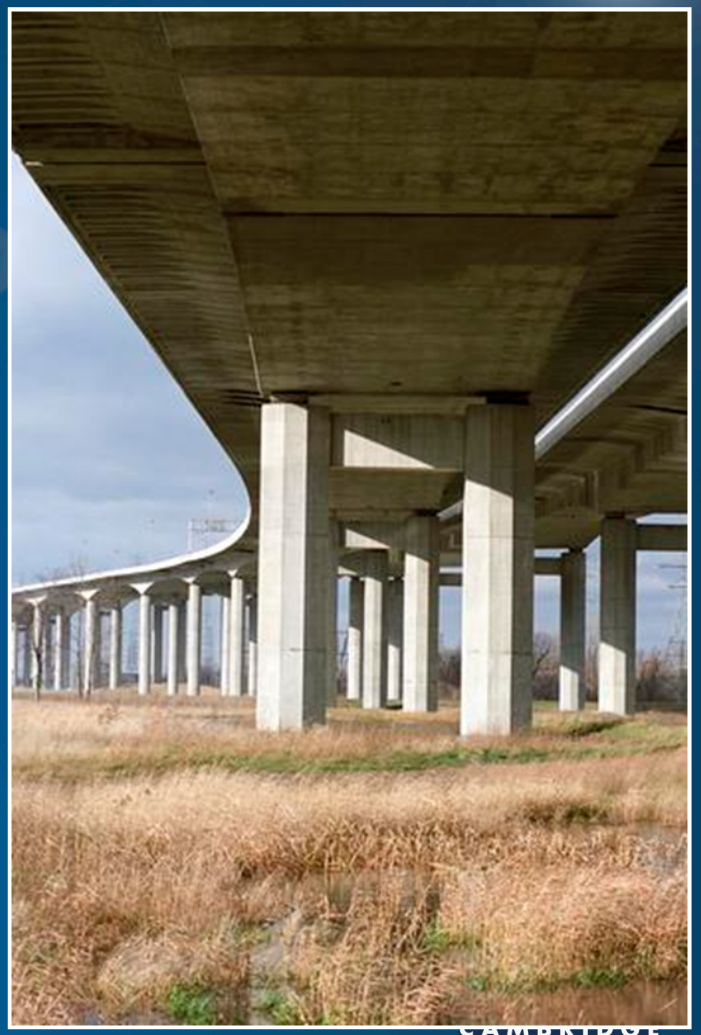
- Continue to Develop Asset Management Databases
- Data will be used to Identify Potential Risks
- Address these Risks through Regular Transportation Program Process

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

What to Do

- Opportunity to apply for an FHWA Pilot Study to Assess Vulnerability to Climate Change
  - » Assess Available Climate Models,
  - » Compare them to Asset Management Data and
  - » Prepare set of Infrastructure at most Risk for Climate Change

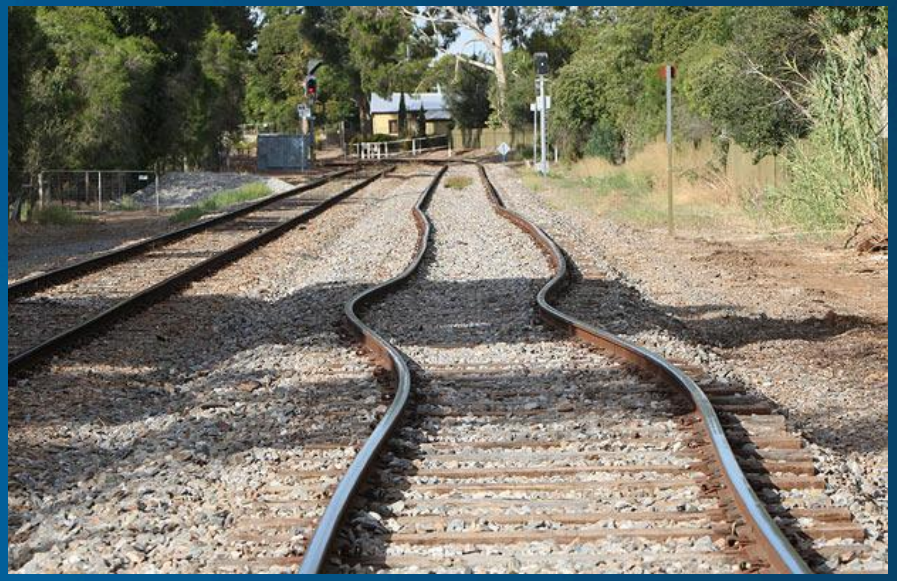


MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

What is Climate Change Vulnerability?

Climate change and extreme weather vulnerability in the transportation context a function of a transportation asset or system's **sensitivity** to climate effects, **exposure** to climate effects, and **adaptive capacity**

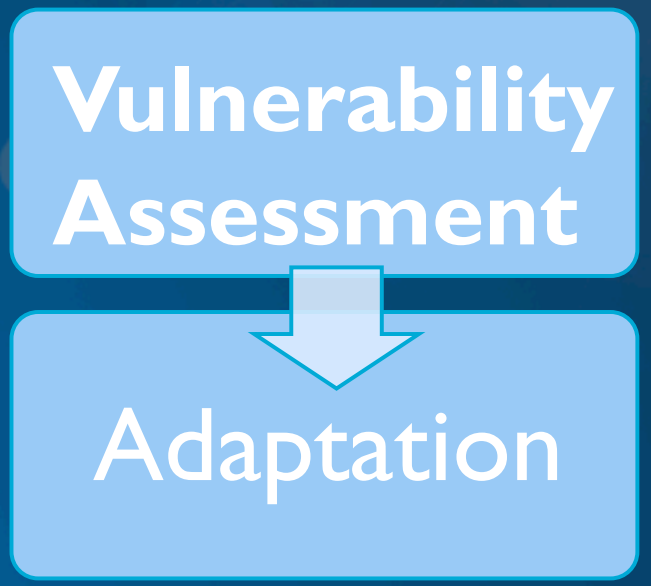


MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Objective of Climate Vulnerability Assessments

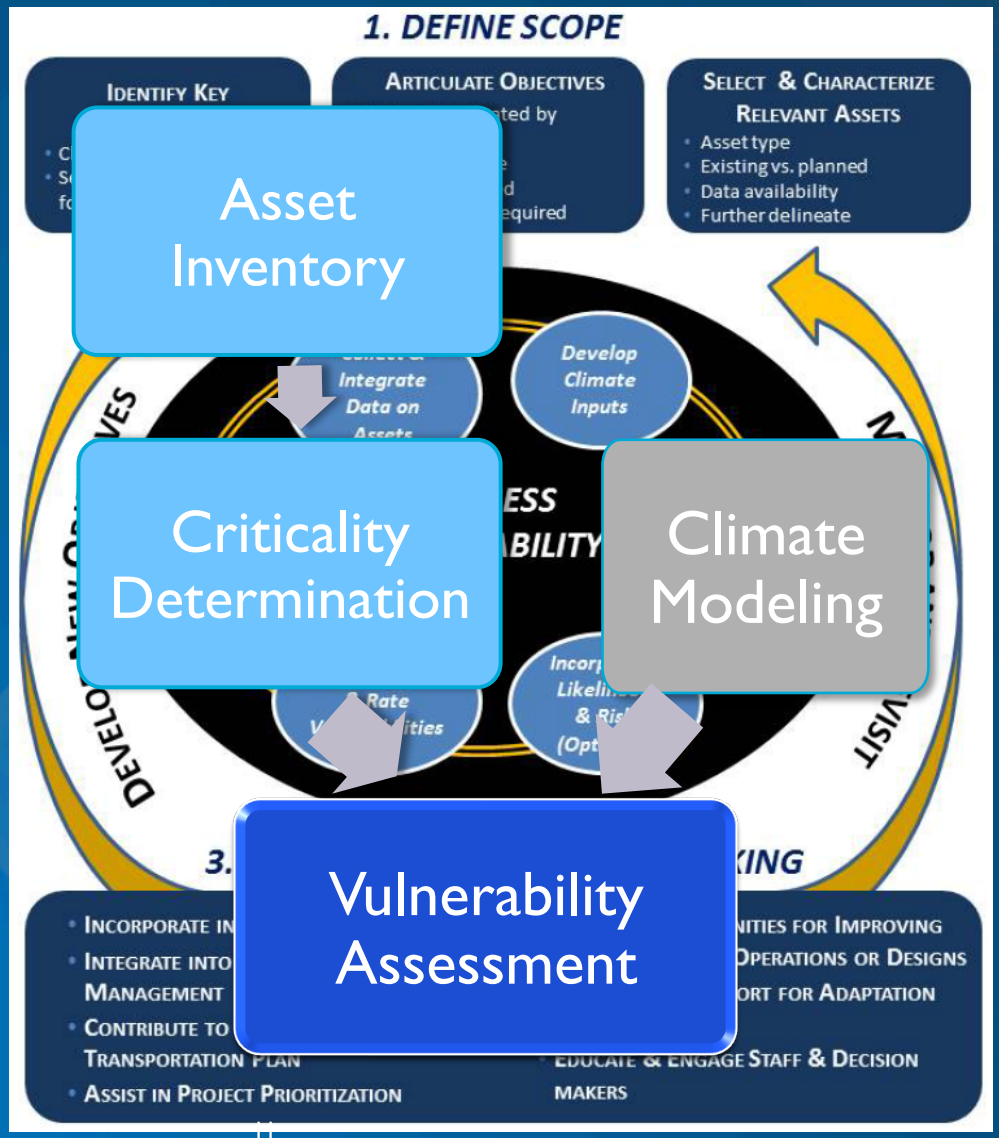
- Assess vulnerability of transportation infrastructure to climate change
- Develop adaptation strategies and update asset management process to address these vulnerabilities



MDOT Michigan Department of Transportation

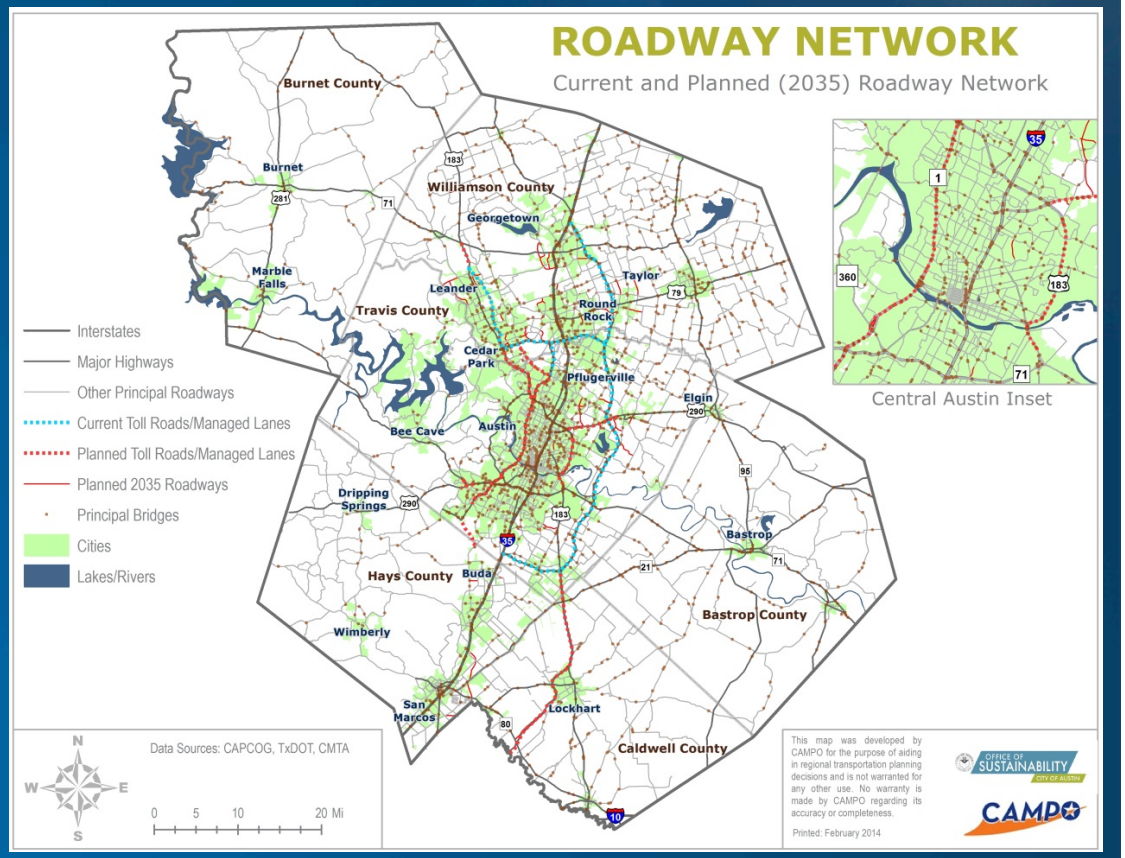
CAMBRIDGE SYSTEMATICS

FHWA Vulnerability Assessment Framework



Asset Inventory

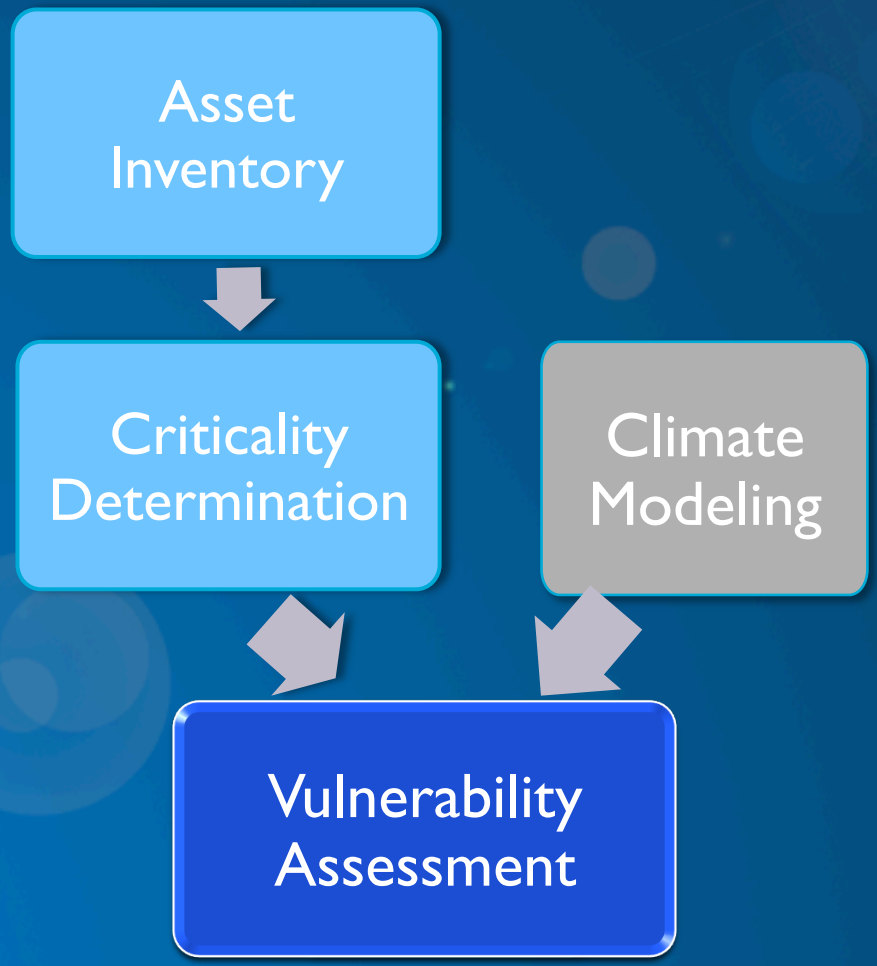
- A meaningful vulnerability assessment requires robust, accurate transportation system data
- Obtaining the best available spatial and attribute data in Geographic Information System (GIS) format a critical first step



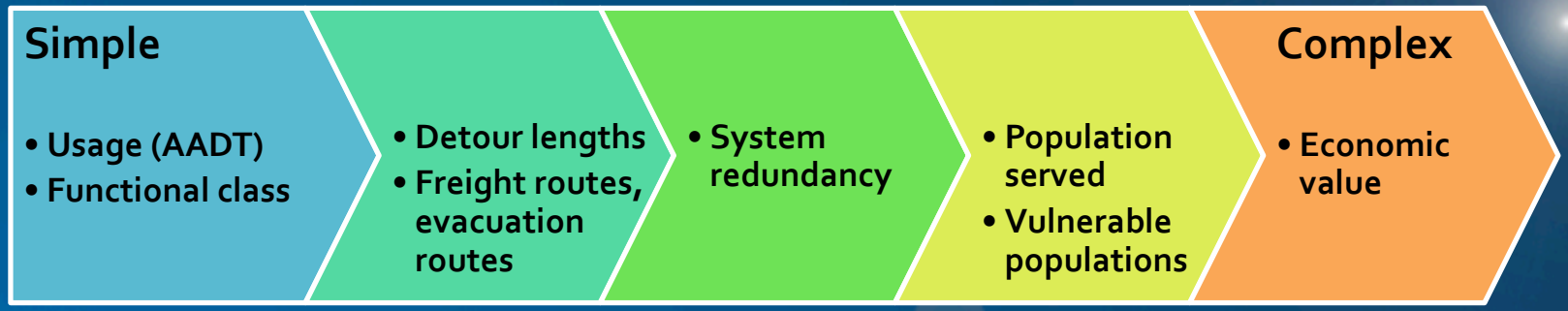
CMDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

FHWA Vulnerability Assessment Framework



Range of Approaches for Defining Criticality



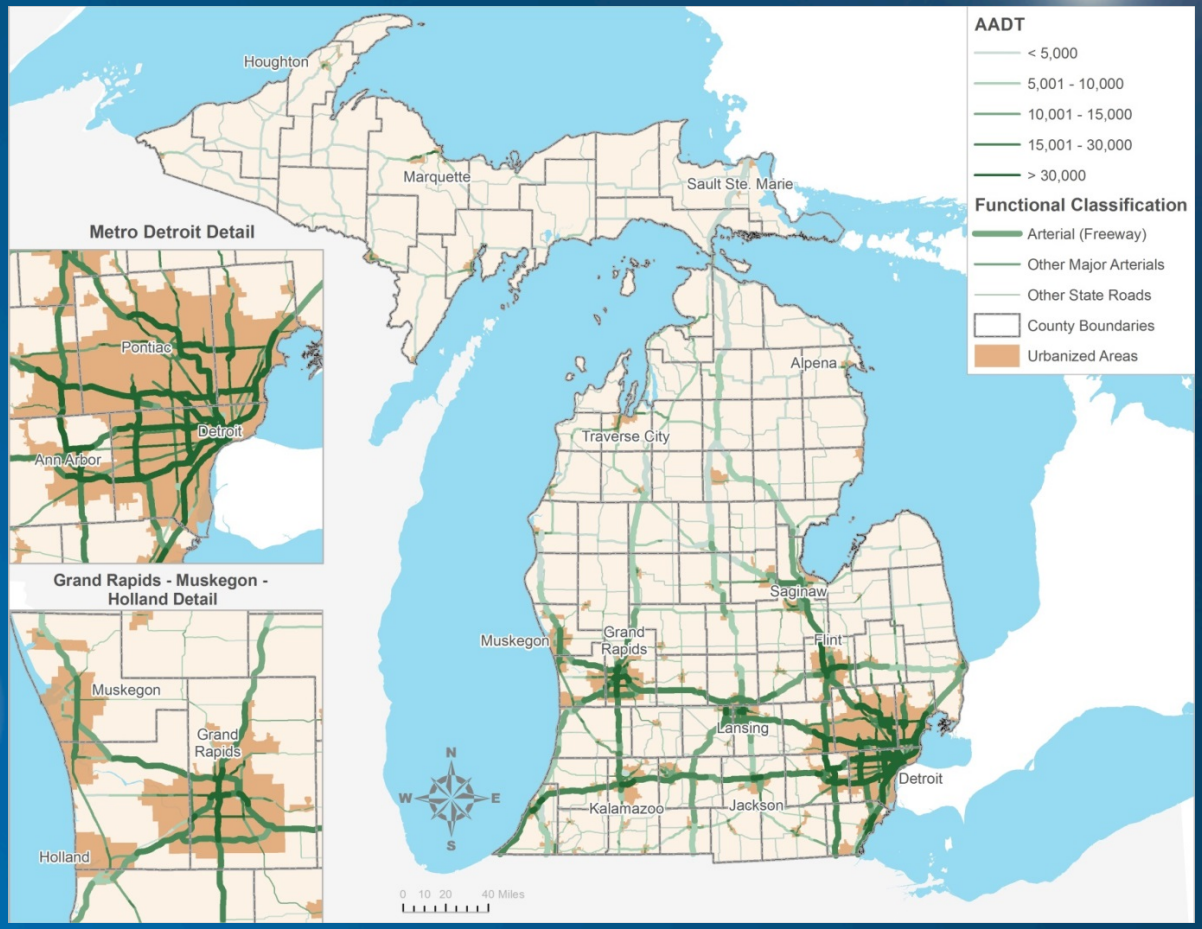
- Approaches for assessing asset criticality can range from simple to complex
- Criticality assessment attempts to define the consequence of asset unavailability
- Used to screen down number of assets for vulnerability assessment

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Determining Asset Criticality - Michigan

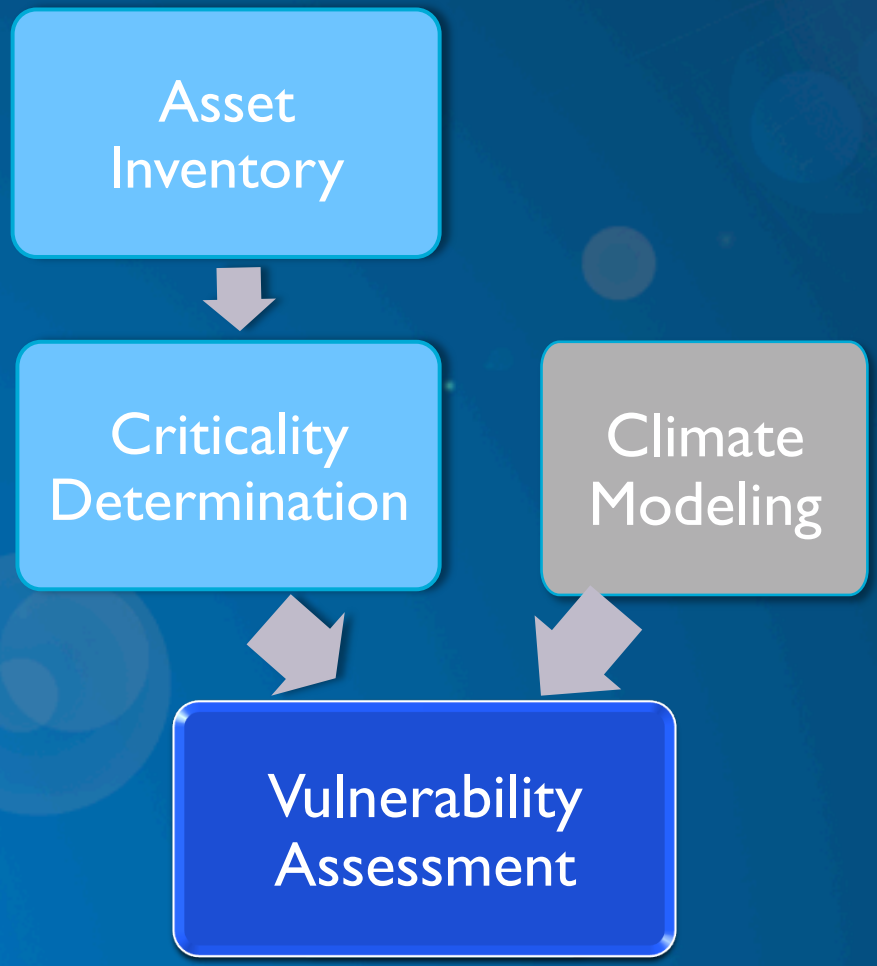
- Using "desk review" approach
- Incorporating some stakeholder input
- Ranking assets based on "low, medium, high" criticality



MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

FHWA Vulnerability Assessment Framework



Climate Stressors: Michigan

Issues of concern:

- Increased erosion from intense precipitation, decreased snow/increased rain
- Bridge scour
- Freeze/thaw cycle
- Great Lakes ice cover and impact on lake effect snow; lake levels
- Road buckling

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Climate Stressors: Michigan

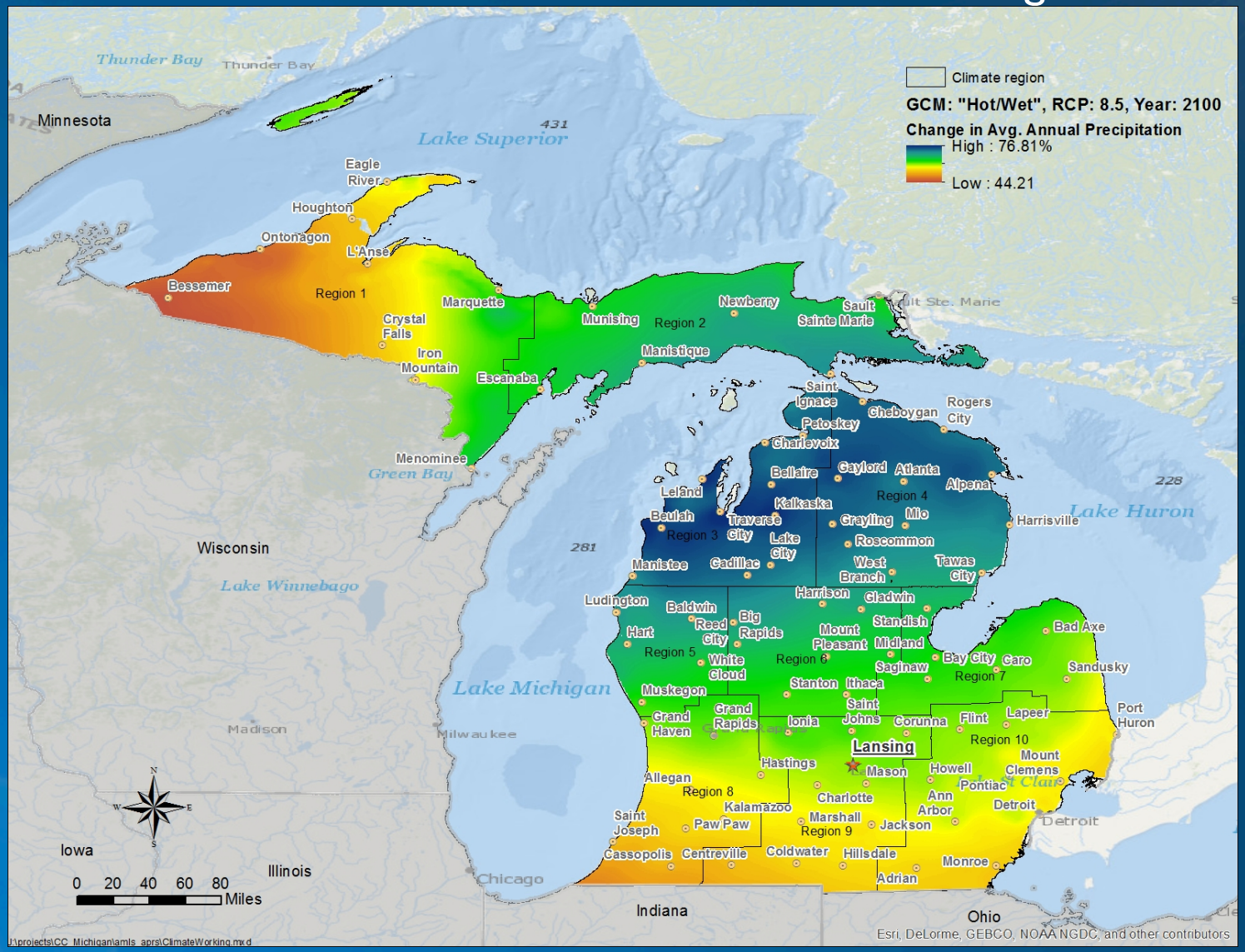
Issue(s) of Concern	Climate Variable for Analysis	Operationalized Climate Variables
Increased erosion and flooding from intense precipitation (particularly extreme precipitation events in a 3-6 hour time period)	Extreme precipitation	• Change in 25, 50, and 100-year rain events • Change in precipitation as snow vs. rain

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

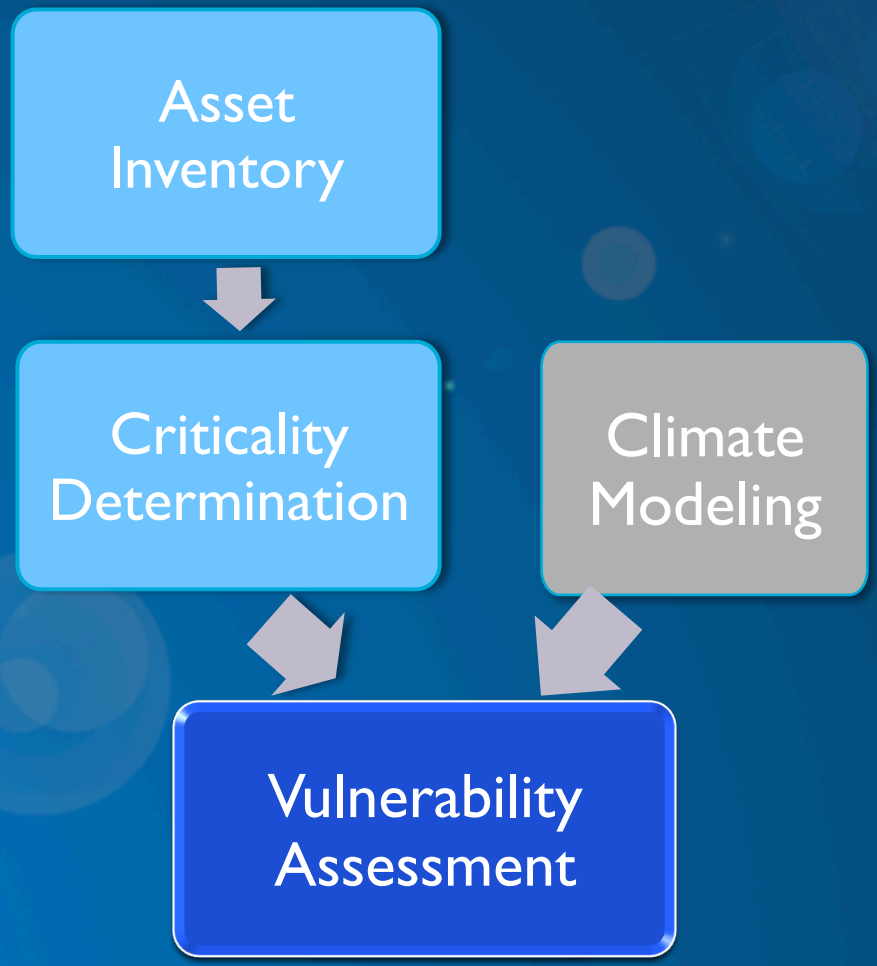
Sample of Climate Projections: Michigan

"Worst Case" Scenario: 44 – 77% increase in Average Annual Precipitation



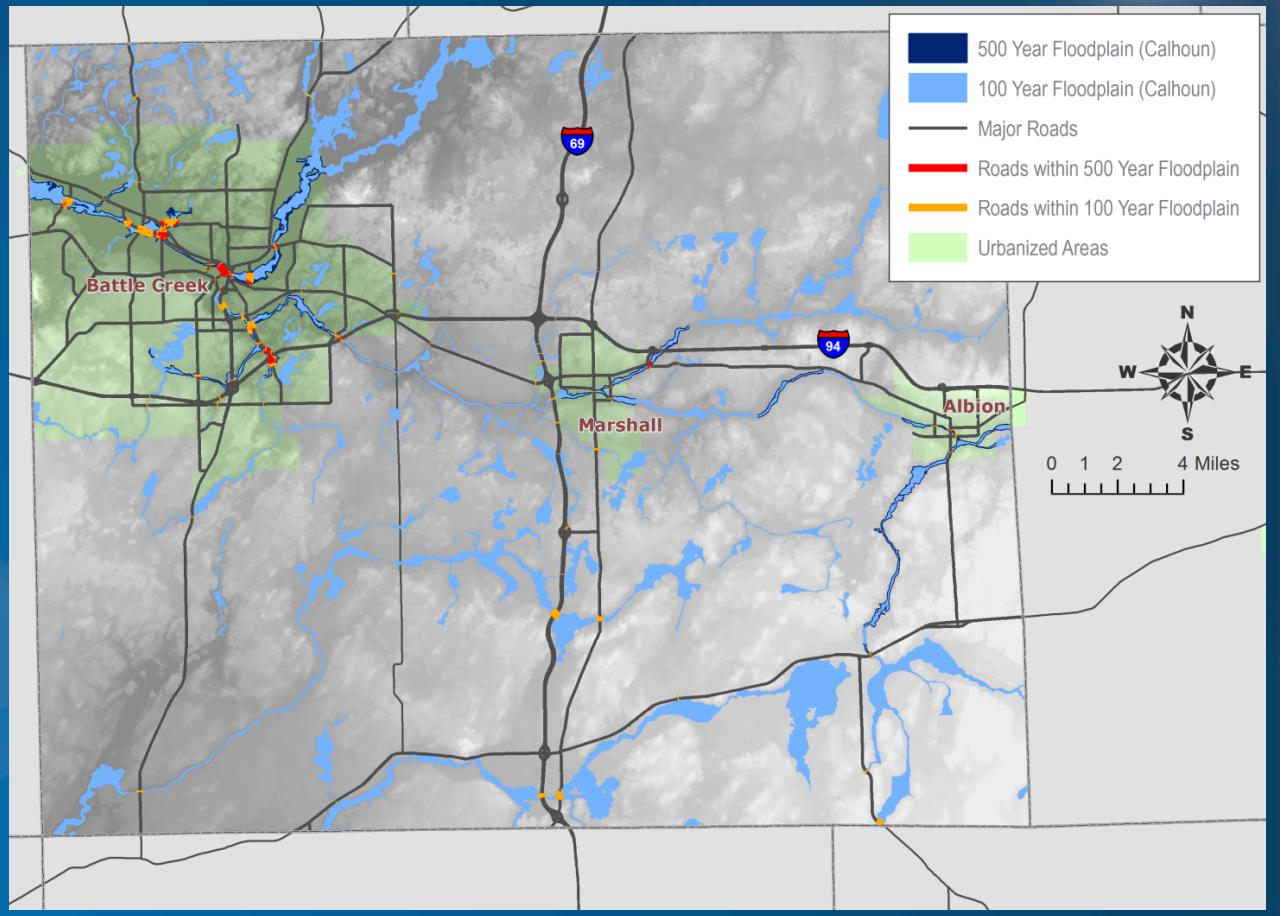
CAMBRIDGE SYSTEMATICS

FHWA Vulnerability Assessment Framework



Michigan Vulnerability Example: Flooding

	Major Roadways
Total in County	383 Miles
Number in 100 Year Floodplain	8.5 Miles
% in 100 Year Floodplain	2.2%
Number in 500 Year Floodplain	10 Miles
% in 500 Year Floodplain	2.6%



MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

Final Step: Integrate Findings into Decision-making Processes

- Educate staff regarding overall climate risks to the agency's transportation system
- Inform the development of adaptation strategies, such as updated design standards
- Site new assets in areas less vulnerable to climate change

MDOT Michigan Department of Transportation

CAMBRIDGE SYSTEMATICS

THANK YOU!