Resilience and Vulnerability Indicators

Rappahannock-Rapidan Regional Commission

Draft component of the Comprehensive Economic Development Strategy



Oct. 2, 2023







RESILIENCE & VULNERABILITY

Overview

This section examines county, regional, state, and national level data to examine the resilience and vulnerability of the Rappahannock-Rapidan Region and GO Virginia's Region 9. A collection of indices has been created based on a variety of measures. The objective is to explore the factors associated with economic resilience and vulnerability, shedding light on the performance of the region and its counties across various measures. These indices include social, economic, infrastructure, and environmental aspects which are examined for both resilience and vulnerability. The aim is to gain a comprehensive understanding of the region's and counties' performance in vital areas related to sustainability and economic well-being. Additionally, this analysis seeks to identify opportunities for enhancing resilience and reducing vulnerability in the region. This resilience and vulnerability plan works in conjunction with the Rappahannock Rapidan Regional Hazard Mitigation Plan¹², as this document works in tandem to identify and addressed regional resilience and vulnerability. As a result, strategies presented in this plan will not perfectly align with those identified in the hazard mitigation plan and any prior recommendations and findings should still be implemented. The data presented in this report works to help identify weaknesses that could be supported through strategies in the CEDS³.

Community Resiliency Assessment Tool⁴

This study makes use of the Community Resiliency Assessment Tool developed at the Institute of Public Policy at the University of Missouri. It includes 45 variables across four categories to capture community resilience and vulnerability. These four categories are:

¹ 1. Rappahannock-Rapidan Hazard Mitigation Plan - 20181205 Update.red.pdf

² <u>Haz-Mit-Report-Jan-2023-Full-Res-FEMA-Approved.pdf</u>

³ Strategies to address tying hazard mitigation plans with CEDS strategies have been outlined here: <u>fema_ceds-hmp-alignment-guide_2022.pdf</u>, and explored in conjunction with the provided analysis

⁴ Data Notes regarding further explanations of selected measures are included in the Data Notes Appendix at the end of this report.

1. **Social**: Measures the degree to which a community has a strong set of social and human capital

Social Measures

Resilience Measures	Vulnerability Measures
Number of Nonprofits per Capita	Share of Population age 65+
Number of Associations per Capita	Share of Population Under the age of 18
Voter Participation Rate	Share of Population Disabled
Share of Population with a Bachelors Degree or Higher	Violent Crime Rate
Life Expectancy	Income Inequality (GINI Index)
Share of Housing Units that are Owner Occupied	Number of Jurisdictions
Share of Population Living in Same County as one year prior	Share of Households that are Linguistically Isolated
	Share pf Population Living below 100% of Poverty
	Share of Population without Health Insurance

2. **Economic**: Measures the economic strength and vulnerability of the community

Economic Measures

Resilience Measures	Vulnerability Measures
Average Nonfarm Proprietor Income	Business Vacancy Rate
Proprietors as a Share of Total Nonform Employment	Share of Households Spending 30% or More of Total
Proprietors as a Share of Total Nonfarm Employment	Income on Housing Costs
Establishment Births	Unemployment Rate
Francis mannet Contain Diversity	Share of Population Employed in Extractive Industries
Employment Sector Diversity	or Manufacturing (including Agriculture and Forestry)
Labor Force Participation	

3. **Infrastructure**: Measures the capacity of a community to withstand a natural disaster and manage evacuations and immediate repairs following a disaster event

Infrastructure Measures

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Resilience Measures	Vulnerability Measures	
Number of Persons in Emergency Response Occupations as a	High Datous Pridges	
Share of Total Population	High-Detour Bridges	
Share of Population within 1 mile of a Grocery Store	Share of Homes Built before 1960	
Share of Population within 10 miles of Hospital or Emergency	Share of Housing Units that are Mobile Homes	
Room	Share of Housing Office that are Mobile Hoffies	
Evacuation Routes (lane miles)	Share of Population within 5 Miles of a Dam	
Number of Primary Care Physicians per Capita	Share of Population with no Motor Vehicle	
Per Capita Expenditures on police and Fire	Share of Population within 10 miles of a Nuclear Facility	
	Unsafe Drinking Water	

4. **Environmental:** Measures the likelihood of a disaster befalling the community

Environmental Measures

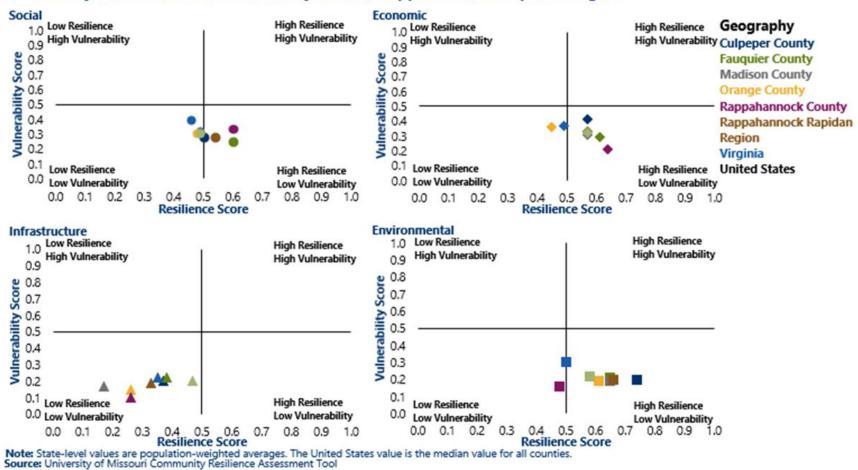
Resilience Measures	Vulnerability Measures
Environmental Diversity	Drought
	Seismic Hazard
	Proximity to Levees
	Number of Severe Storm Events
	Diversity of Storm Events

The indices rank all counties into four quadrants based on their relative resilience and vulnerability to national median scores across these four dimensions. Each dimension has its own set of indicators used to determine relative resilience (indicators that increase capacity for resilience) and vulnerability (indicators that are a liability for resilience) for that specific dimension. Each of the regional metrics are compared to the state metric to determine what indices need to be further addressed within each region. Any measure performing worse than the state will be highlighted as needing addressed while measure performing better than the state will be seen as strengths in the region.

Resilience and Vulnerability, Rappahannock-Rapidan Region

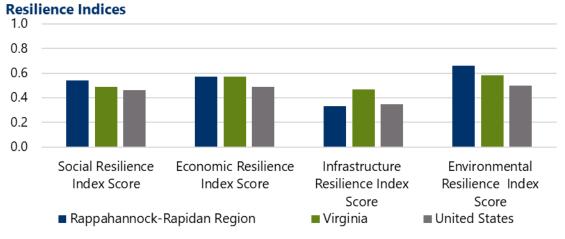
The graphics below display an overview of the resilience and vulnerability performance of each of the region's geographies benchmarked to the state and national performance. Each of the four categories is also displayed. Key takeaways include, i) all geographies are least resilient in their infrastructure and most resilient in their environment and, ii) none of the geographies were highly vulnerable across any of the categories.

Community Resilience and Vulnerability Scores, Rappahannock-Rapidan Region



Rappahannock-Rapidan Region Resilience

The graph on the right indicates the relative performance of the Rappahannock-Rapidan Region's resilience in comparison to the State of Virginia and US as a whole. The region is more resilient than the state across all metrics except for infrastructure resilience.



Source: University of Missouri Community Resilience Assessment Tool

The table to the right explores the determinants of the region's resilience, allowing us to see the drivers of the four categories. The region would benefit from improving access to emergency facilities and medical professionals. The region could also look to find ways to incentivize labor force participation and new establishment births to improve the region's resilience.

Rappahannock-Rapidan Region Resilience

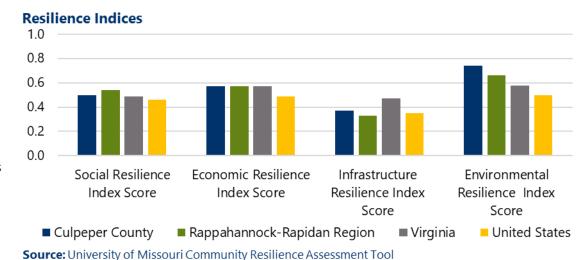
Indicator	More Resilient	Less Resilient
Social	Higher Home-ownership	Lower Share with College Degrees
	Higher Share lived in the Same County a Year Ago	Lower Life Expectancy
	Higher Voter Participation Rate	
	Higher Proprietor Employment	Fewer Establishment Births
Economic	More Employment Diversity	Lower Labor Force Participation Rate
	Higher Proprietor Income	
la fue et un et me	More Emergency Response Occupations	Less Access to Emergency Facilities
Infrastructure	More Evacuation Routes	Less Access to Grocery Stores
		Less Access to Medical Professionals
Environmental	Greater Environmental Diversity	

Note: Region is compared to Virginia

Culpeper County Resilience

The graph on the right indicates the relative performance of Culpeper County's resilience in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is more resilient than the state in environmental resilience but is less resilient than the state in its infrastructure. The county's social and economic indices rate very close to statewide measures.

The table to the right explores the determinants of the county's resilience, allowing us to see the drivers of the four categories. The county would benefit from improving access to medical professionals and investing more in police and fire. The region could also look for ways to incentivize labor force participation to improve the resilience of the county.



Culpeper County Resilience

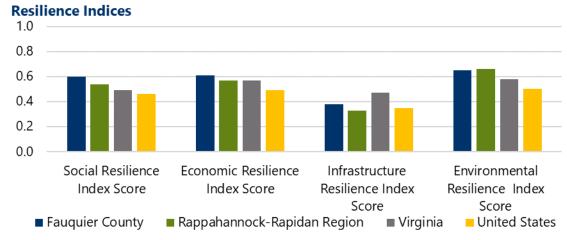
Indicator	More Resilient	Less Resilient
Cartal	Higher Share lived in the Same County a Year Ago	Lower Share with College Degrees
Social	Higher Home-ownership	Lower Life Expectancy
	More Non-Profits per Capita	Fewer Associations per Capita
	Higher Proprietor Employment	Lower Labor Force Participation Rate
Economic	More Employment Diversity	
	Higher Proprietor Income	
	More Evacuation Routes	Less Access to Grocery Stores
Infrastructure		Less Access to Medical Professionals
		Lower Share of Expenditures on Police
		and Fire
Environmental	Greater Environmental Diversity	

Note: Region is compared to Virginia

Fauquier County Resilience

The graph on the right indicates the relative performance of Fauquier County's resilience in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is more resilient than the state in environmental, social, and economic resilience but less resilient than the state in its infrastructure.

The table to the right explores the determinants of the county's resilience, allowing us to see the drivers of the four categories. The county would benefit from improving access to emergency facilities and medical professionals. The region could also look to find ways to increase establishment births to improve the resilience of the county.



Source: University of Missouri Community Resilience Assessment Tool

Fauquier County Resilience

Indicator	More Resilient	Less Resilient
Social	Higher Home-ownership	Lower Life Expectancy
	Higher Voter Participation Rate	
Social	Higher Share lived in the Same County	
	a Year Ago	
	Higher Proprietor Employment	Fewer Establishment Births
Economic	More Employment Diversity	
	Higher Labor Force Participation Rate	
	More Emergency Response	Less Access to Grocery Stores
	Occupations	Less Access to Grocery Stores
Infrastructure	Higher Share of Expenditures on Police	Less Access to Emergency Facilities
	and Fire	Less Access to Emergency racinities
	More Evacuation Routes	Less Access to Medical Professionals
Environmental	Greater Environmental Diversity	
Note: Region is	compared to Virginia	

Madison County Resilience

The graph on the right indicates the relative performance of Madison County's resilience in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is more resilient than the state in environmental resilience but is less resilient than the state in its infrastructure. For social and economic resilience, the county registers an index value similar to the state.

8.0 0.6 0.4 0.2 0.0 Social Resilience Economic Resilience Infrastructure Environmental Index Score Index Score Resilience Index Resilience Index Score Score ■ Madison County ■ Rappahannock-Rapidan Region ■ Virginia United States Source: University of Missouri Community Resilience Assessment Tool

The table to the right explores the determinants of the county's resilience, allowing us to see the drivers of the four categories. The county would benefit from improving access to emergency facilities and investing more in police and fire. The region could also look to find ways to increase establishment births, incentivize labor force participation, and increase the number of associations per capita to improve the resilience of the county.

Madison County Resilience

Resilience Indices

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Indicator	More Resilient	Less Resilient
	Higher Home-ownership	Lower Share with College Degree
Social	Higher Voter Participation Rate	Fewer Associations per Capita
_	More Non-Profits per Capita	Lower Life Expectancy
	Higher Proprietor Employment	Fewer Establishment Births
Economic	More Employment Diversity	Lower Labor Force Participation Rate
	Higher Proprietor Income	
	More Evacuation Routes	Less Access to Emergency Facilities
Infrastructure —		Less Access to Grocery Stores
		Lower Share of Expenditures on Police
		and Fire

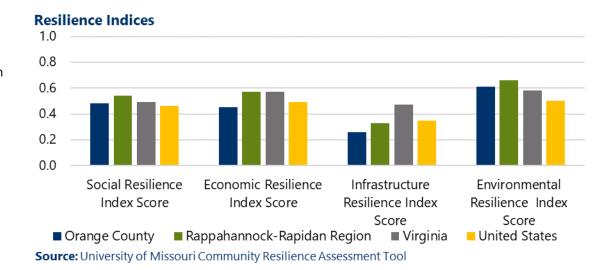
Environmental Greater Environmental Diversity

Note: Region is compared to Virginia

Orange County Resilience

The graph on the right indicates the relative performance of Orange County's resilience in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is more resilient than the state in environmental resilience but is less resilient than the state in its infrastructure and economic resilience but rates similar to Virginia in Social Resilience.

The table to the right explores the determinants of the county's resilience, allowing us to see the drivers of the four categories. The county would benefit from improving access to emergency facilities and medical professionals. The region could also look to find ways to increase establishment births, incentivize labor force participation, and increase the number of associations per capita to improve the resilience of the county.



Orange County Resilience

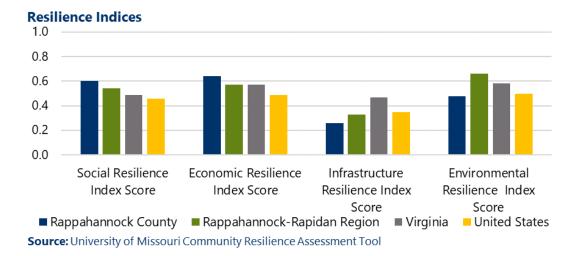
Indicator	More Resilient	Less Resilient
	Higher Home-ownership	Lower Share with College Degree
Social	Higer Voter Participation Rate	Lower Life Expectancy
		Fewer Associations per Capita
	More Employment Diversity	Fewer Establishment Births
Economic	Higher Proprietor Employment	Lower Labor Force Participation Rate
		Lower Proprietor Income
Infrastructure —	More Emergency Response Occupations	Less Access to Emergency Facilities
	More Evacuation Routes	Less Access to Grocery Stores
		Less Access to Medical Professionals
Environmental	Greater Environmental Diversity	

Note: Region is compared to Virginia

Rappahannock County Resilience

The graph on the right indicates the relative performance of Rappahannock County's resilience in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is more resilient than the state in social and economic resilience but is less resilient than the state on the infrastructure and environmental scales.

The table to the right explores the determinants of the county's resilience, allowing us to see the drivers of the four categories. The county would benefit from improving access to emergency facilities and medical professionals. The region could also look to find ways to incentivize labor force participation to improve the resilience of the county



Rappahannock County Resilience

Indicator	More Resilient	Less Resilient
	More Non-Profits per Capita	Lower Life Expectancy
Social	Higher Share lived in the Same County	Loss Associations per Capita
Social	a Year Ago	Less Associations per Capita
	Higher Voter Participation Rate	
Economic	Higher Proprietor Employment	Lower Labor Force Participation Rate
	Higher Proprietor Income	
	More Establishment Births	
Infrastructure	More Emergency Response	Less Access to Emergency Facilities
	Occupations	
	More Evacuation Routes	Less Access to Grocery Stores
		Less Access to Medical Professionals
Environmental		Less Environmental Diversity

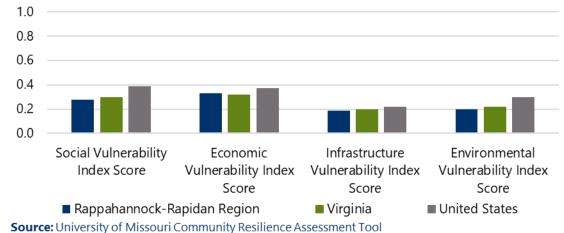
Note: Region is compared to Virginia

Rappahannock-Rapidan Region Vulnerability

The graph on the right indicates the relative performance of the Rappahannock-Rapidan Region's vulnerability in comparison to the State of Virginia and US as a whole. The region is less vulnerable than the state across the social, infrastructure, and environmental metrics and on par with the state for economic vulnerability.

The table to the right explores the determinants of the region's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from decreasing unsafe drinking water to decrease the region's vulnerability.

Vulnerability Indices



Rappahannock-Rapidan Region Vulnerability

Indicator	Less Vulnerable	More Vulnerable
	Less Linguistic Isolation	Higher Share of Population Over 65
Social	Lower Violent Crime Rate	Higher Share of Population Under 18
	Lower Poverty Rate	Higher Share of Population Disabled
	Fewer Cost-Burdened Households	Higher Share of Employment in
Economic	rewel Cost-buildened Households	Extractive Industries
	Lower Unemployment Rate	Higher Business Vacancy Rate
	Higher Share with Motor Vehicles	Close to Major Dams
Infrastructure	Fewer Mobile Homes	Higher Share of Unsafe Drinking Water
	Far From Nuclear Power Facility	
	Far From Levees	Higher Likelihood of Droughts
Environmental	Less Diversity of Storm Events	Higher Likelihood of Seismic Hazards
		More Severe Storm Events

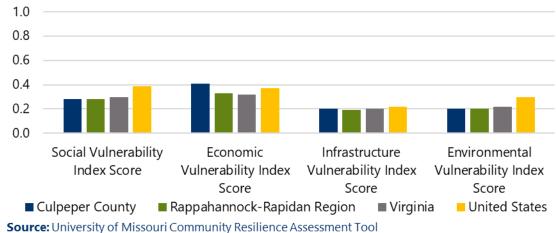
Note: Region is compared to Virginia

Culpeper County Vulnerability

The graph on the right indicates the relative performance of Culpeper County's vulnerability in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is less vulnerable than the state in social and environmental vulnerability but more vulnerable in economic vulnerability. For infrastructure, the county registers a similar degree of vulnerability as the state.

The table to the right explores the determinants of the county's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from exploring ways to alleviate cost-burdened households and lower business vacancy rates to decrease the region's vulnerability.

Vulnerability Indices



Culpeper County Vulnerability

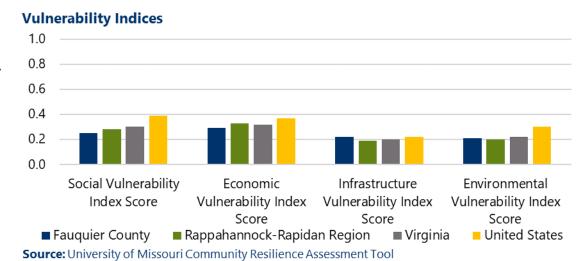
Indicator	Less Vulnerable	More Vulnerable
	Lower Income Inequality	Higher Share of Population Under 18
Social	Less Linguistic Isolation	Higher Share of Population Uninsured
	Lower Poverty Rate	
		Higher Business Vacancy Rate
Economic —		More Cost-Burdened Households
ECONOMIC —		Higher Share of Employment in Extractive
		Industries
	Fewer High-Detour Bridges	Close to Major Dam
Infrastructure	High Share with Motor Vehicles	
	Fewer Older Homes	
	Fewer Severe Storm Events	More Diversity of Storm Events
Environmental	Far From Levees	Higher Likelihood of Drought
		Higher Likelihood of Seismic Hazards

Note: Region is compared to Virginia

Fauquier County Vulnerability

The graph on the right indicates the relative performance of Fauquier County's vulnerability in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is less vulnerable than the state in social, economic, and environmental vulnerability but slightly more vulnerable in infrastructure vulnerability.

The table to the right explores the determinants of the county's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from exploring ways to lower the businesses vacancy rate and reduce unsafe drinking water to decrease the region's vulnerability.



Fauquier County Vulnerability

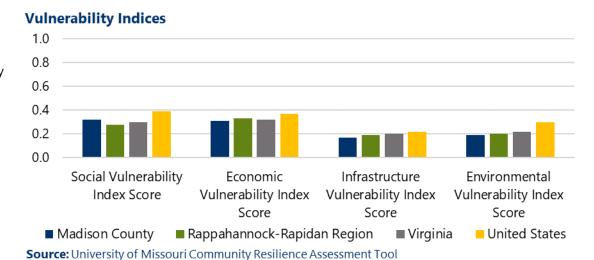
Indicator	Less Vulnerable	More Vulnerable
Social	Less Linguistic Isolation	Higher Share of Population Under 18
	Lower Poverty Rate	Higher Share of Population Over 65
	Lower Violent Crime Rate	
Economic	Fewer Cost-Burdened Households	Higher Share of Employment in Extractive Industries
	Lower Unemployment Rate	Higher Business Vacancy Rate
Infrastructure	High Share with Motor Vehicles	Close to Major Dam
	Fewer Mobile Homes	More High-Detour Bridges
	Far from Nuclear Power Facility	High Share of Unsafe Drinking Water
Environmental	Less Diversity of Storm Events	More Severe Storm Events
	Far From Levees	Higher Likelihood of Droughts
	Lower Likelihood of Seismic Hazards	

Note: Region is compared to Virginia

Madison County Vulnerability

The graph on the right indicates the relative performance of Madison County's vulnerability in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is less vulnerable than the state in economic, infrastructure, and environmental vulnerability but is more vulnerable in social vulnerability.

The table to the right explores the determinants of the county's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from exploring ways to alleviate cost-burdened households to decrease the region's vulnerability.



Madison County Vulnerability

Indicator	Less Vulnerable	More Vulnerable
Social	Less Linguistic Isolation	Higher Share of Population Over 65
	Lower Violent Crime Rate	Higher Share of Population Uninsured
	Lower Share of Population Under 18	Higher Income Inequality
Economic	Lower Business Vacancy Rate	Higher Share of Employment in Extractive
		Industries
		More Cost-Burdened Households
Infrastructure	Less High-Detour Bridges	More Older Homes
	Far from Major Dams	Lower Share with Motor Vehicles
	Further from Nuclear Power Facility	
Environmental	Fewer Severe Storm Events	Higher Likelihood of Droughts
	Far From Levees	Higher Likelihood of Seismic Hazards
	Higher Diversity of Storm Events	

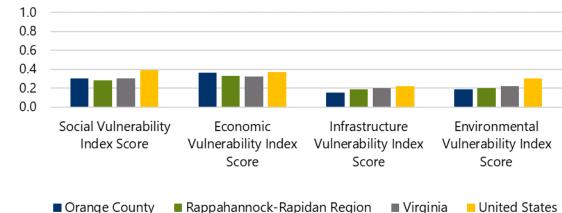
Note: Region is compared to Virginia

Orange County Vulnerability

The graph on the right indicates the relative performance of Orange County's vulnerability in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is less vulnerable than the state in infrastructure and environmental vulnerability but is more vulnerable in economic vulnerability. The county scores an index level similar to the state for social vulnerability.

The table to the right explores the determinants of the county's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from exploring ways to decrease the unemployment rate and business vacancies to decrease the region's vulnerability.

Vulnerability Indices



Source: University of Missouri Community Resilience Assessment Tool

Orange County Vulnerability

Indicator	Less Vulnerable	More Vulnerable
Social	Less Linguistic Isolation	Higher Share of Population Over 65
	Lower Violent Crime Rate	Higher Share of Population Disabled
	Lower Income Inequality	Higher Share of Population Uninsured
	Fewer Cost-Burdened Households	Higher Share of Employment in Extractive
Economic -		Industries
ECONOMIC		Higher Unemployment Rate
		Higher Business Vacancy Rate
Infrastructure	Less High-Detour Bridges	Close to Major Dams
	Higher Share with Motor Vehicles	More Mobile Homes
	Fewer Older Homes	
Environmental	Less Diversity of Storm Events	Higher Likelihood of Seismic Hazards
	Fewer Severe Storm Events	Higher Likelihood of Droughts
	Far From Levees	

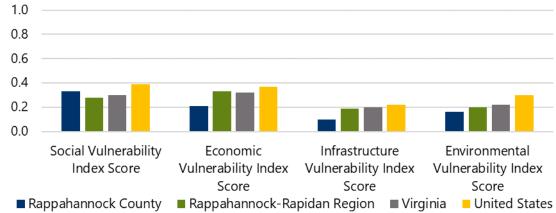
Note: Region is compared to Virginia

Rappahannock County Vulnerability

The graph on the right indicates the relative performance of Rappahannock County's vulnerability in comparison to the Rappahannock-Rapidan Region, State of Virginia, and US as a whole. The county is less vulnerable than the state in economic, infrastructure, and environmental vulnerability but is more vulnerable in social vulnerability.

The table to the right explores the determinants of the county's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from exploring ways to decrease the share of the population that is uninsured to decrease the region's vulnerability.

Vulnerability Indices



Source: University of Missouri Community Resilience Assessment Tool

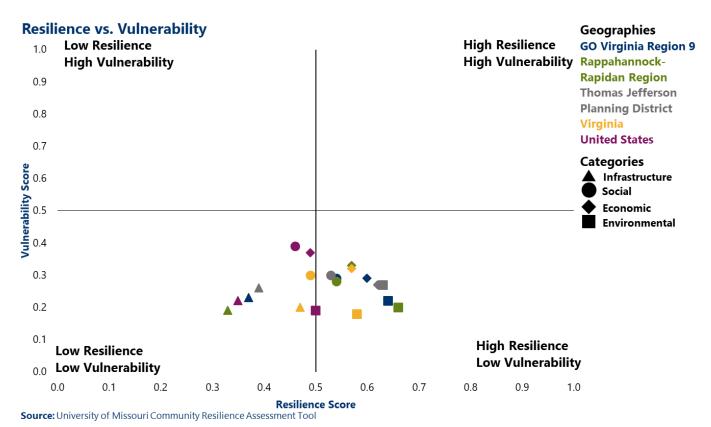
Rappahannock County Vulnerability

Indicator	Less Vulnerable	More Vulnerable
Social	Lower Share of Population Under 18	Higher Share of Population Over 65
	Lower Violent Crime Rate	Higher Income Inequality
	Lower Poverty Rate	Higher Share of Population Uninsured
Economic	Lower Business Vacancy Rate	Higher Share of Employment in Extractive Industries
	Lower Unemployment Rate	
	Fewer Cost-Burdened Households	
Infrastructure	Far from Major Dams	More Older Homes
	Fewer High-Detour Bridges	
	Higher Share with Motor Vehicles	
Environmental	Less Diversity of Storm Events	Higher Likelihood of Droughts
	Fewer Severe Storm Events	
	Far From Levees	

Note: Region is compared to Virginia

Resilience and Vulnerability, GO Virginia Region 9

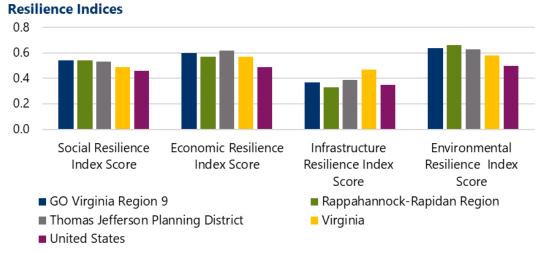
The graphic below displays an overview of the resilience and vulnerability performance of each of the region's geographies benchmarked to the state and national performance. Each of the four categories is also displayed. Key takeaways include: i) all geographies are *least resilient* in infrastructure and *most resilient* in aspects of the environment and ii) none of the geographies register as highly vulnerable across any of the categories.



GO VA Region 9 Resilience⁵

The graph on the right indicates the relative performance of the GO Virginia 9 region's resilience in comparison to the RRRC and TJPDC regions, the State of Virginia, and the US. Note that the GO Virginia Region 9 is more resilient than the state across all metrics except for infrastructure resilience.

The table to the right explores the determinants of the region's resilience, allowing us to see the drivers of the four categories. The region would benefit from improving access to emergency facilities and increasing emergency occupations. The region could also consider finding ways to incentivize labor force participation and new establishment births to improve the region's resilience.



Source: University of Missouri Community Resilience Assessment Tool

GO Virginia Region 9 Resilience

Indicator	More Resilience	Less Resilience
Social	Higher Voter Participation Rate	Lower Share lived in the Same County a
		Year Ago
	More Non-Profits per Capita	
	Greater Home-ownership	
Economic	Higher Proprietor Employment	Lower Proprietor Income
	More Employment Diversity	Lower Labor Force Participation
		Fewer Establishment Births
Infrastructure	More Access to Medical Professionals	Less Access to Emergency Facilities
	More Evacuation Routes	Less Access to Grocery Stores
		Fewer Emergency Response Occupations
Environmental	Greater Environmental Diversity	
Note: Region is cor	mpared to Virginia	

mean that the region is entirely resilient in that given metric, a score of "0" means that the regi

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Source: University of Missouri Community Resilience Assessment Tool

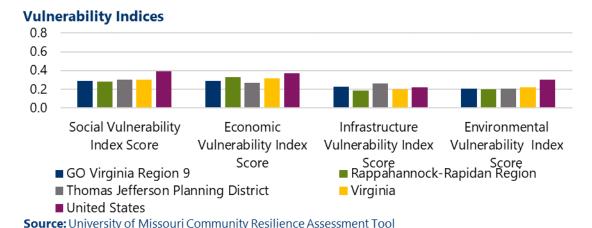
DRAFT

⁵ To interpret the scores: a resiliency score of "1" would mean that the region is entirely resilient in that given metric, a score of "0" means that the region has no resiliency in that given metric.

GO VA Region 9 Vulnerability⁶

The graph on the right indicates the relative performance of the GO Virginia 9 region's vulnerability in comparison to the RRRC and TJPDC regions, State of Virginia, and US as a whole. By these measures, the GO Virginia Region 9 is less vulnerable than the state across all metrics except for infrastructure vulnerability.

The table to the right explores the determinants of the region's vulnerability, allowing us to see the drivers of the four categories. The region would benefit from investing in water drinking improvements to decrease the region's vulnerability.



GO Virginia Region 9 Vulnerability

	Less Vulnerability	More Vulnerability
Social	Lower Linguistic Isolation	Higher Share of Population 65+
	Lower Violent Crime Rate	Greater Income Inequality
	Lower Share of Population Under 18	
Economic	Lower Unemployment Rate	Higher Share of Employment in Extractive Industries
ECOHOMIC	Fewer Cost-Burdened Households	
	Lower Business Vacancy Rate	
	Fewer High-Detour Bridges	Close to Major Dams
Infrastructure	Higher Share with Motor Vehicles	Close to Nuclear Power Facility
	Fewer Older Homes	Higher Share of Unsafe Drinking Water
Environmental	Less Diversity of Storm Events	Higher Likelihood of Seismic Hazards
	Far From Levees	Higher Likelihood of Droughts
	Fewer Severe Storm Events	

Note: Region is compared to Virginia

⁶ To interpret the scores: a vulnerability score of "1" would mean that the region is entirely vulnerable in that given metric, a score of "0" means that the region has no vulnerability in that given metric.