O‘ahu Social Vulnerability Index

City and County of Honolulu

Office of Climate Change, Sustainability and Resiliency

RESILIENT O‘AHU

Mandate from O‘ahu Voters

The Resilience Office is a Charter-mandated City office created to respond to climate change, resilience, and other sustainability challenges.

Green City Operations

Reduce Climate Emissions & Impact

Promote Resilient Communities

Coordinate with Federal & State Agencies

Ensure Sustainable City Plans & Policies

Facilitate Climate Change Commission

100 Resilient Cities

A **$100+ million effort** launched by **The Rockefeller Foundation** in 2013 to help cities **build resilience to social, economic, and physical challenges.** To respond to impacts of **urbanization, globalization, and climate change.**

The Resilient Cities Network comprised 100 cities spanning 40 countries and 27 languages.

PIONEERED BY THE ROCKEFELLER FOUNDATION
100 RESILIENT CITIES

Resilience

The capacity of individuals, communities, institutions, businesses, and systems to **survive, adapt, and thrive** no matter what kinds of chronic **stresses** and acute **shocks** they experience.


ACUTE
SHOCKS


CHRONIC
STRESS

Strategy Development Process

Office of Climate Change, Sustainability and Resiliency

Community Resilience Perceptions

Community Input

Agenda Setting Workshop

140+

Stakeholders from **19** sectors representing **117** unique organizations

+2,200

Resilience Perception Surveys Conducted

33 Neighborhood Board Presentations

219 Meetings with other Stakeholder Groups

On a scale of 1-10 (low – high), how resilient do you think O'ahu is today?

3.9

Survey Responses: Top Five Shocks & Stresses

Top 5 Shocks	Top 5 Stresses
Hurricane	Cost of Living
Tsunami	Climate Change Impacts
Infrastructure Failure	Aging Infrastructure
Rainfall Flooding	Lack of Affordable Housing
External Economic Crisis	Over-reliance on Imports
Disease Outbreak	Food or Water Shortage
Nuclear Attack	Income Inequality
Earthquake	Lack of Political Leadership
Cyber Attack	Over-reliance on Tourism and Military Economy
Terrorist Attack	Decline of Aloha Spirit
Heat Wave	Educational Disparity
Other	
Riot/Civil Unrest	

O‘ahu Resilience Strategy | Working Groups

Chief Output:

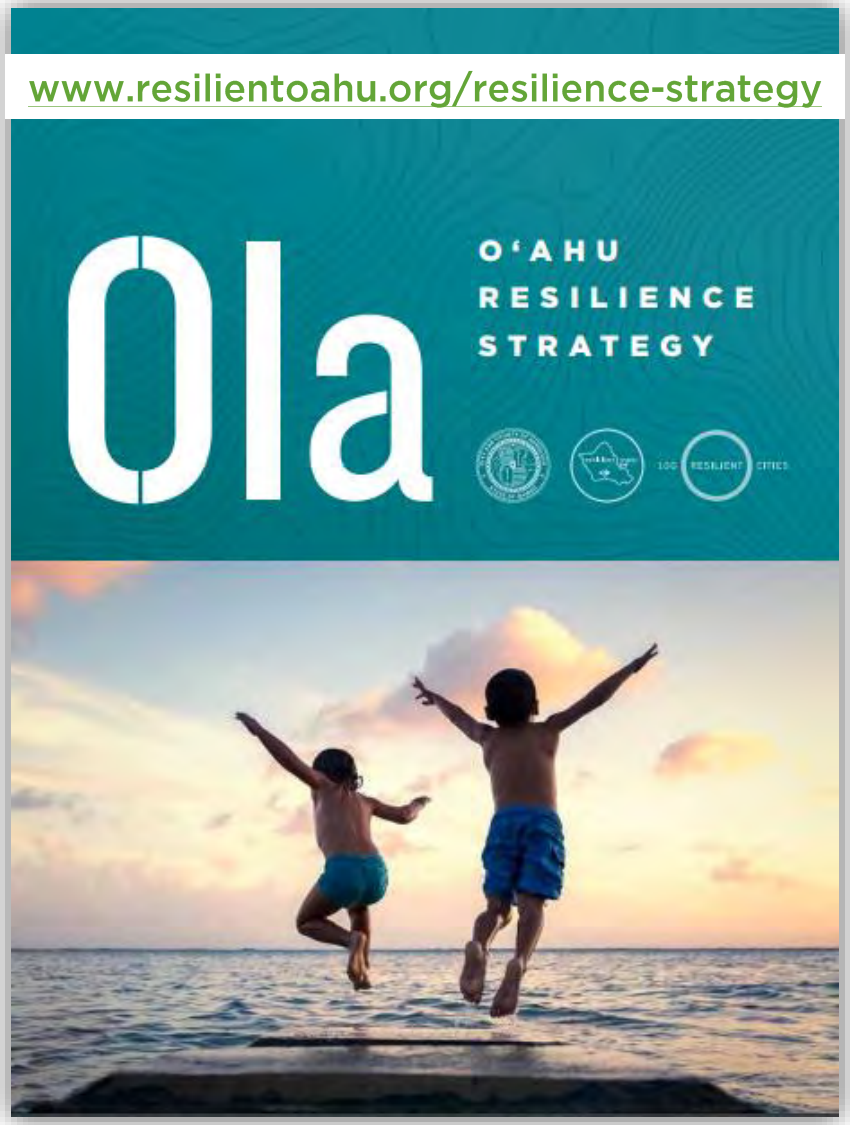
RESILIENCE ACTIONS

recommendations for specific initiatives, projects, or policies that the City might take

Office of Climate Change, Sustainability and Resiliency

O‘ahu Resilience Strategy

www.resilientoahu.org/resilience-strategy



Remaining Rooted

Bouncing Forward

Climate Security

Community Cohesion

Bouncing Forward

Group Question

Which residents and communities are most vulnerable to disaster hazards and what household and community-level actions can best prepare these populations?

Socioeconomic Vulnerability Index

Project Team

This study was developed as part of the Oʻahu Resilience Strategy development process

City Lead
Matthew Gonser
Office of Climate Change, Sustainability & Resiliency

Consultant Team (AECOM)
Paul Peninger – Principal and Director, Design, Planning and Economics
Johannes Veerkamp – Economist

The process included a workshop with representatives from the following organizations:

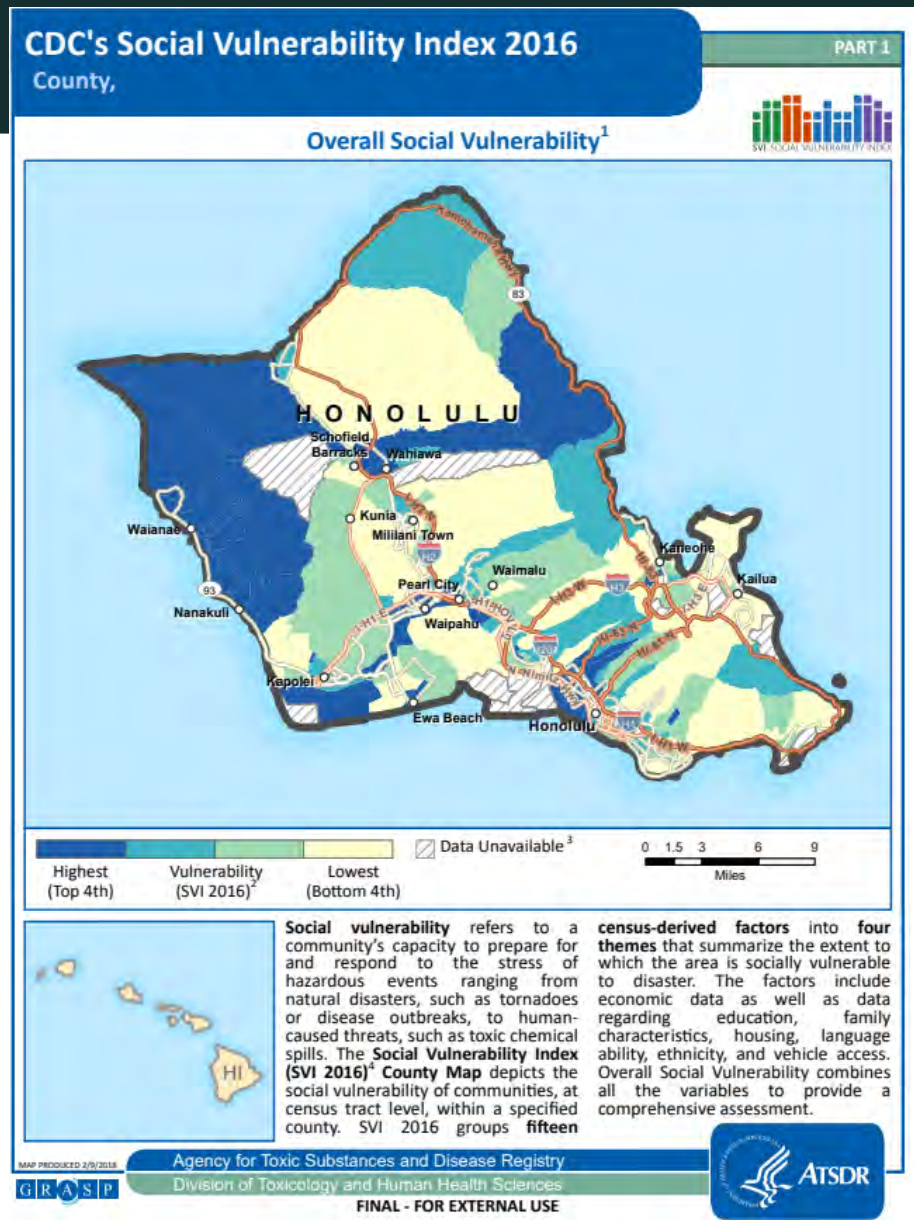
Aloha United Way
AmeriCorps VISTA
CCH DEM
CCH HOU
CCH DPP
CCH CCSR
Hawaiʻi State Department of Health
Kamehameha Schools
Hawaiʻi Green Growth Local2030 Hub
Hauʻula Emergency Leadership Plan
Hawaiʻi Appleseed Center for Law and Economic Justice
HHF Planners
Honolulu Authority for Rapid Transportation
Martin & Chock Inc.
US HUD

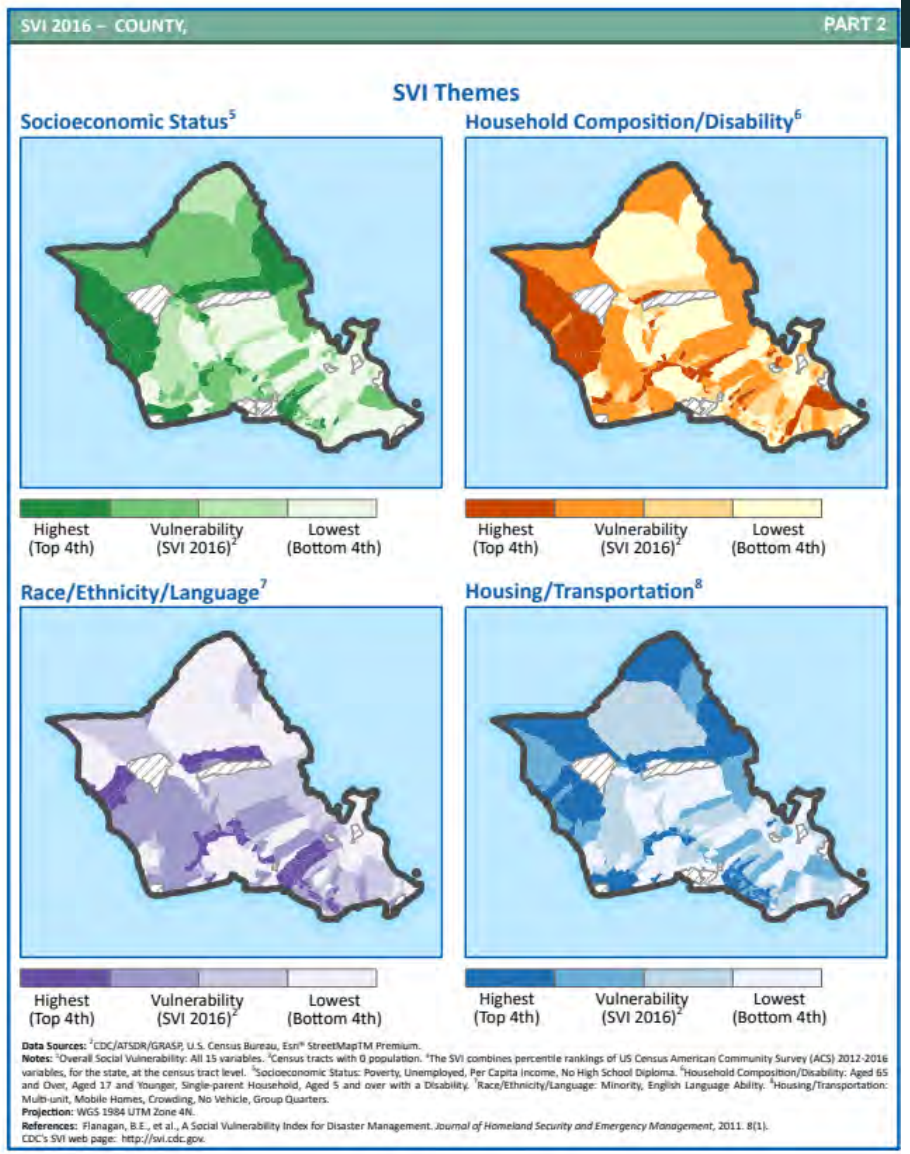
Content

SOCIAL VULNERABILITY BACKGROUND

Social Vulnerability Index (SVI)

U.S. Centers for Disease Control & Prevention

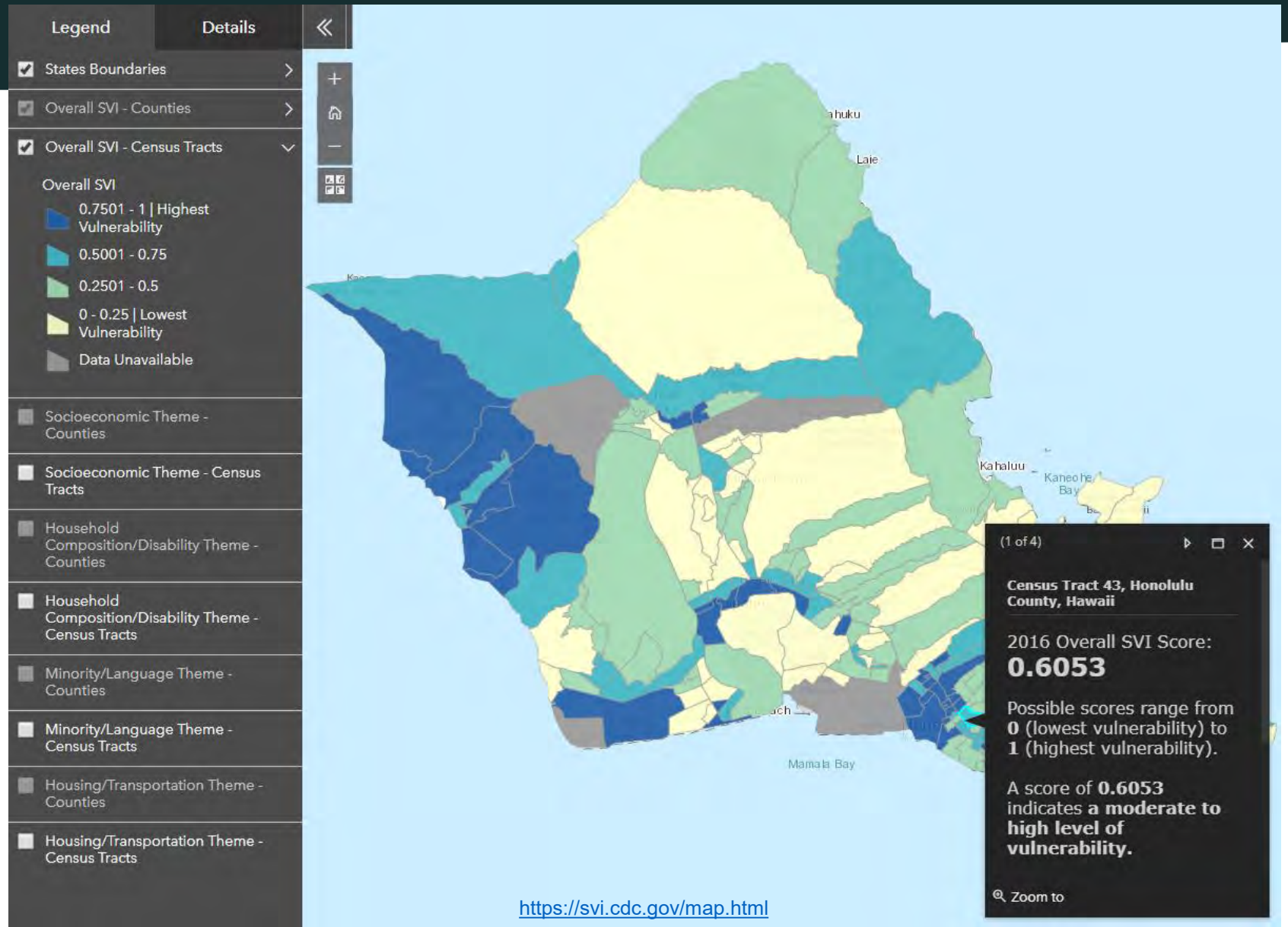




https://svi.cdc.gov/Documents/CountyMaps/2016/Hawaii/Hawaii2016_Honolulu.pdf

Social Vulnerability Index (SVI)

U.S. Centers for Disease Control & Prevention



https://svi.cdc.gov/map.html

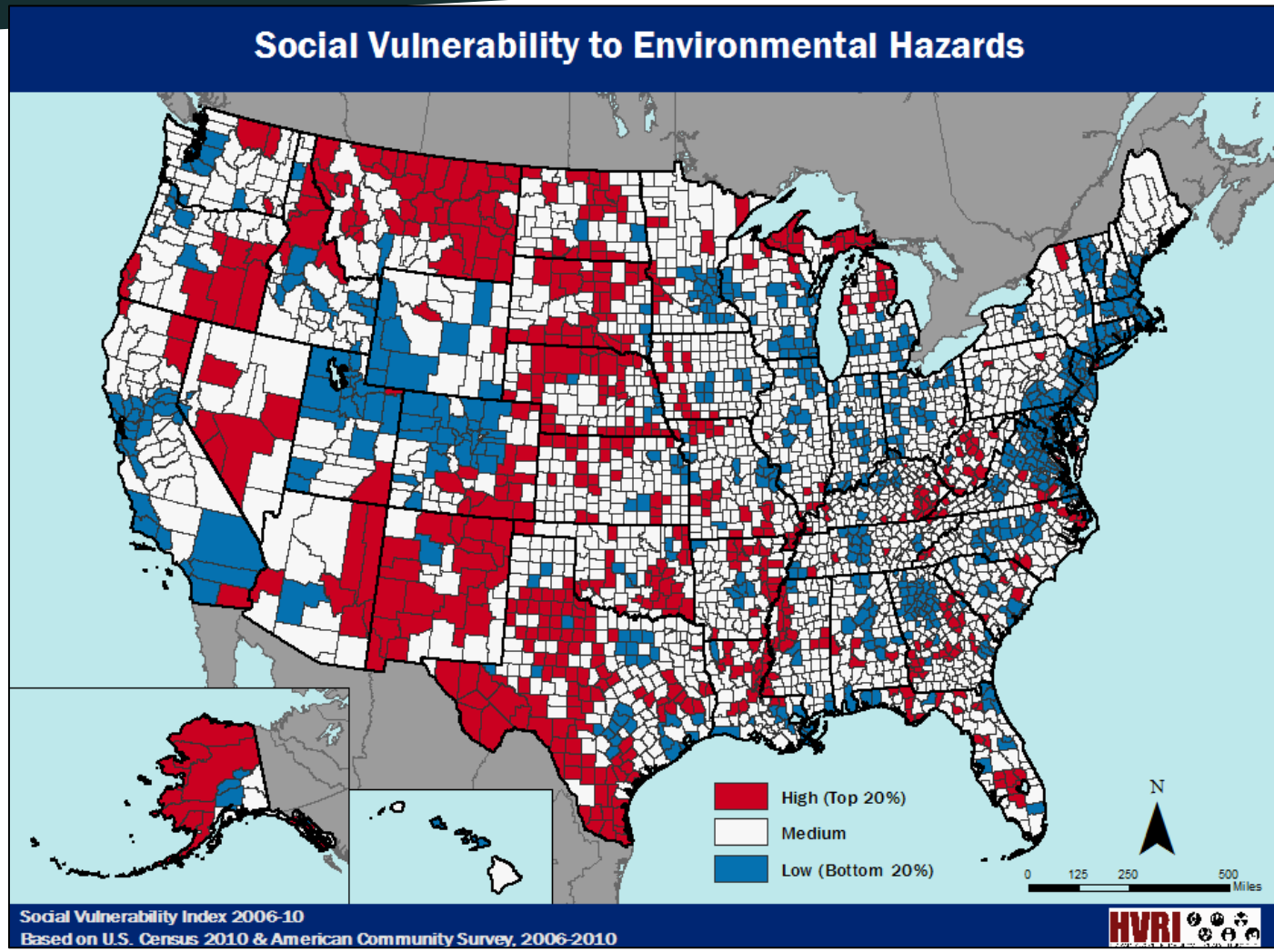
Social Vulnerability Index (SoVI)

Susan Cutter *et al.* (2008 & 2010)
Focus: vulnerability and disaster resilience

Method: proxies for resilience

- social resilience
- economic resilience
- institutional resilience
- infrastructure resilience
- community capacity

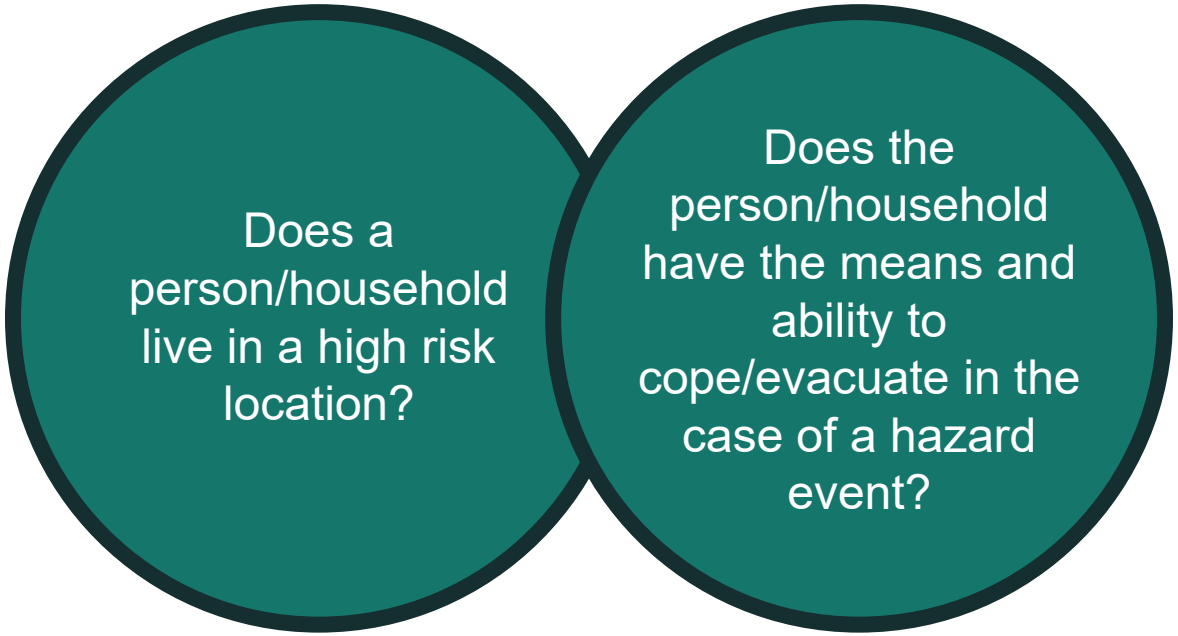
Assumption: Resilient communities are far less vulnerable to hazards and disasters than less resilient places, and if communities can increase their resilience then they are in a much better position to ***withstand adversity and to recover more quickly than would be the case if there were few or no investments in building community capacity***.



http://webra.cas.sc.edu/hvri/products/sovi.aspx
https://coast.noaa.gov/dataregistry/search/collection

Social Vulnerability Index (SOVI)

A SOVI can assess and rank a community's resilience by considering vulnerability and adaptive capacity across multiple indicators, as well as, in this case, across different hazards.



Background & Rationale

- ***Hazard*** is a condition posing the threat of harm

- ***Vulnerability*** is the extent to which persons, places, or things are likely to be affected

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- ***Resources*** are those assets in place that will diminish the effects of hazards

How can SOVI help communities?

"The SVI can help public health officials and local planners better prepare for and respond to emergency events like hurricanes, disease outbreaks, or exposure to dangerous chemicals."

- Agency for Toxic Substances & Disease Registry (ATSDR)

"Effectively addressing social vulnerability decreases human suffering and reduces post-disaster expenditures for social services and public assistance."

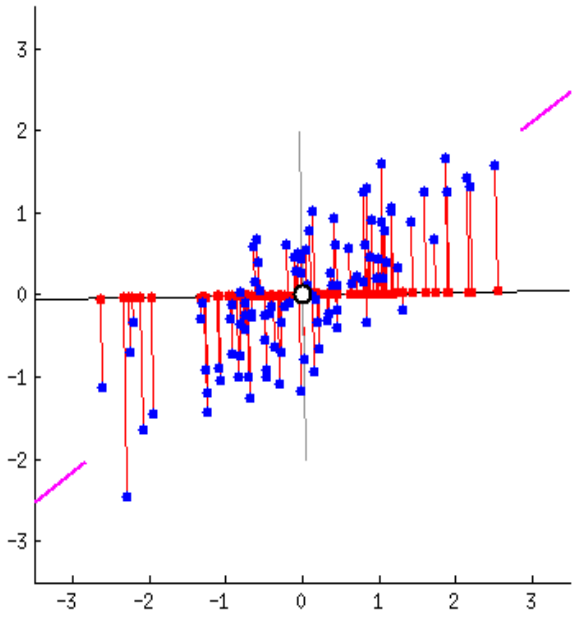
- Center for Disease Control (CDC)

Insights from the SOVI

1. Localization	Where do vulnerable populations live?
2. Identification	What drives the vulnerability of these communities?
3. Action	Which drivers of vulnerability are correlated and should be addressed in conjunction?

METHODOLOGY

Methodology | Principal Component Analysis



Wat is a PCA?

PCA is a dimension-reduction tool that can be used to reduce a large set of variables to a small set that still contains most of the information in the large set.

When to use the PCA?

If want to reduce the number of variables, but aren't able to identify variables to completely remove from consideration.

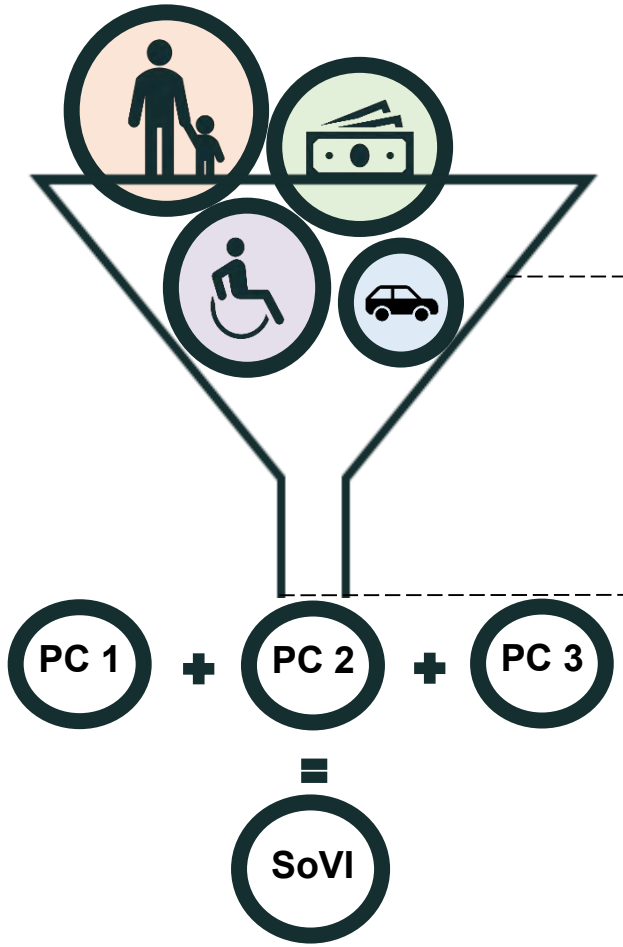
If you want to ensure your variables are independent of one another.

If you are comfortable making your independent variables less interpretable.

How to use the PCA?

Using a statistical package in R to create new dimensions (Principal Components) that capture more variance than the original variables and thus reduce the number of variable to express the same information.

Methodology | Principal Component Analysis



Variable Selection

The variables for a PCA are composed of a set of standard variables (based on Cutter 2003) and a set of localized and context specific variables.

Principal Component Analysis

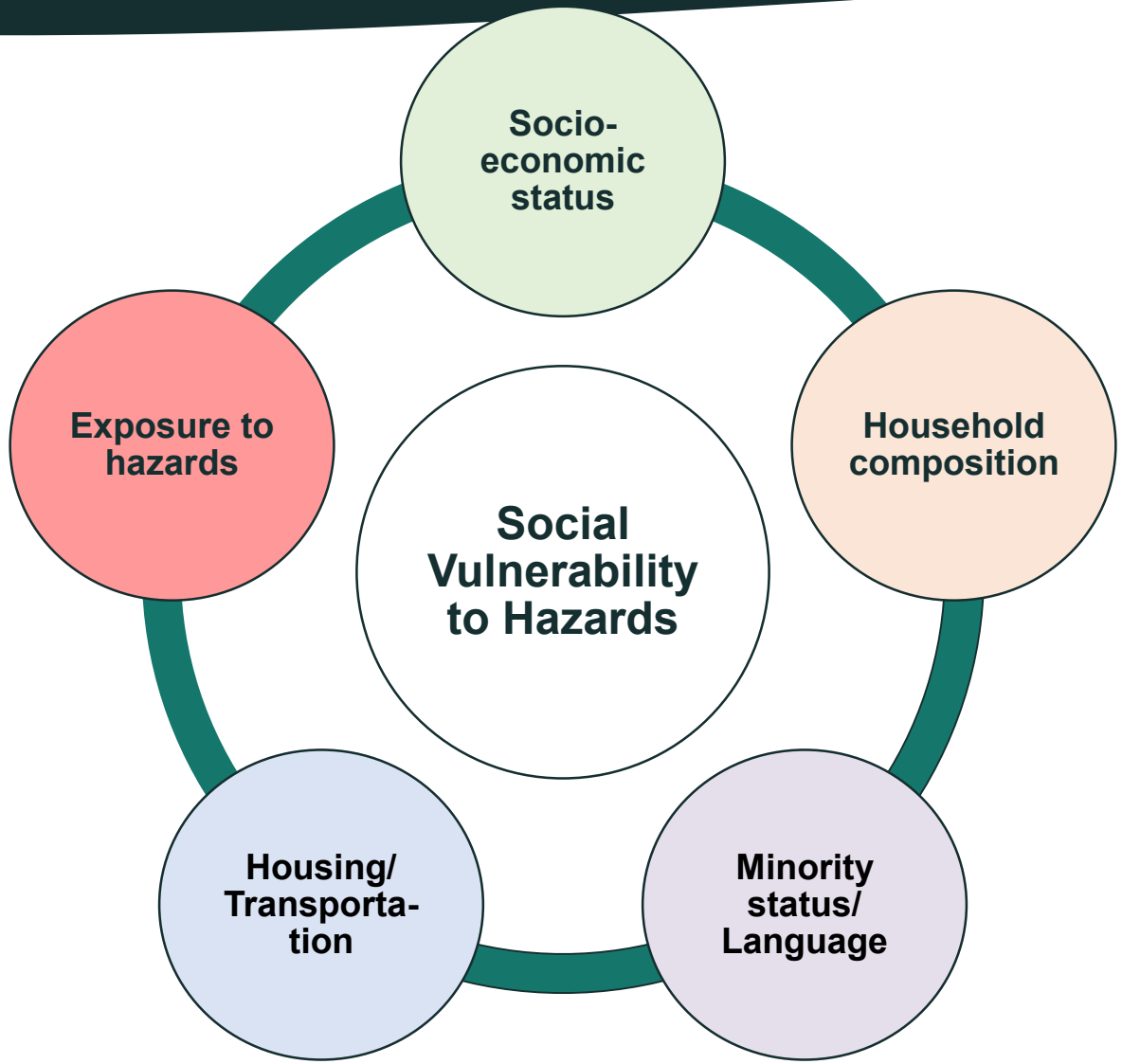
Creating new dimensions (Principal Components) that capture more variance than the original variables and thus reduce the number of variable to express the same information.

Construction of SoVI

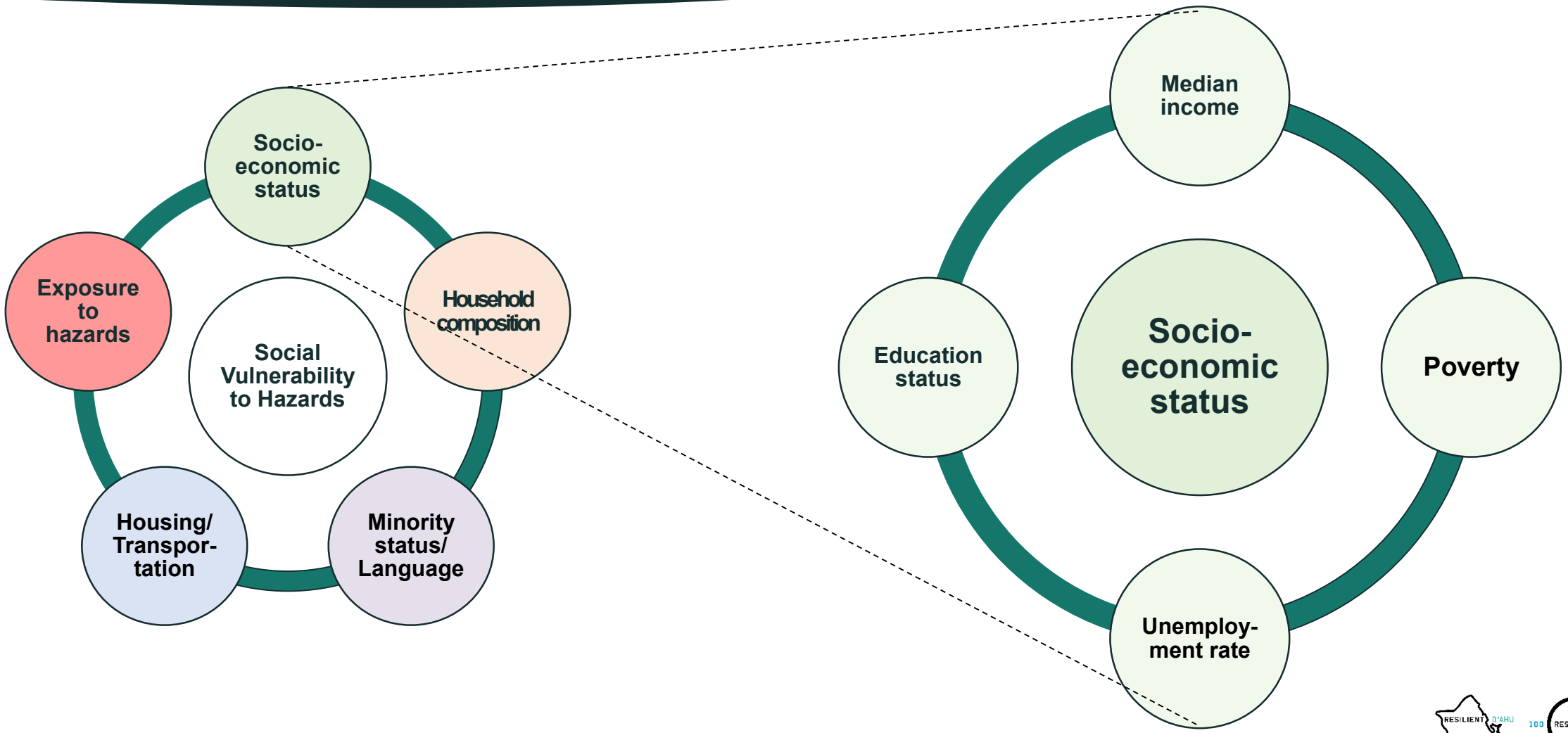
First, determine relevant number of Principal Components (PC). Second, for each observation, add PC scores weighted by the contribution to the total variance explained to obtain the SoVI.

VARIABLE SELECTION AND EFFECT ON VULNERABILITY

Methodology | Dimensions of Vulnerability



Socioeconomic Status



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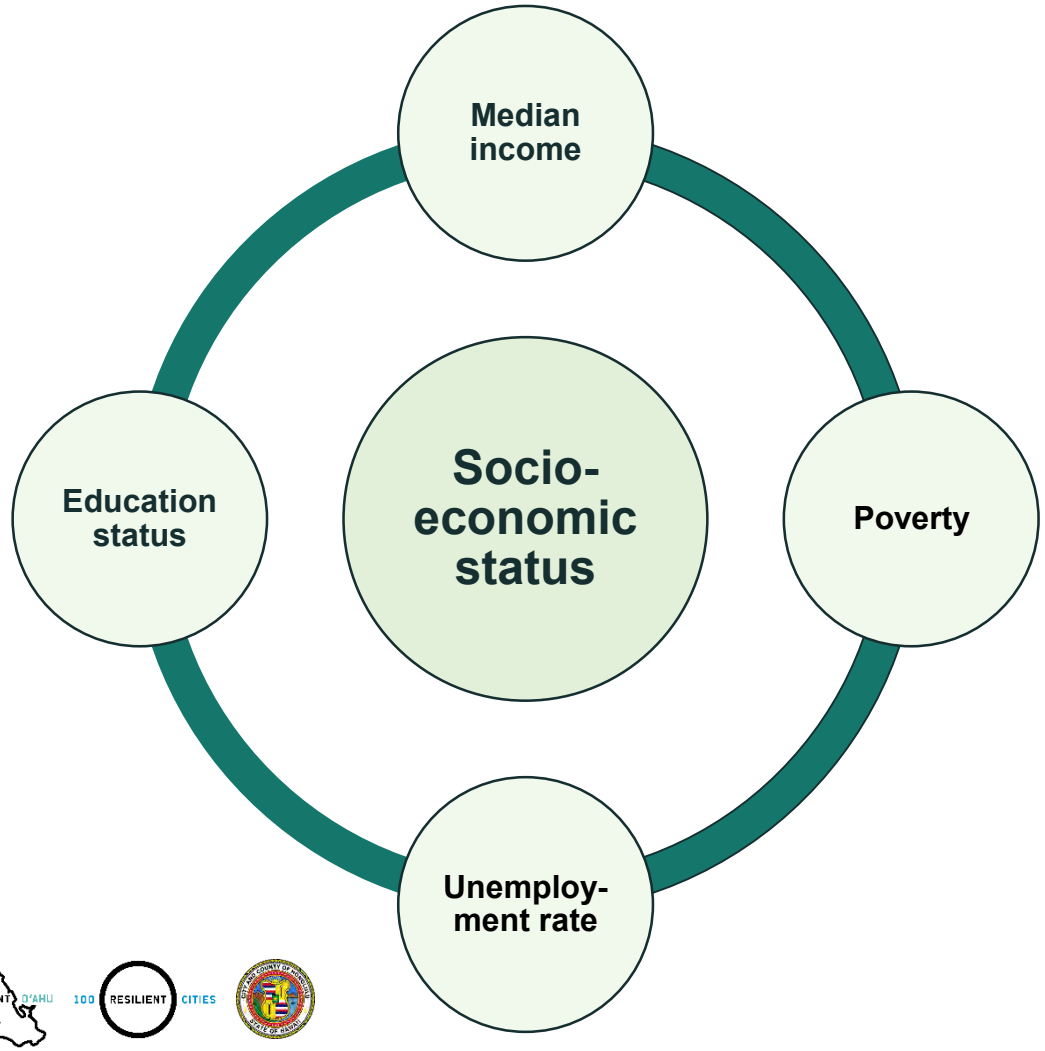
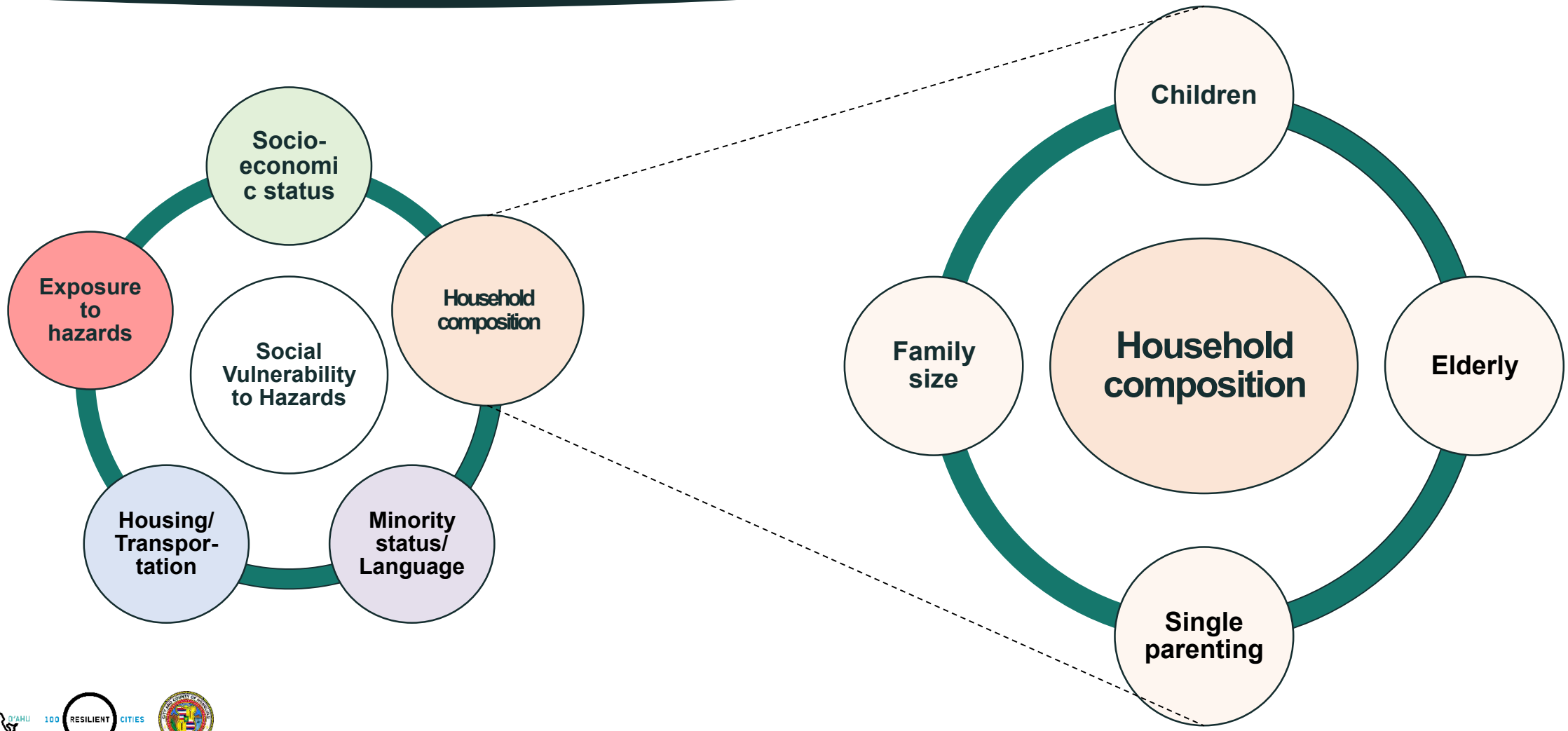


Category	Indicator	Description	Increases (+) or decreases (-) social vulnerability
Socio-economic status	Median income (dollars)	Income enables individuals to absorb and recover from losses more quickly due to insurance, social safety nets and entitlement programs.	Income (-)
	Poverty (%)	Communities with high poverty rates lack mechanisms such as insurances to absorb and recover from hazards.	Poverty (+)
	Unemployment rate (16+) (%)	Communities with high unemployment rates lack mechanisms such as insurances to absorb and recover from hazards.	Unemployment rate (+)
	Education (No high School or less)	Higher educational attainment results in greater lifetime earnings. Lower education constraints the ability to understand warning information and access to recovery information.	Education (+)

Household Composition



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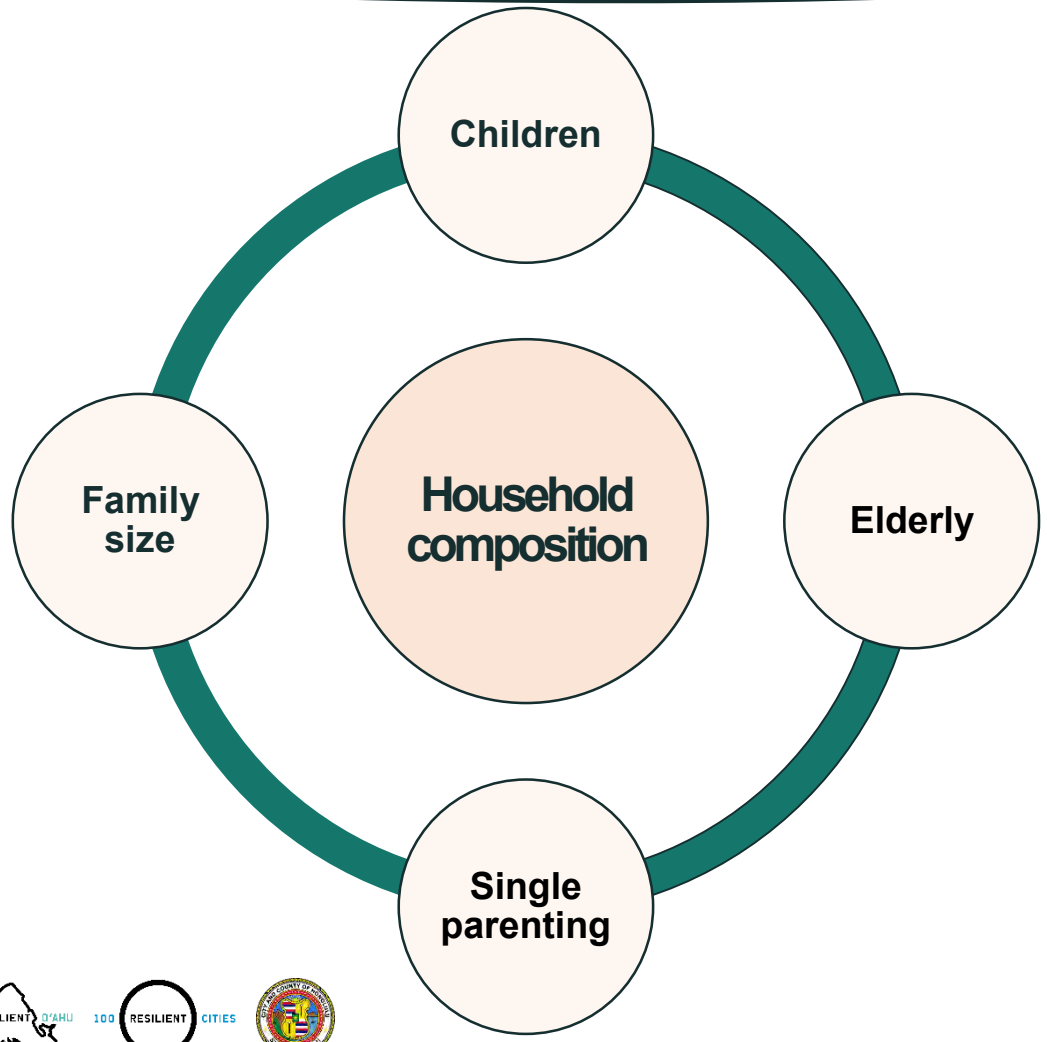
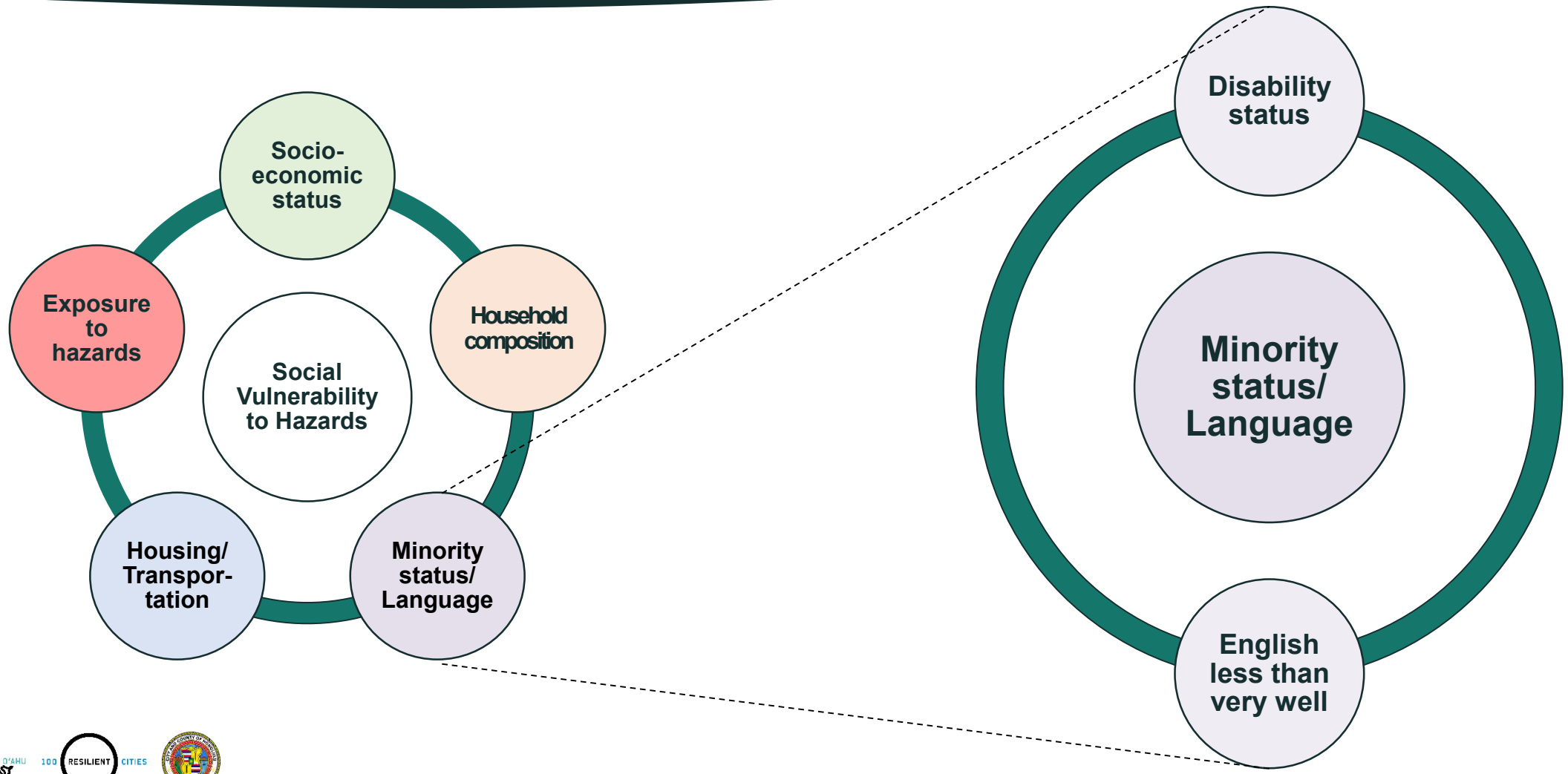
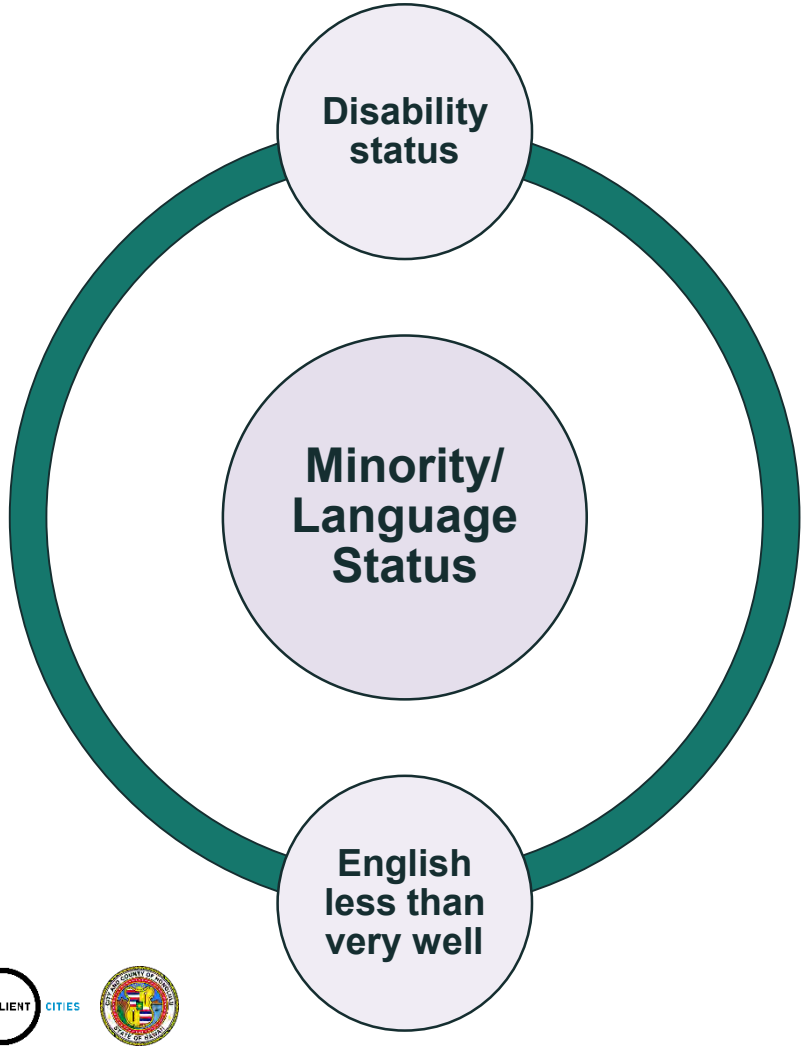


Category	Indicator	Description	Increases (+) or decreases (-) social vulnerability
Household composition	Children, <17 (%)	Extremes of the age spectrum affect the movement out of harm's way. Parents lose time and money caring for children when daycare facilities are affected.	Children (+)
	Elderly, 65+ (%)	Elderly may have mobility constraints or mobility concerns increasing the burden of care and lack of resilience.	Elderly (+)
	Single parenting (%)	Single-parent households often have limited finances to outsource care for dependents, and thus must juggle work responsibilities and care for family members.	Single Parenting (+)
	Family size	Families with large numbers of dependents often have limited finances to outsource care for dependents, and thus must juggle work responsibilities and care for family members. All affect the resilience to and recovery from hazards.	Family size (+)

Minority Status / Language

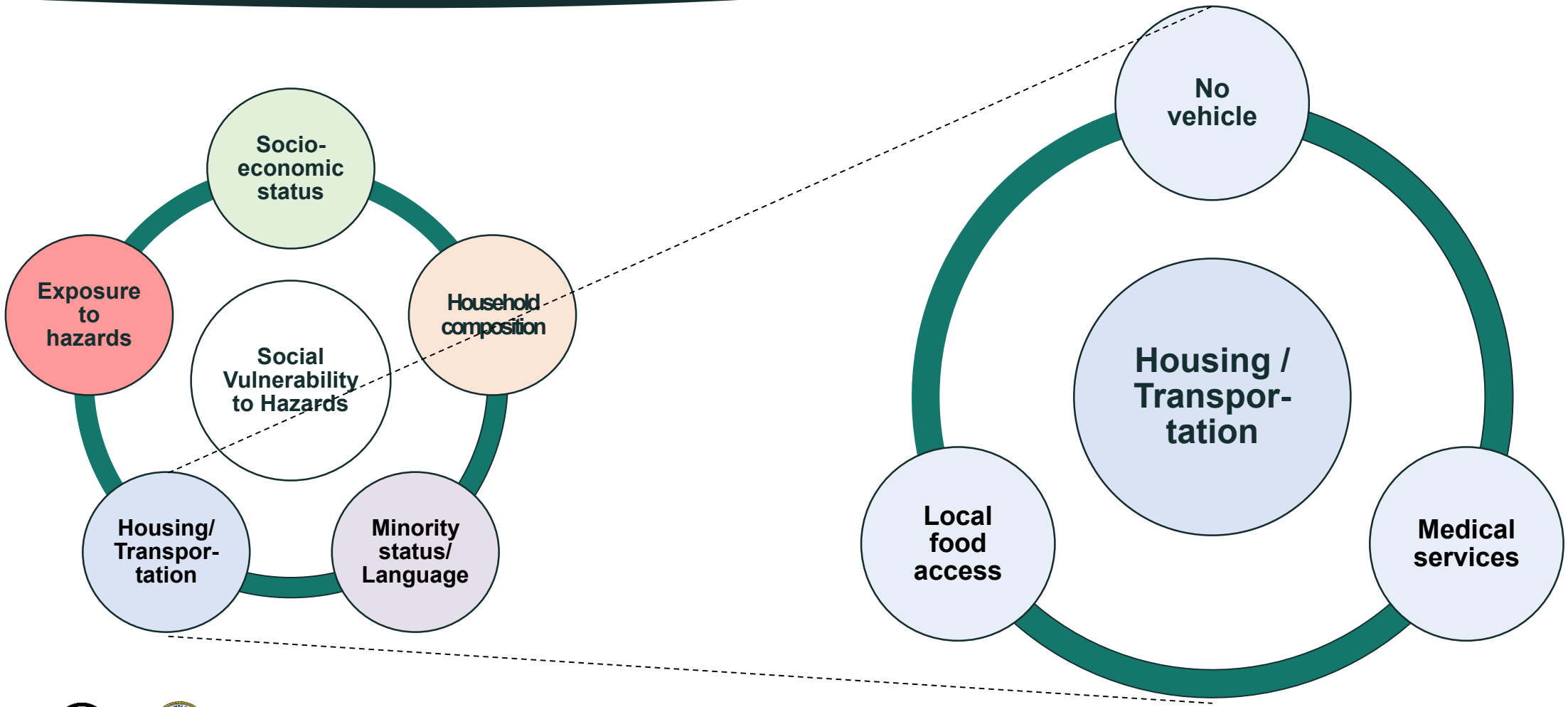


Minority Status / Language

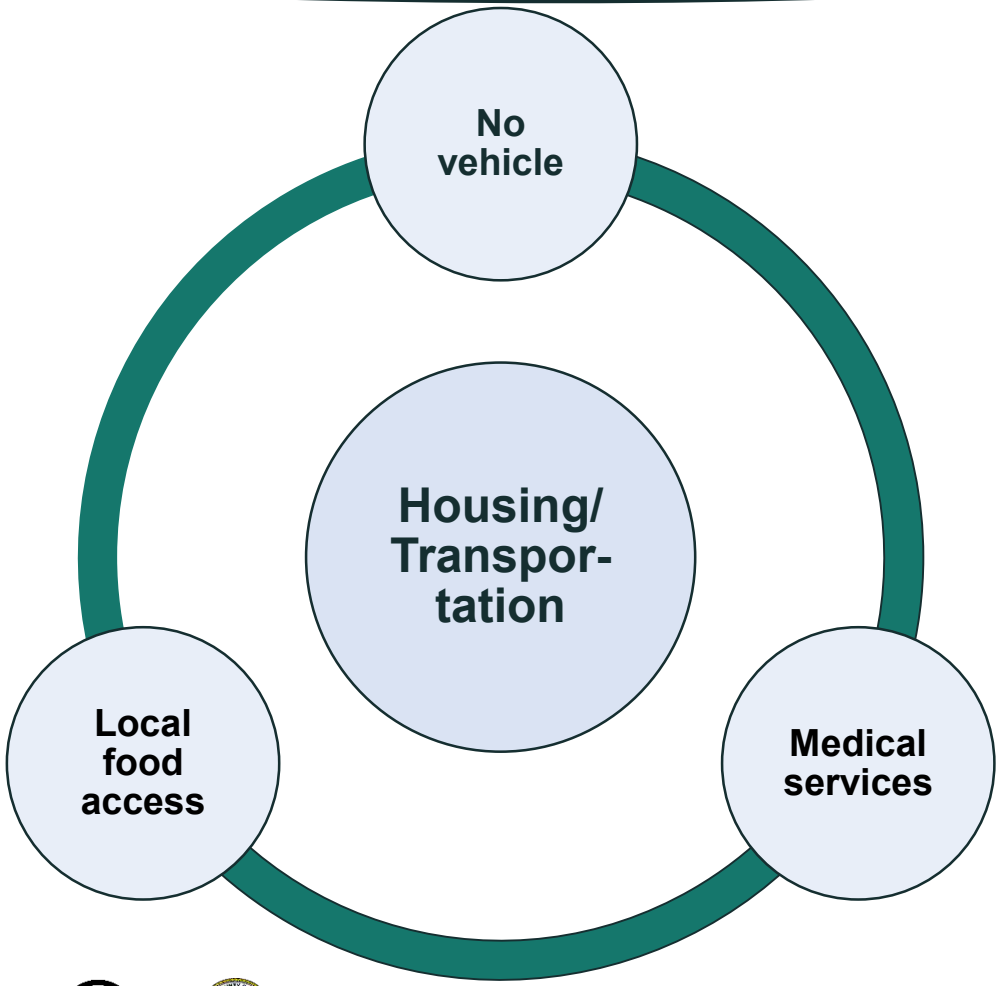


Category	Indicator	Description	Increases (+) or decreases (-) social vulnerability
Minority status/ Language	Disability (%)	Special needs populations are disproportionately affected during disasters and, because of their invisibility in communities, mostly ignored during recovery.	Disability (+)
	Speak English less than "very well" (%)	Language barriers affect access to post-disaster funding as well as immediate evacuation information.	Speak English less than "very well" (+)

Housing / Transportation



Housing / Transportation



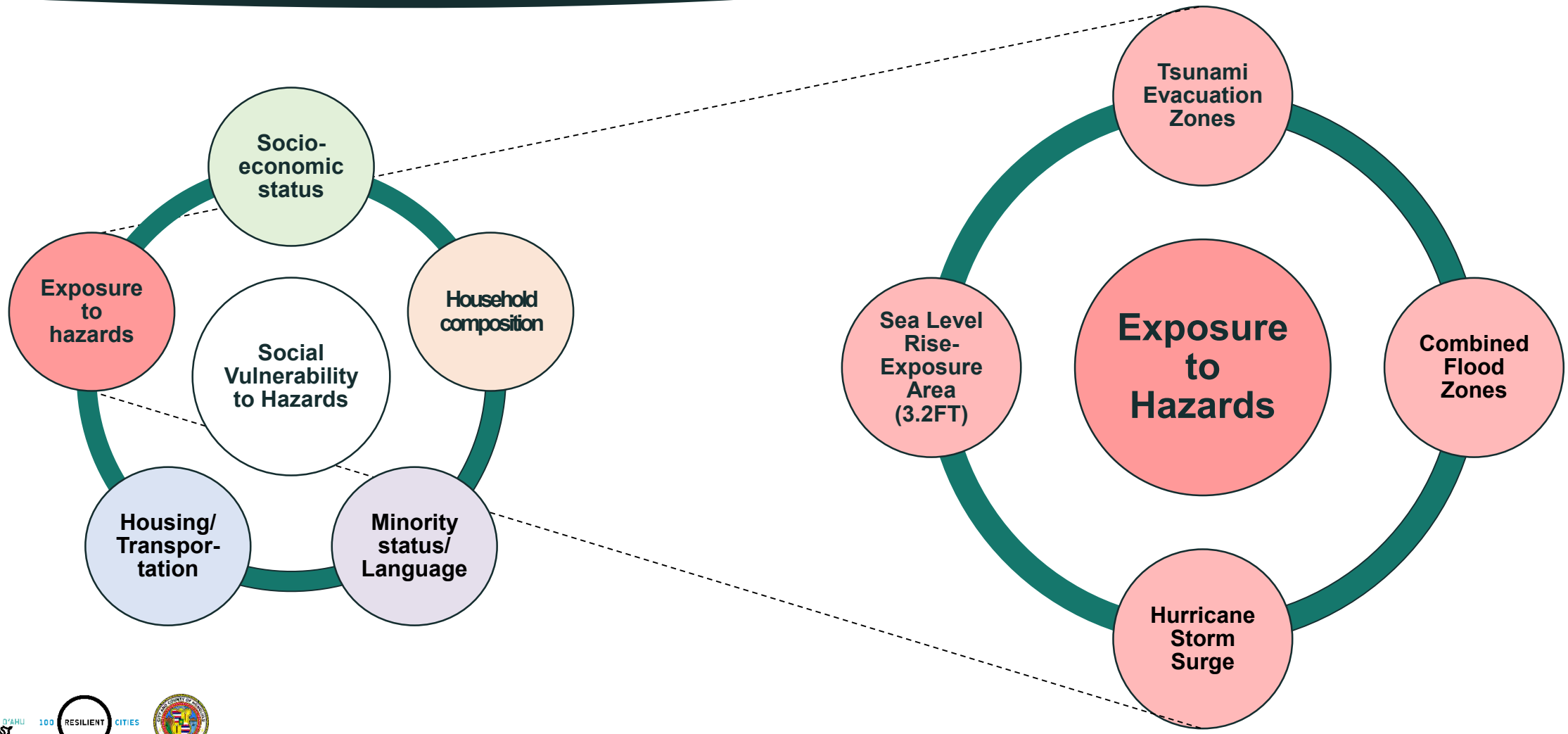
Category	Indicator	Description	Increases (+) or decreases (-) social vulnerability
Housing/ Transportation	No vehicle available (%)	Households without vehicle face greater obstacles to evacuation and recovery.	No vehicle (+)
	Medical Services (%)	Access to medical services in the recovery phase can be crucial to survival.	Medical Services (-)
	Local access to food (%)	Access to local food supplies can be essential when supply chains are disturbed during the recovery phase.	Access to food (-)

Methodology | Final Set of Variables

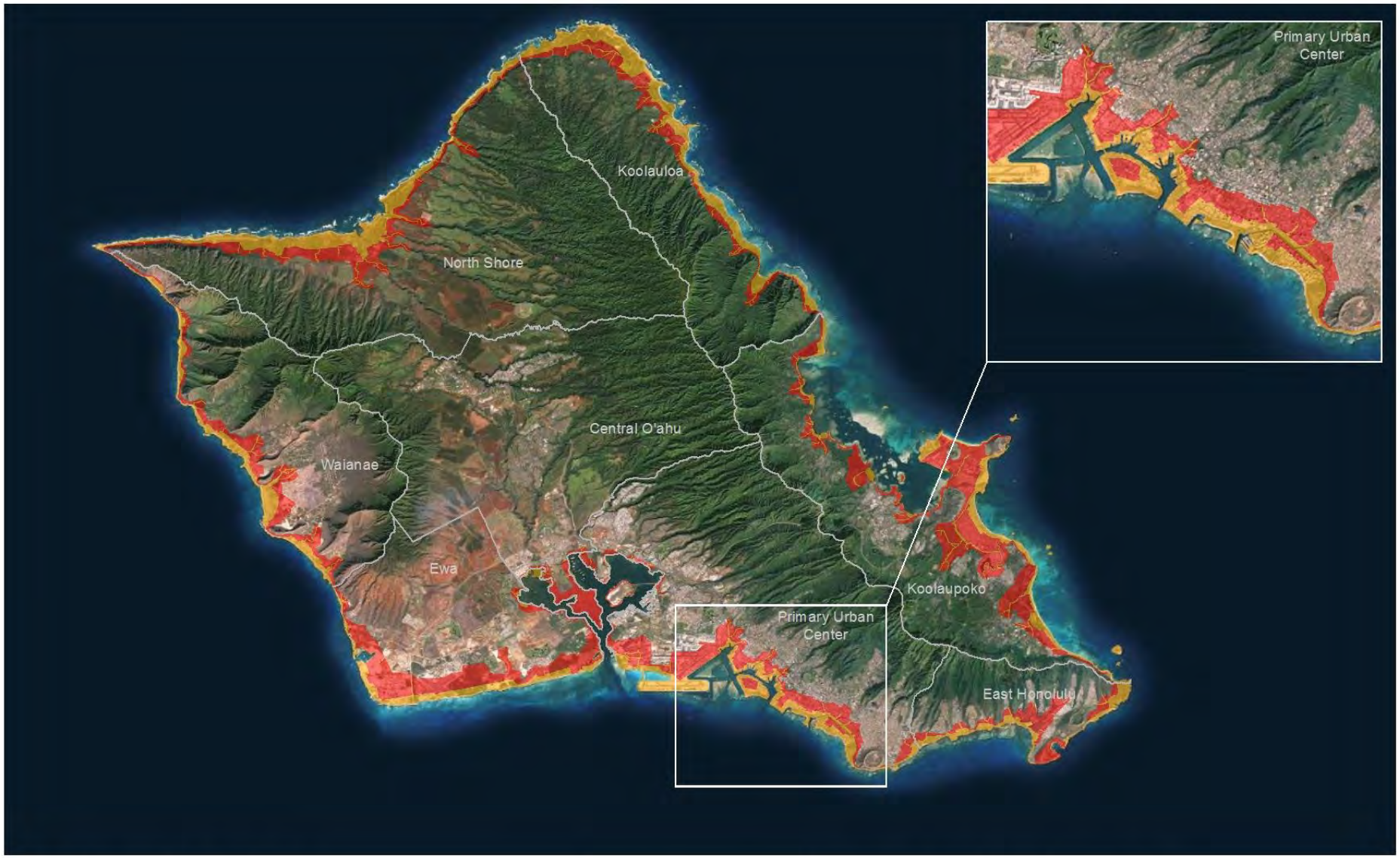
Category	Indicator	Increases (+) or decreases (-) social vulnerability
Socioeconomic status	Median income (dollars)	Income (-)
	Poverty (%)	Poverty (+)
	Unemployment rate (16+) (%)	Unemployment rate (+)
	Education (No high School or less)	Education (+)
Household composition	Children, <17 (%)	Children (+)
	Elderly, 65+ (%)	Elderly (+)
	Single parenting (%)	Single Parenting (+)
	Family size	Family size (+)
Minority status/Language	Disability (%)	Disability (+)
	Speak English less than "very well" (%)	Speak English less than "very well" (+)
Housing/ Transportation	No vehicle available (%)	No vehicle (+)

HAZARDS

Hazards | Shocks & Stresses



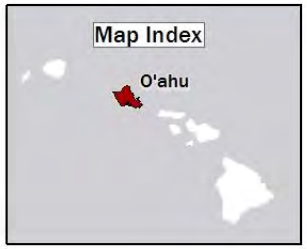
Tsunami



Indicator: Tsunami Evacuation Zones

- Regular Tsunami
- Extreme Tsunami

Map Index



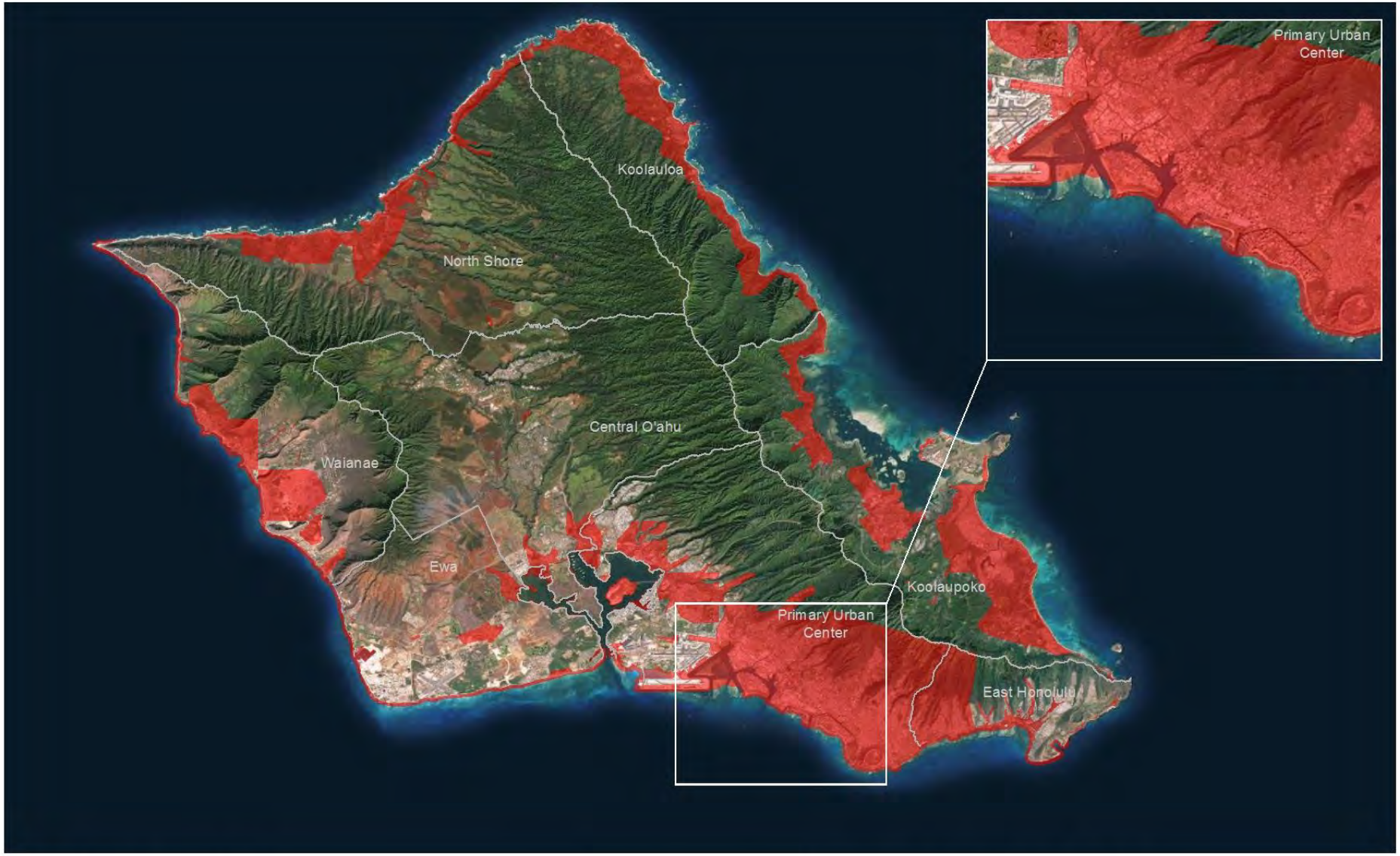
Resilient O'ahu: Tsunami Evacuation Zones

City and County of Honolulu
Hawai'i, USA

Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

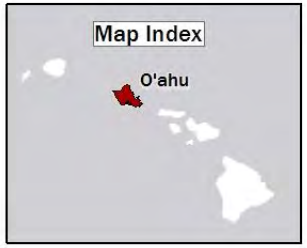
Mapped Special Flood Hazard Areas + Mod/Min Risk Areas



Indicator: Combined Flood Zones

Flood Zones

Map Index



Resilient O'ahu: Combined Flood Zones

City and County of Honolulu
Hawai'i, USA

Map Date: January 11, 2019
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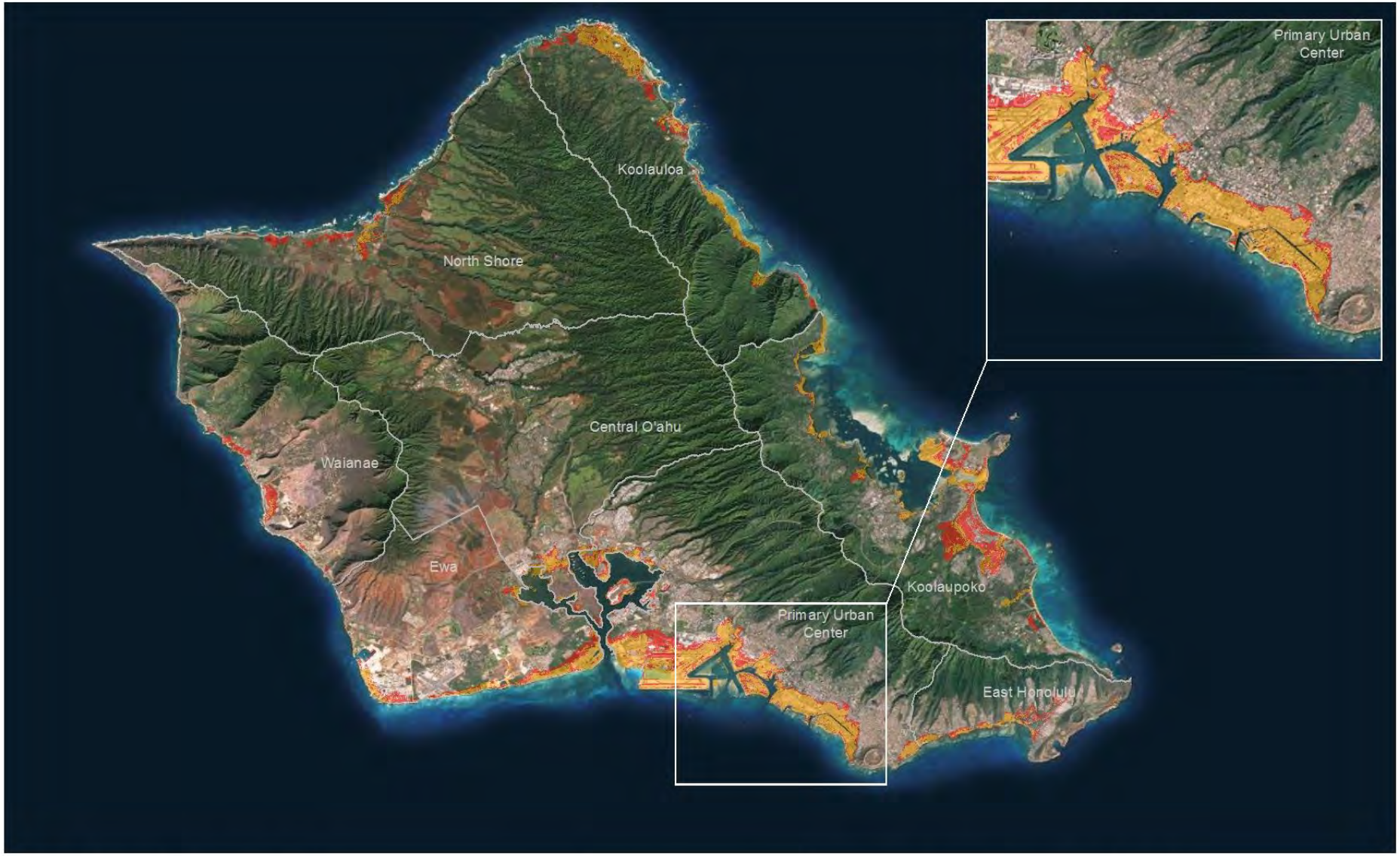
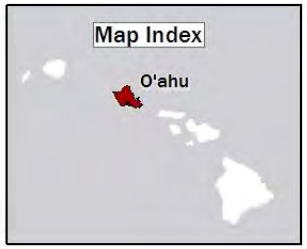
0 2.5 5 7.5 10 Miles

Hurricane Storm Surge



Indicator: Hurricane Storm Surge Zones

- Category 2 Hurricane
- Category 4 Hurricane



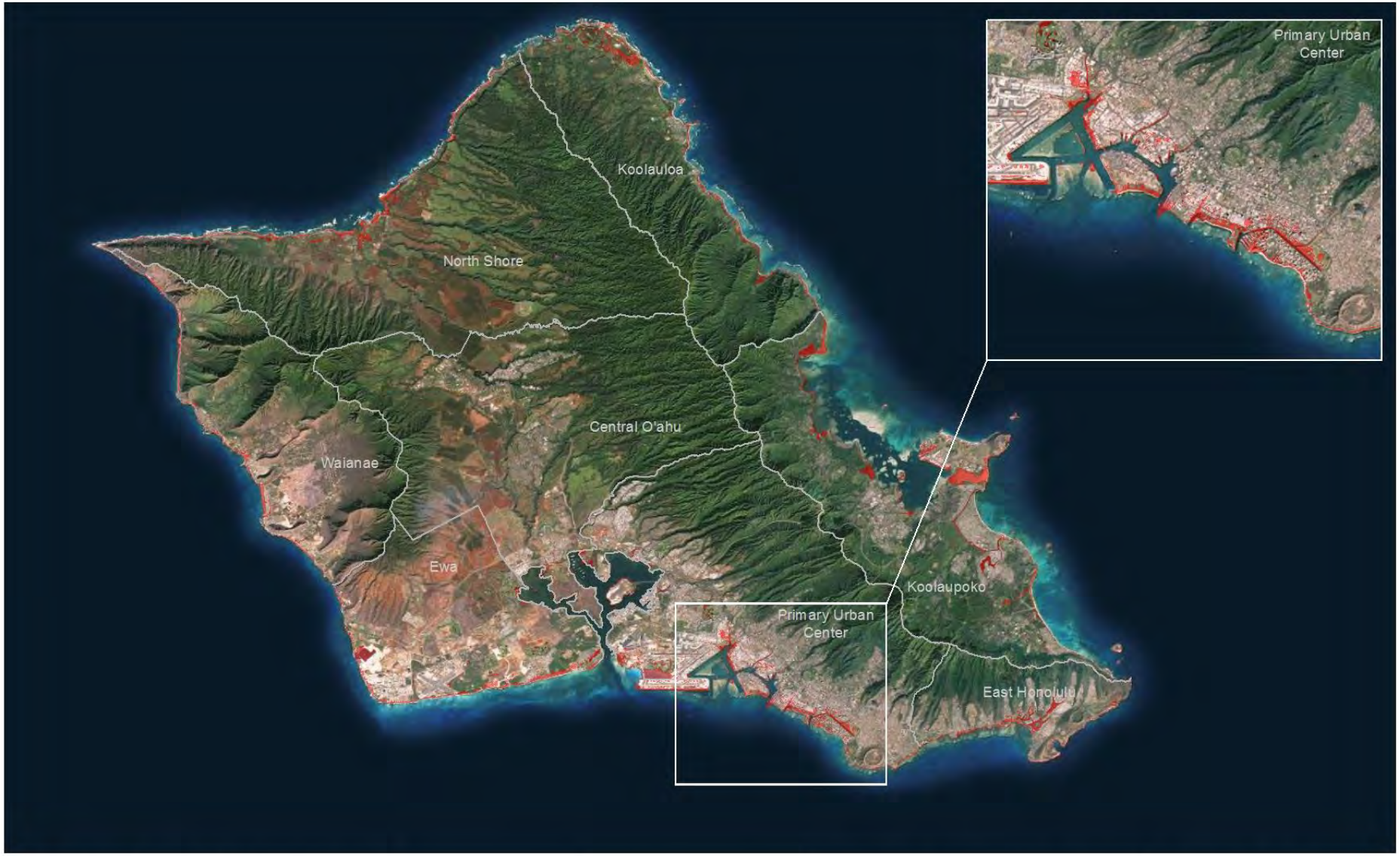
Resilient O'ahu: Hurricane Storm Surge Zones

City and County of Honolulu
Hawai'i, USA

Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

Sea Level Rise-Exposure Area (3.2FT)



Indicator: Year 2100 Sea Level Rise Exposure Area

Sea Level Rise Exposure Area

Map Index

O'ahu

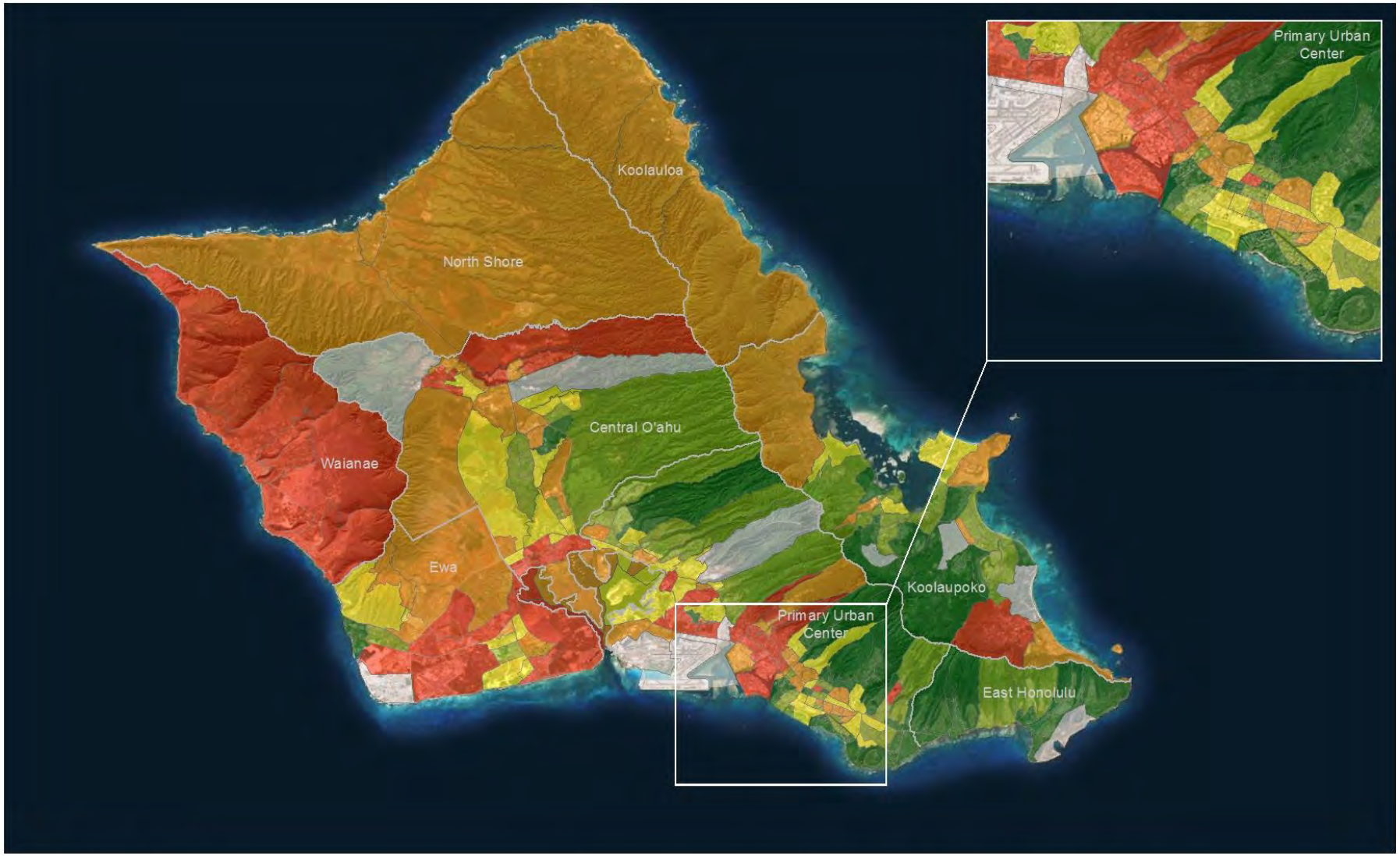
Resilient O'ahu: Year 2100 Sea Level Rise Exposure Area

City and County of Honolulu
Hawai'i, USA

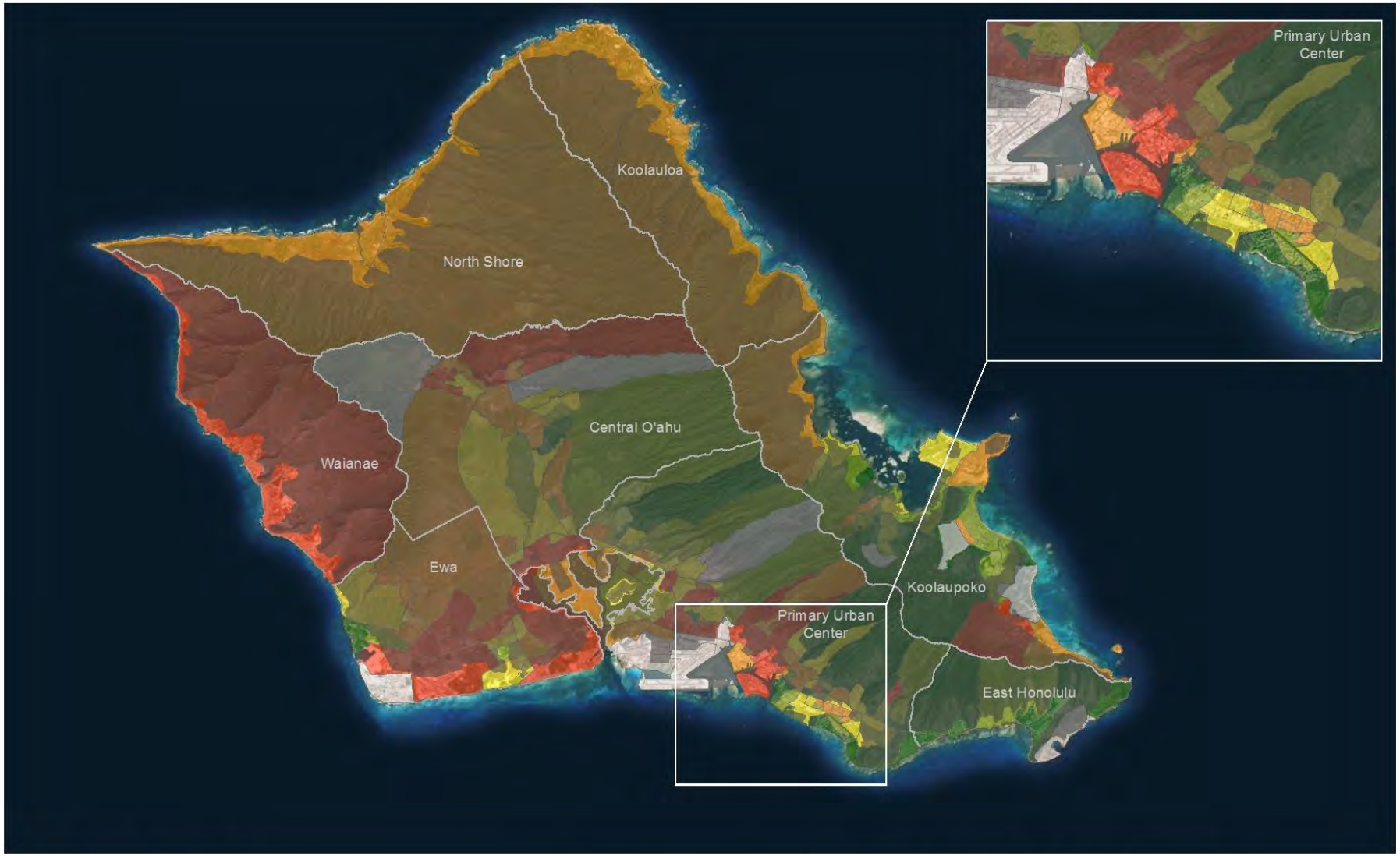
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

RESULTS | SOCIAL VULNERABILITY INDEX

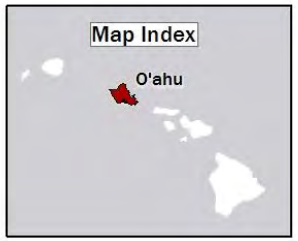


SOCIAL VULNERABILITY INDEX



Social Vulnerability Index (SoVI)

- Very Low Vulnerability
- Low Vulnerability
- Medium Vulnerability
- High Vulnerability
- Very High Vulnerability
- No Data



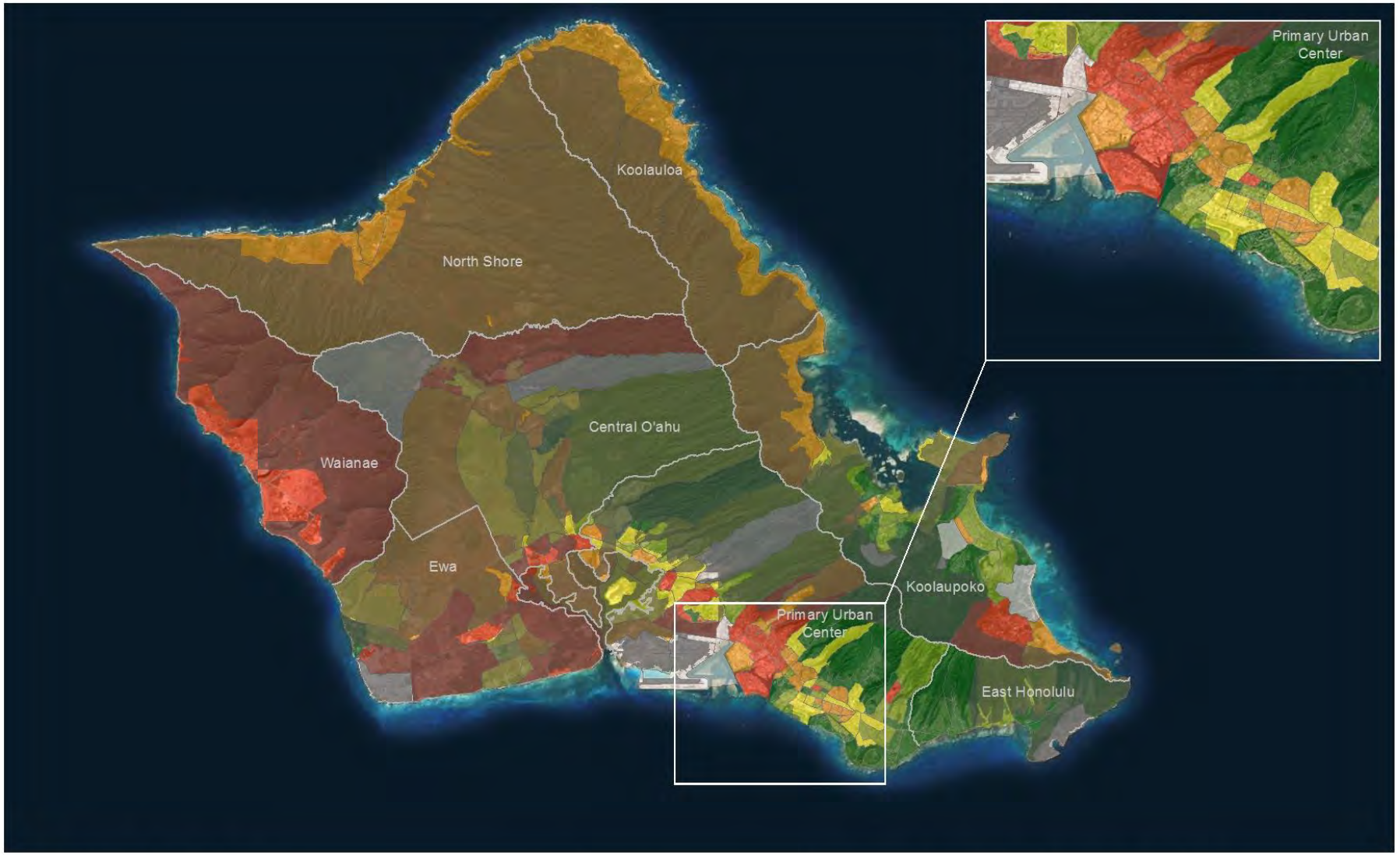
Resilient O'ahu: SoVI with Tsunami Evacuation Zones

City and County of Honolulu
Hawai'i, USA

Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

SOVI – TSUNAMI EVAC ZONES



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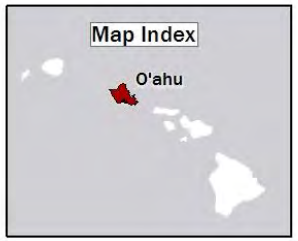
Map Index



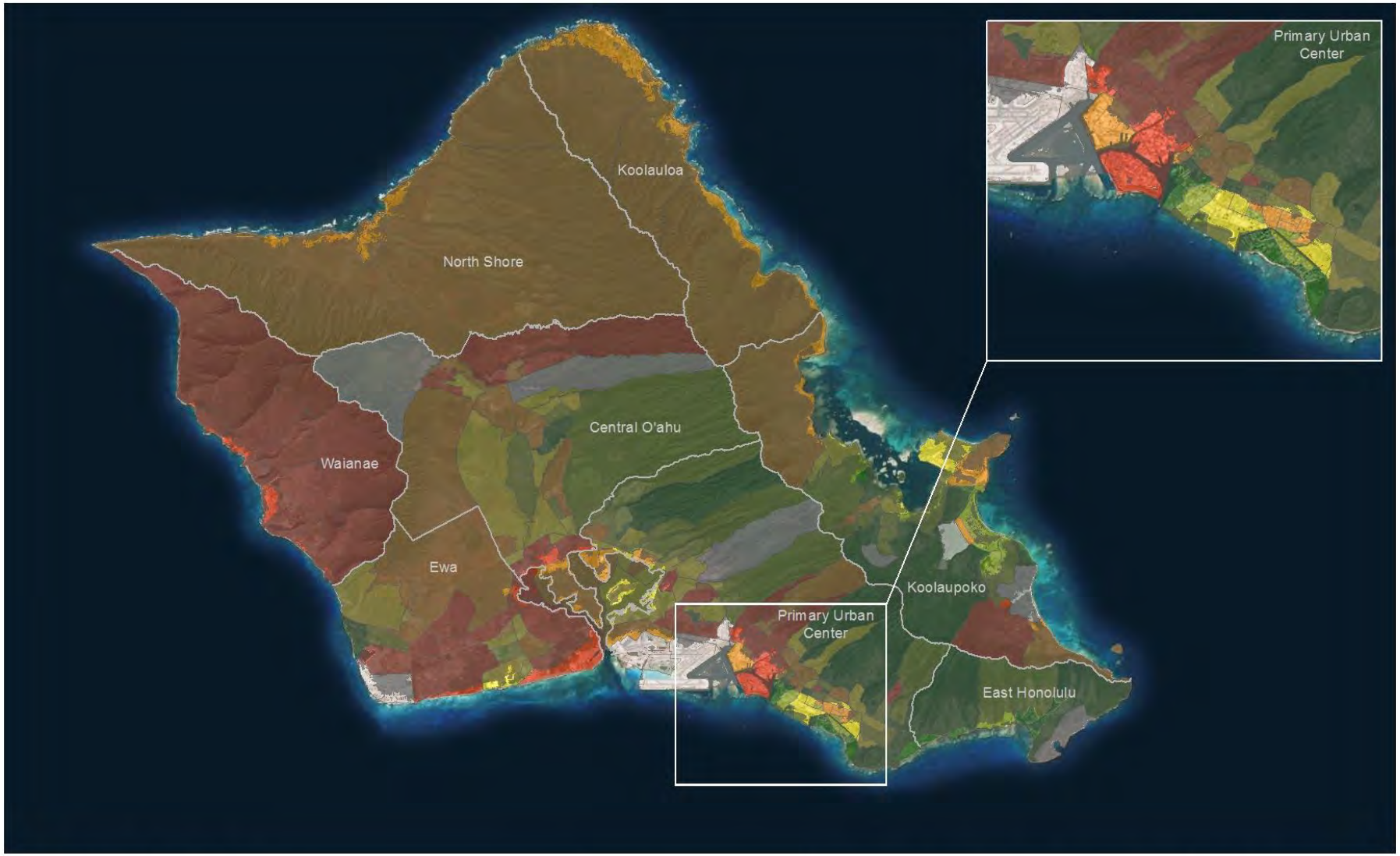
Resilient O'ahu: SoVI with Combined Flood Zones

City and County of Honolulu
Hawai'i, USA

Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

SOVI – FLOOD ZONES (1% ACE)



SOVI – HURRICANE STORM SURGE

Social Vulnerability Index (SoVI)

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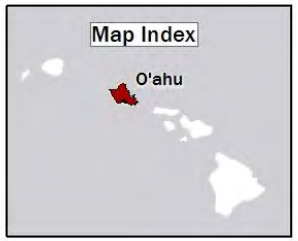

Resilient O'ahu: SoVI with Hurricane Storm Surge Zones

City and County of Honolulu
Hawai'i, USA

Map Date: January 11, 2019
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GCS_North_American_1983

0 2.5 5 7.5 10 Miles

Social Vulnerability Index (SoVI)

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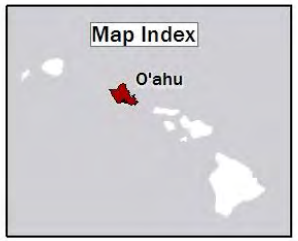


Resilient O'ahu: SoVI with Year 2100 Sea Level Rise Exposure Area

City and County of Honolulu
Hawai'i, USA

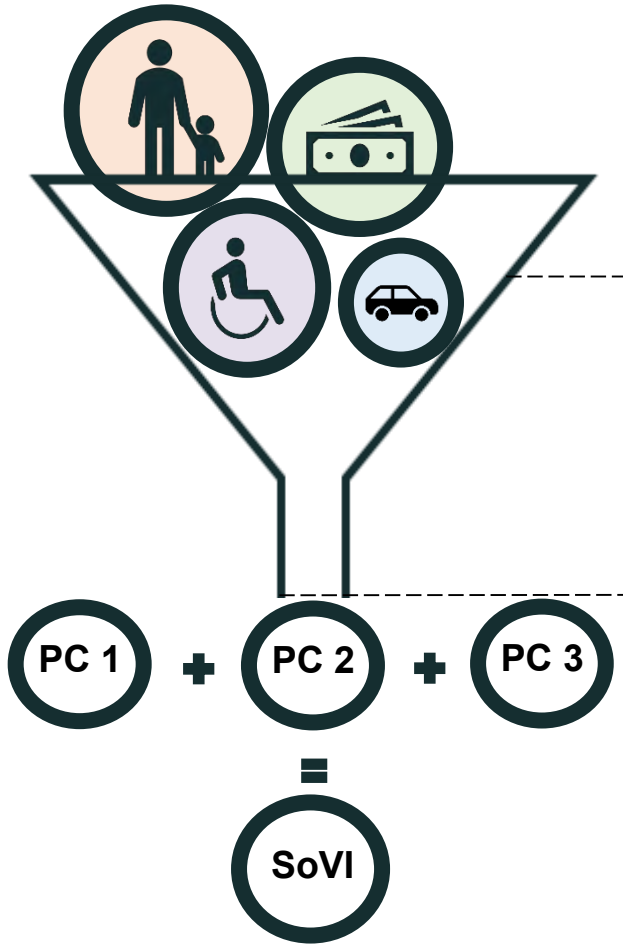
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

SOVI– SEA LEVEL RISE EXPOSURE AREA (3.2FT)

RESULTS | DRIVERS OF VULNERABILITY

Methodology | Principal Component Analysis



Variable Selection

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Principal Component Analysis

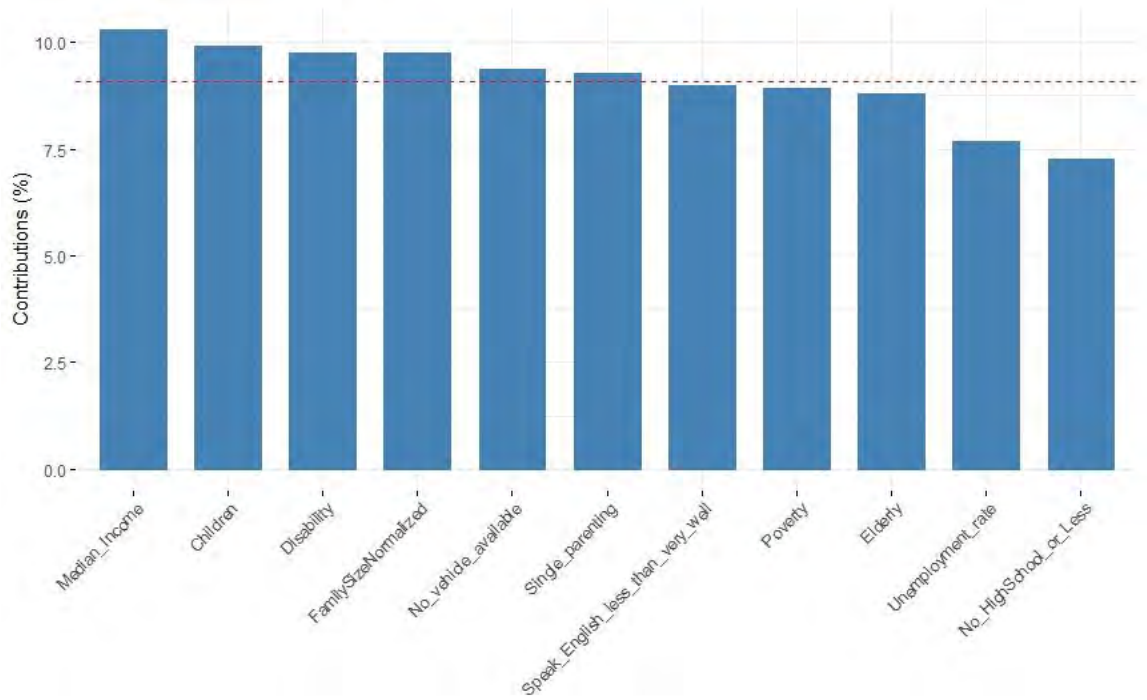
Creating new dimensions (Principal Components) that capture more variance than the original variables and thus reduce the number of variable to express the same information.

Construction of SOVI

First, determine relevant number of Principal Components (PC). Second, for each observation, add PC scores weighted by the contribution to the total variance explained to obtain the SOVI.

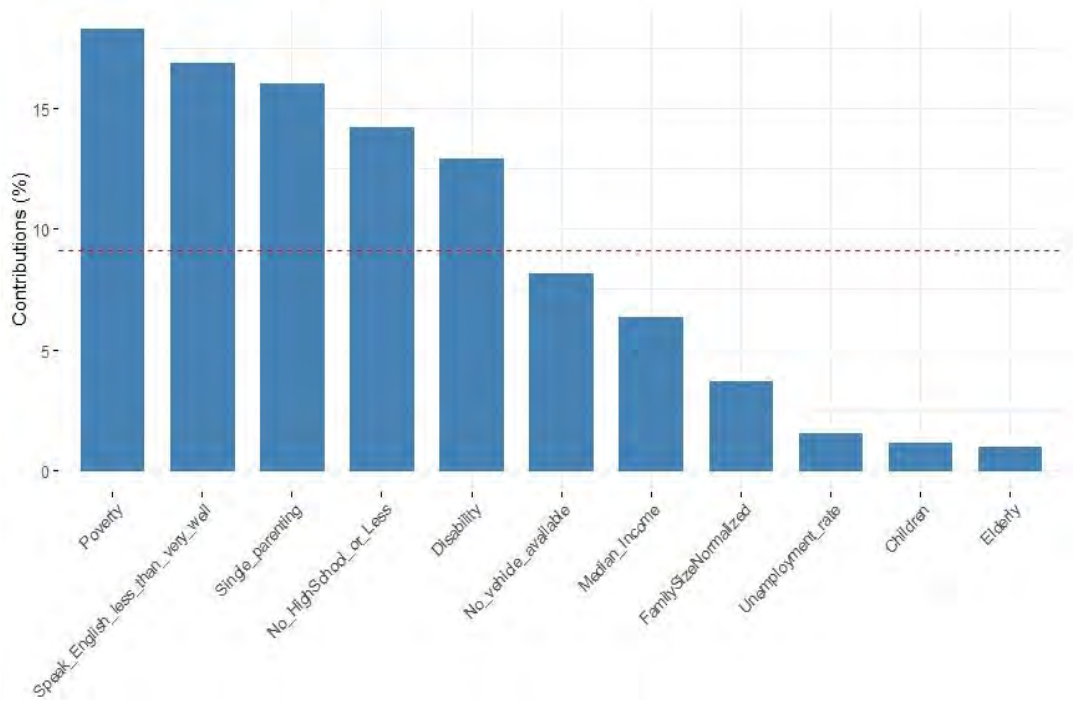
Variable Contribution to the SOVI

- Main drivers
  1. Median income
  2. Number of children
  3. Disability status
  4. Family size
  5. No vehicle available
  6. Single parenting
- Fairly homogenous distribution between drivers



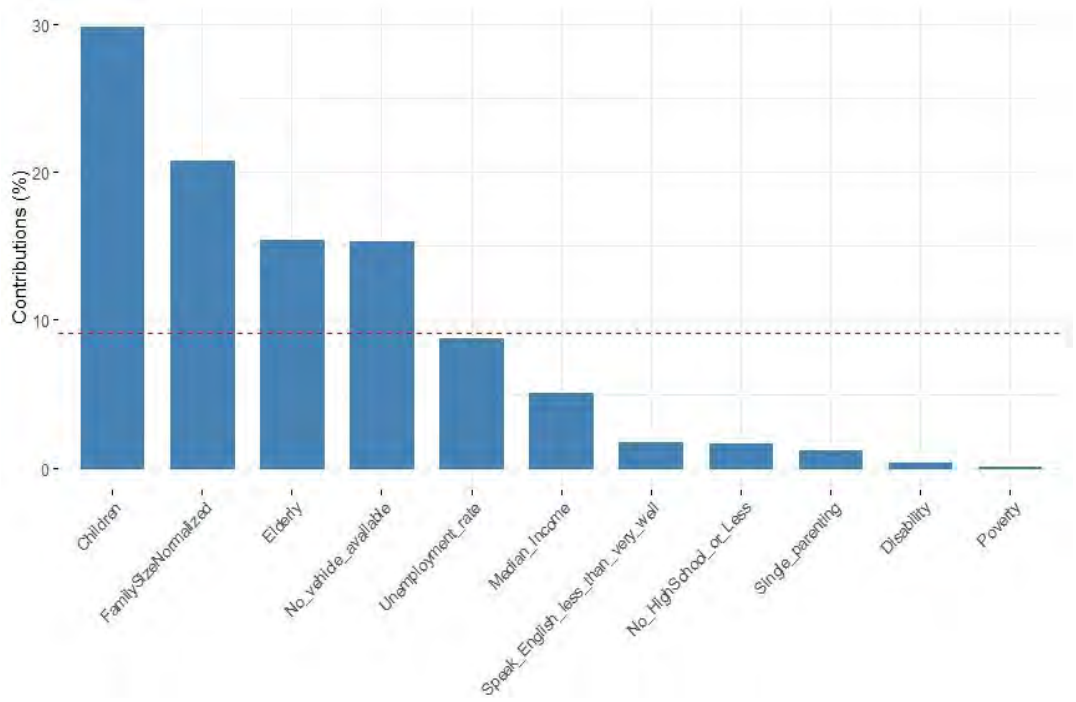
Variable Contribution to the PC1

- PC1 accounts for 34% of all variance within the 11 original variables
- PC1 is the socioeconomic indicator
- Main drivers
    1. Poverty
    2. No English
    3. Single Parenting
    4. No High-School
    5. Disability
- These variables should be addressed collectively



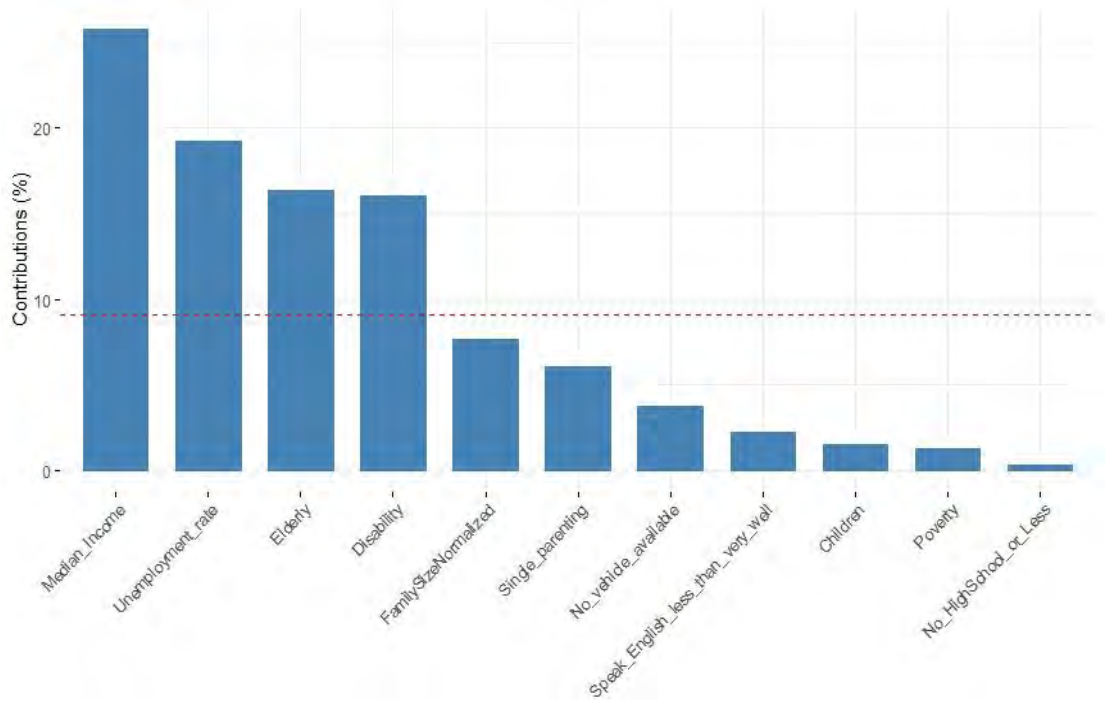
Variable Contribution to the PC2

- PC2 accounts for 23% of all variance within the 11 original variables
- PC2 is the household composition indicator
- Main drivers
    1. Children
    2. Family Size
    3. Elderly
    4. No Vehicle
- These variables should be addressed collectively



Variable Contribution to the PC3

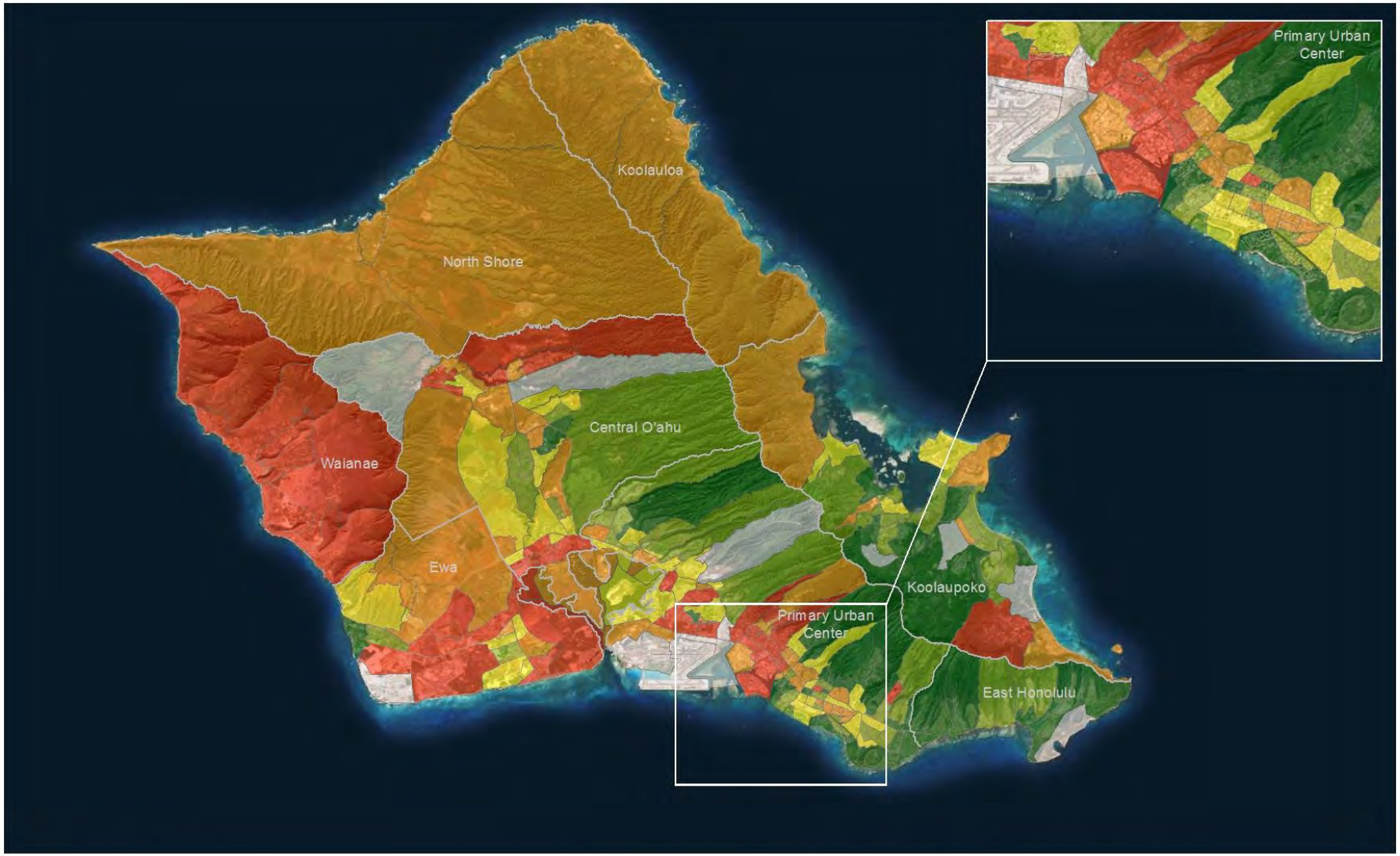
- PC3 accounts for 17% of all variance within the 11 original variables
- PC3 is the economic status indicator
- Main drivers
    1. Median Income
    2. Unemployment rate
    3. Elderly
    4. Disability
- These variables should be addressed collectively



SOVI FOR POLICY DEVELOPMENT

Insights from the SOVI

1. Localization	Where do vulnerable populations tend to live?
2. Identification	What drives the vulnerability of these communities?
3. Action	Which drivers of vulnerability are correlated and should be addressed in conjunction?

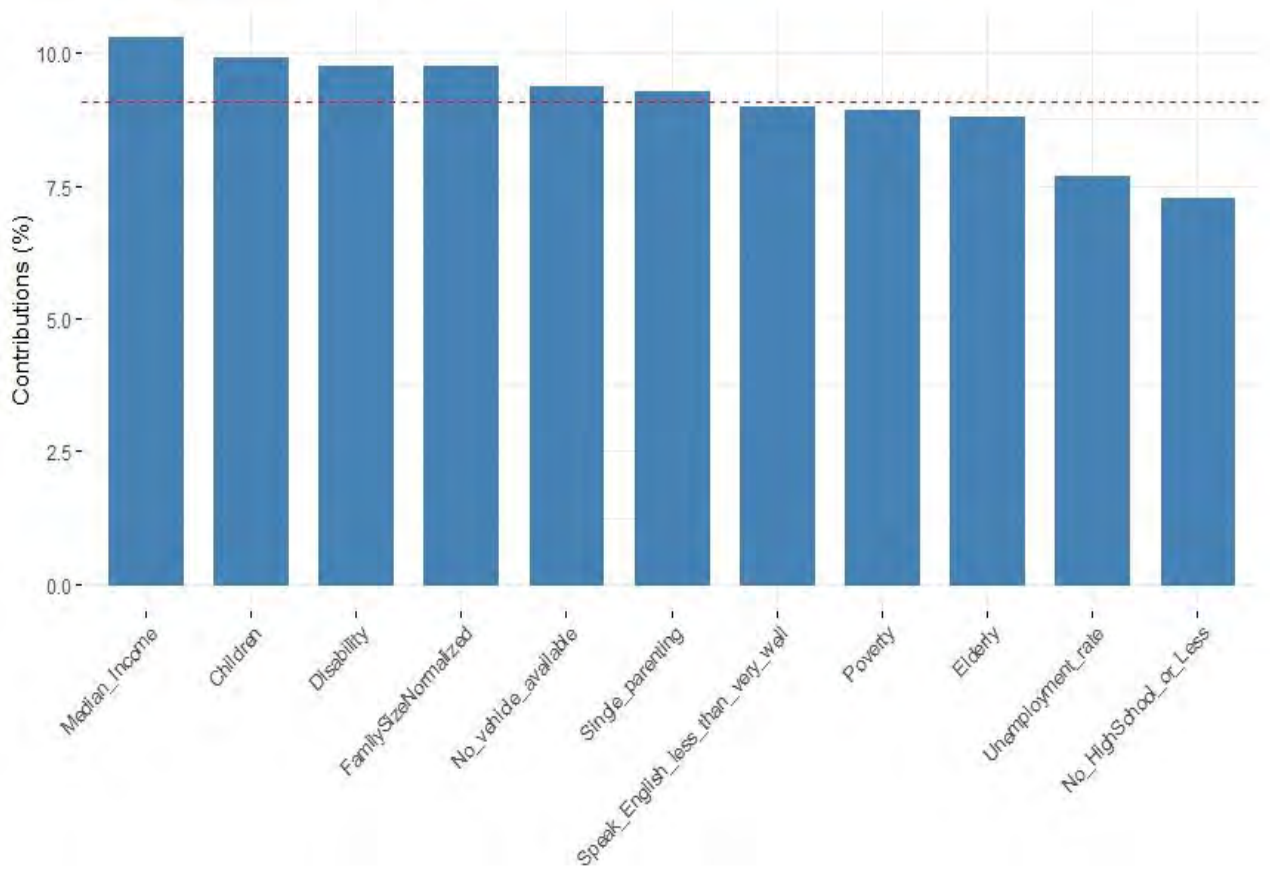


LOCALIZATION

Identification | Drivers of Vulnerability

Top 6 drivers

1. Median income
2. Number of children
3. Disability status
4. Family size
5. No vehicle available
6. Single parenting

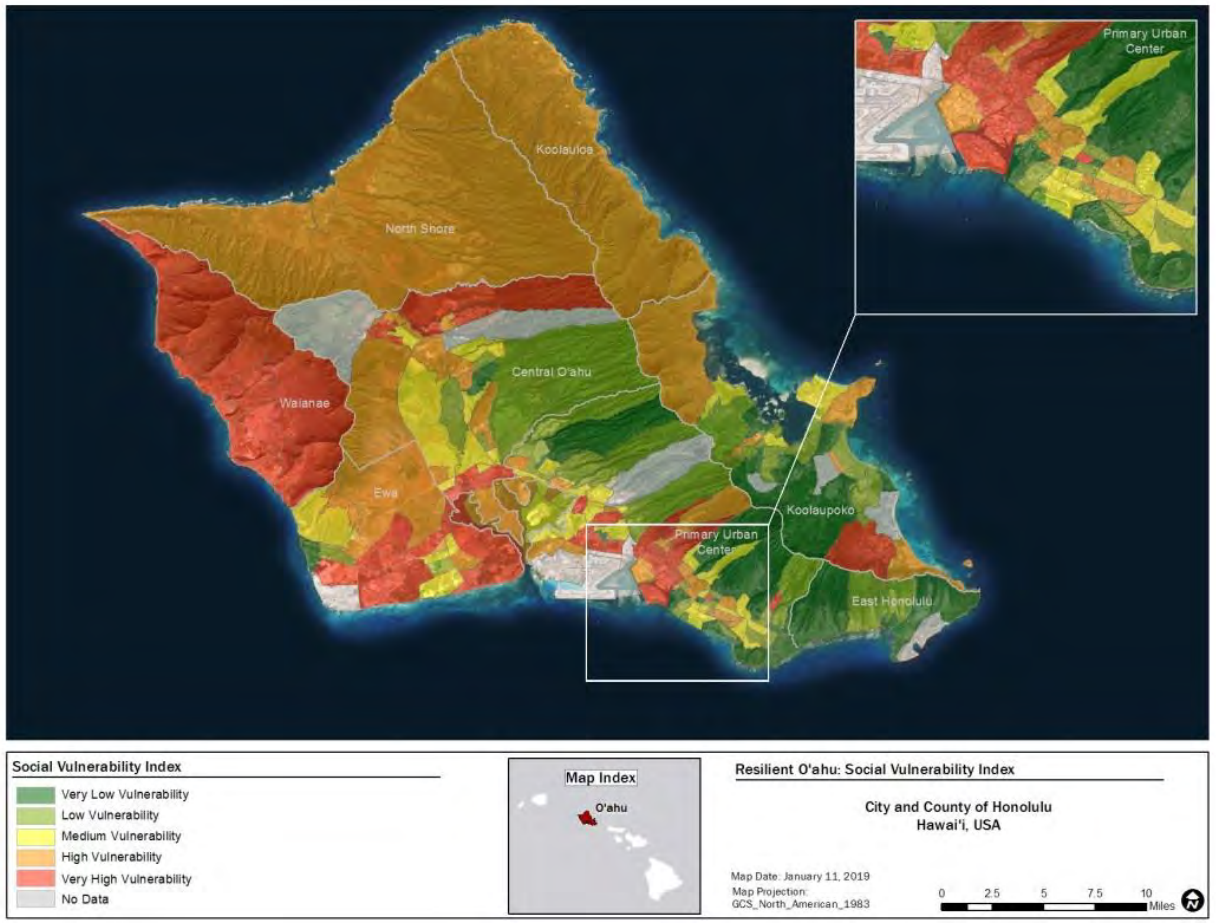


Action | The SOVI in Policy or Program Design

The SOVI for O‘ahu has identified particular community characteristics that increase vulnerability to Tsunamis, Hurricanes, Flooding and Sea Level Rise.

The maps and data developed for the SOVI identify the geographic areas that are most vulnerable, as well as the main socioeconomic drivers of vulnerability.

Targeting actions to these the most vulnerable communities and populations will assist in increasing adaptive capacity in the event of a hazard, and will yield long-term resilience benefits for O‘ahu as a whole.



Action | Aligned Areas for Action

Socioeconomic characteristics

- Poverty
- Ability to speak English
- Single-parenting
- No High-School
- Disability

Household composition

- Children
- Family size
- Elderly
- No vehicle

Economic status

- Median Income
- Unemployment rate
- Elderly
- Children

Action | The SOVI in Policy or Program Design

Key concepts for increasing resilience:

1. Localize & understand vulnerable populations
2. Determine drivers of vulnerability
3. Address policy areas together

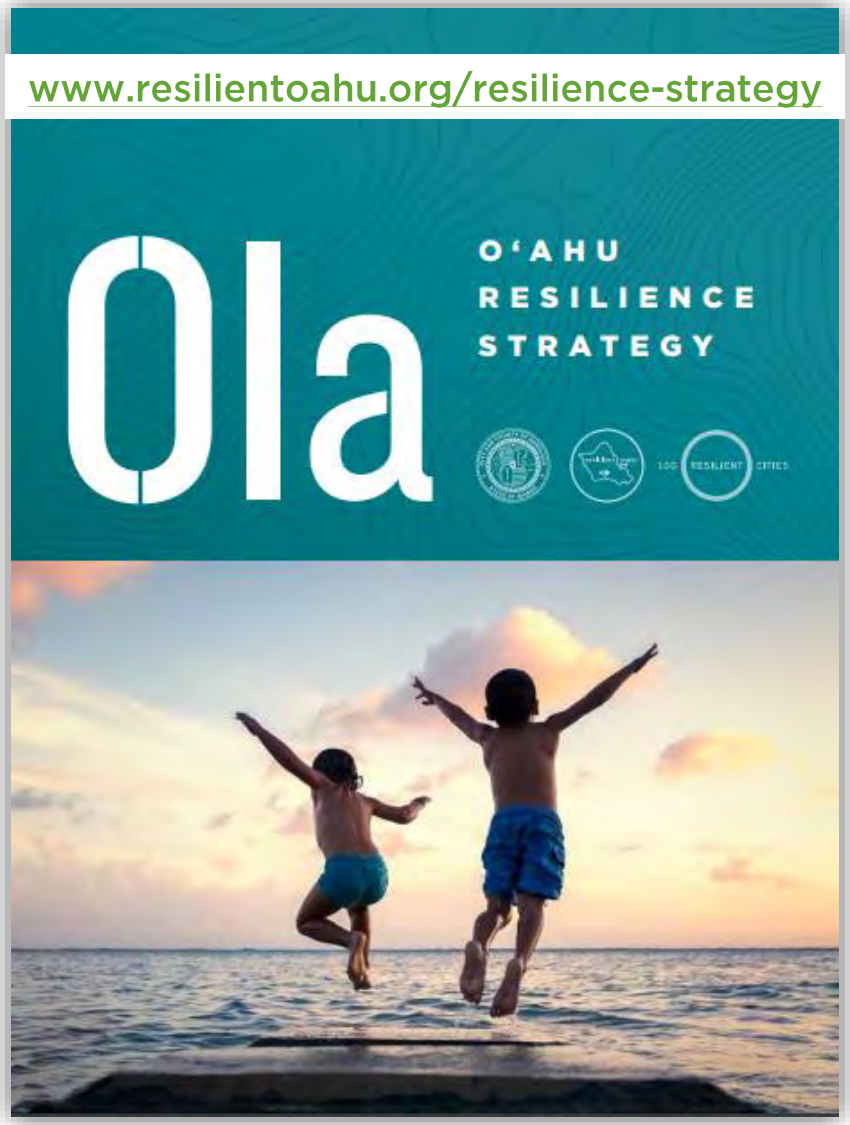
Examples of increasing resilience through the SOVI:

1. Identify areas in need of emergency shelters.
2. Identify communities that will need targeted funding and support before, during, and after a disaster.
3. Plan the best way to evacuate people, accounting for those who have special needs, such as people without vehicles, the elderly, or people who do not understand English well.

Office of Climate Change, Sustainability and Resiliency

O‘ahu Resilience Strategy

www.resilientoahu.org/resilience-strategy



Remaining Rooted

Bouncing Forward

Climate Security

Community Cohesion

Mahalo

RESILIENT O'AHU

Office of Climate Change, Sustainability and Resiliency

(808) 768-2277

resilientoahu@Honolulu.gov

Social Media: @ResilientOahu

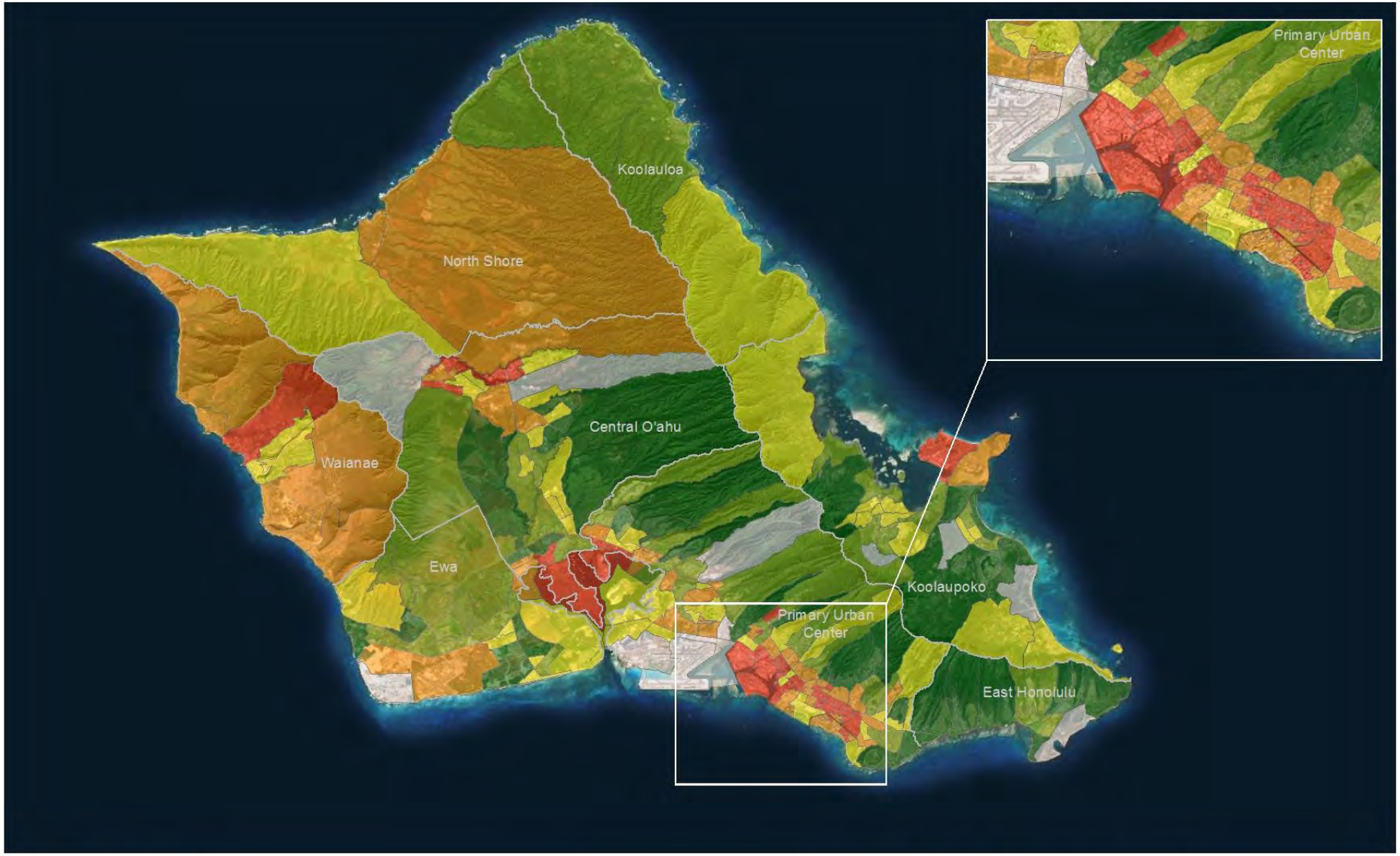
resilientoahu.org

ADDITIONAL SLIDES

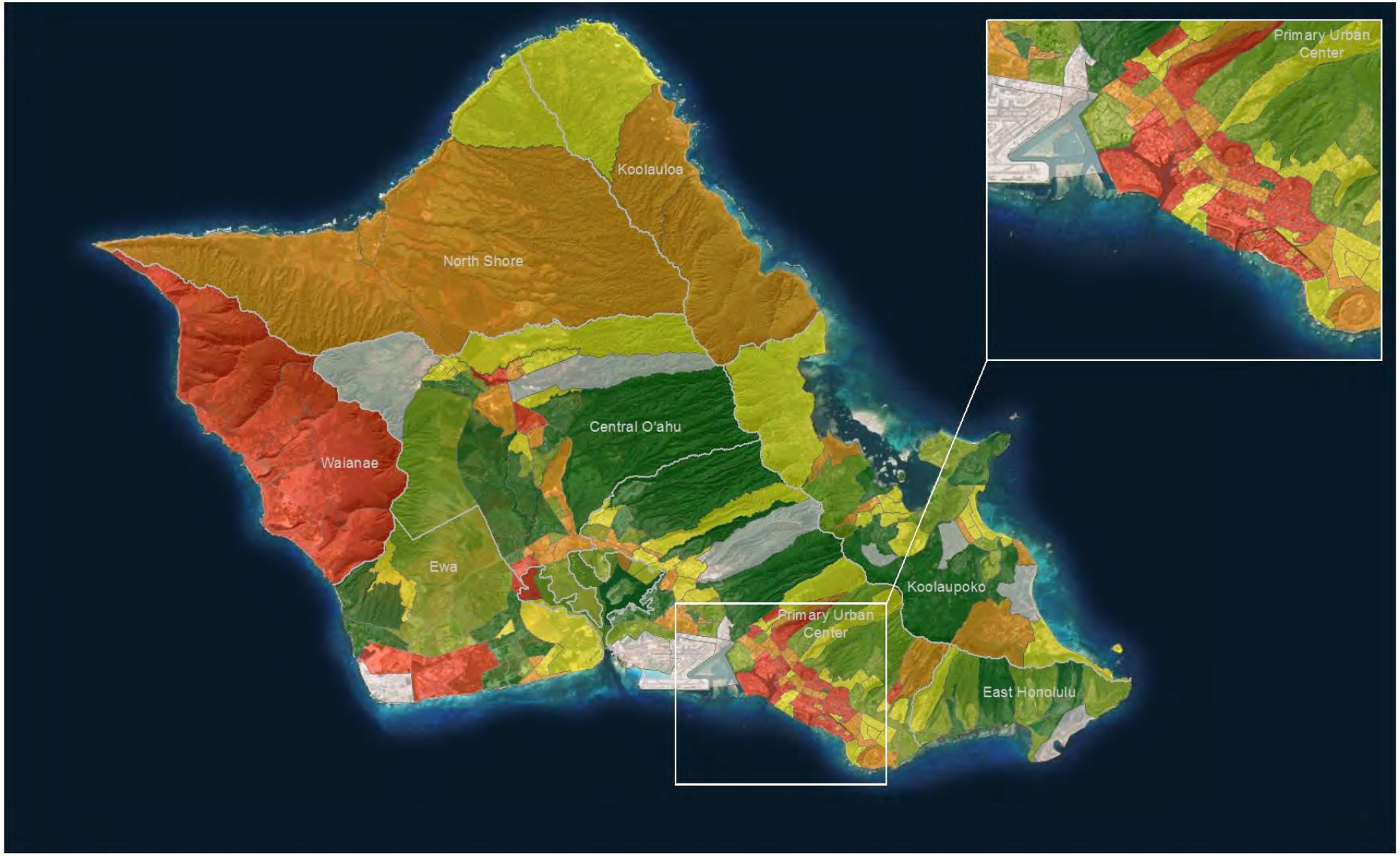
-

MAPS OF VARIABLES

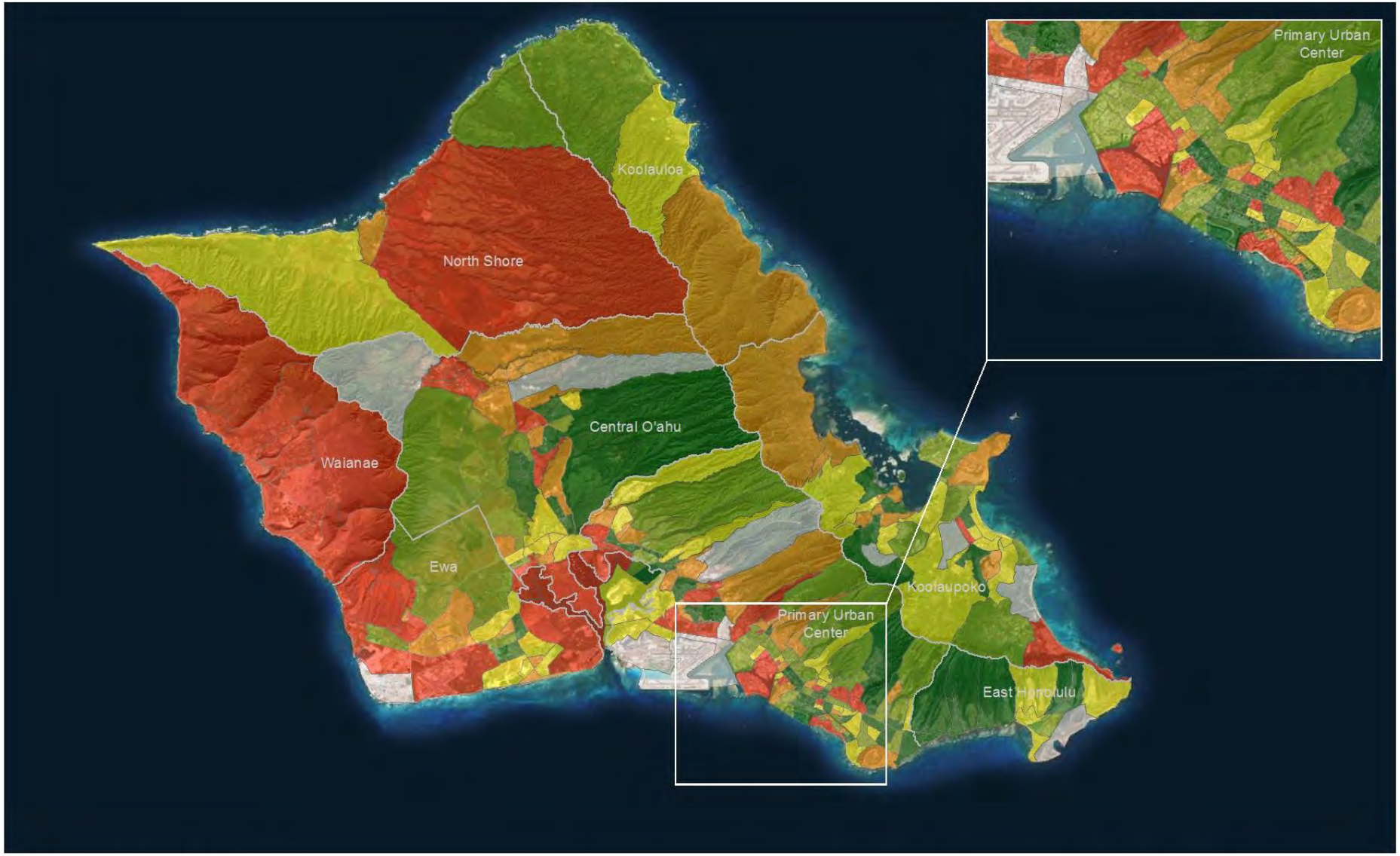
MEDIAN INCOME



POVERTY STATUS

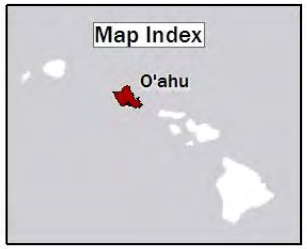


UNEMPLOYMENT RATE



Indicator: Unemployment Rate (%)

- 0.0 - 2.7
- 2.7 - 3.9
- 3.9 - 5.4
- 5.4 - 7.4
- 7.4 - 38.3
- No Data



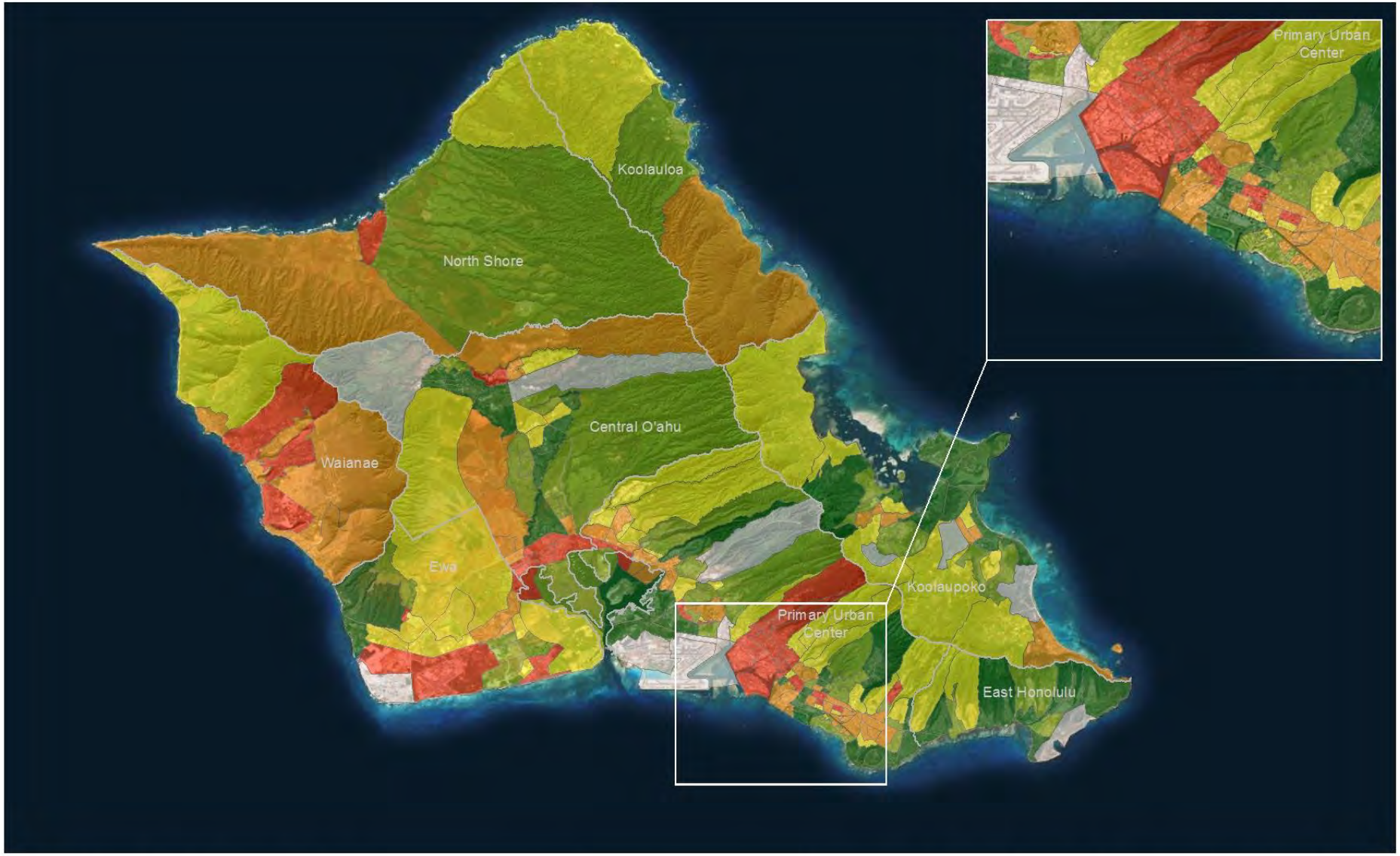
Resilient O'ahu: Unemployment Rate by Census Tract

City and County of Honolulu
Hawai'i, USA

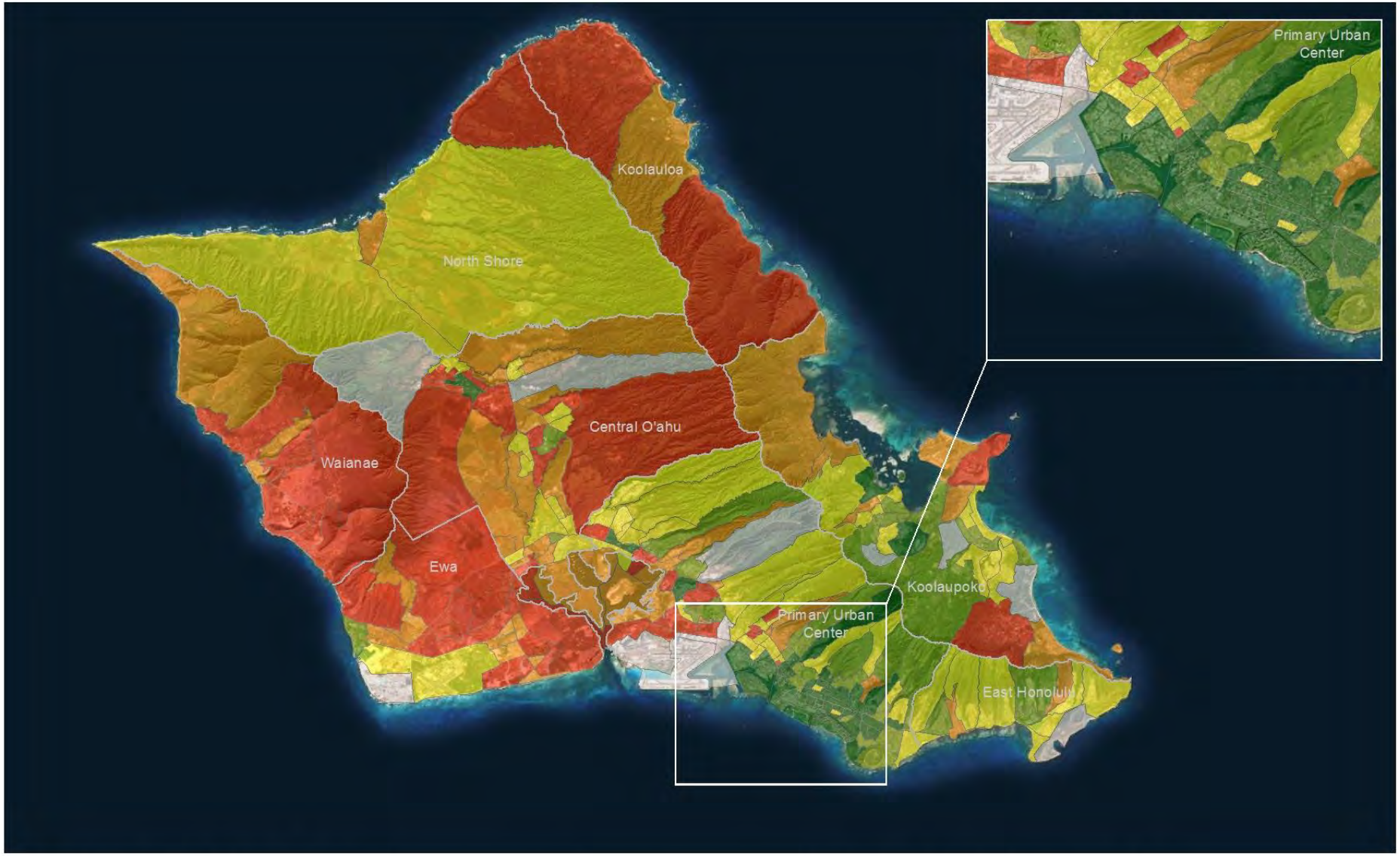
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

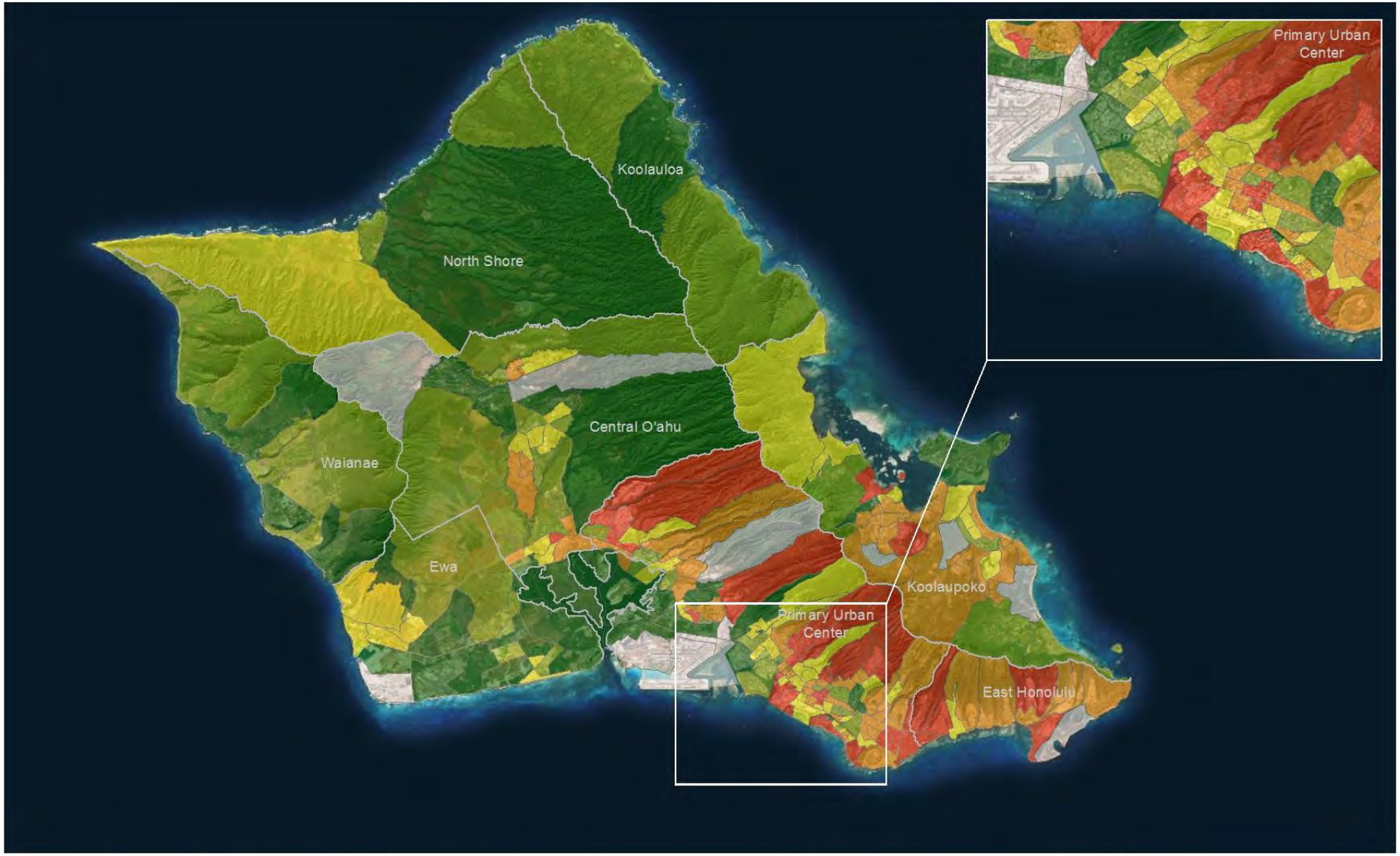
EDUCATION (NO HIGH-SCHOOL OR LESS)



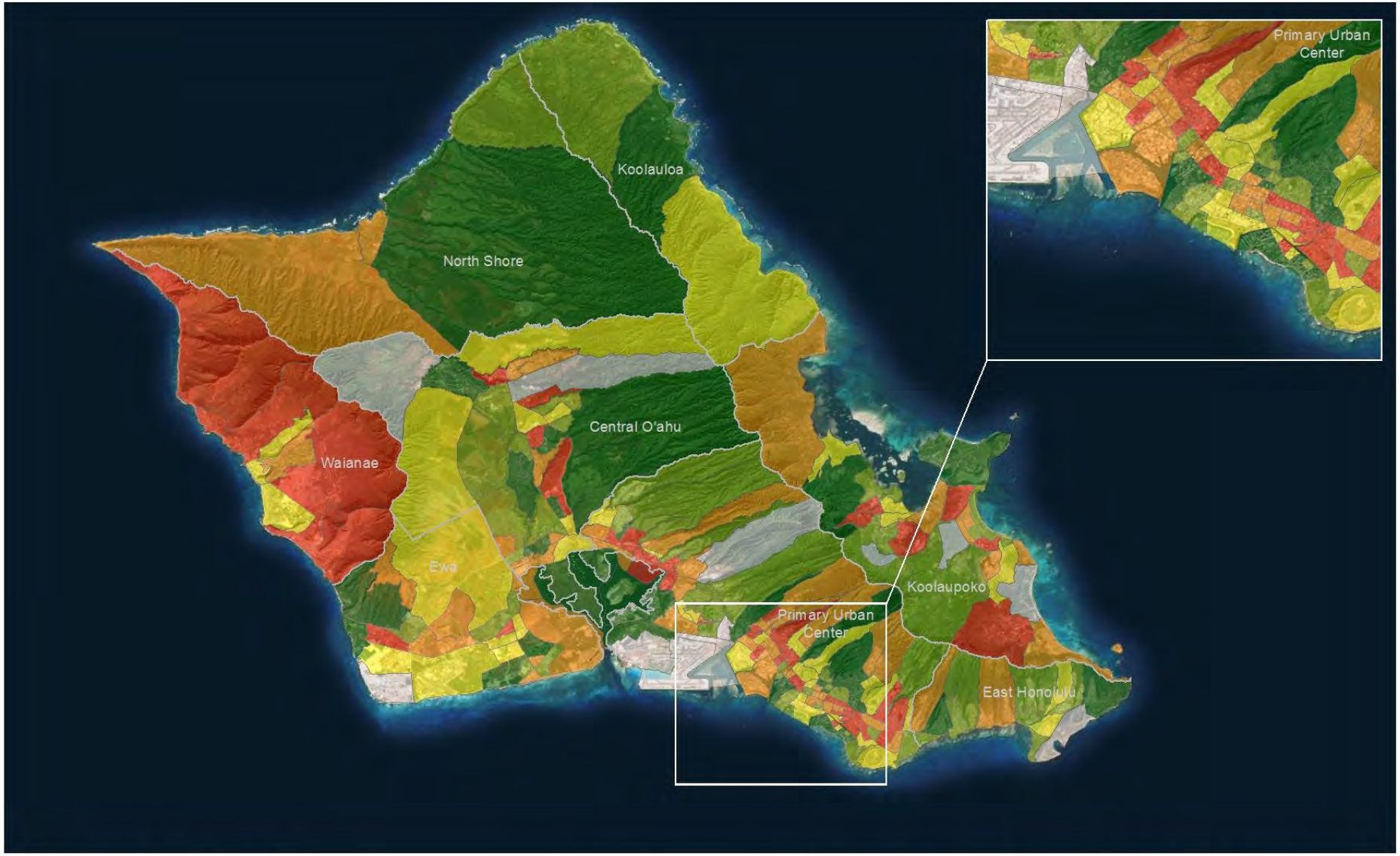
CHILDREN


Primary Urban Center
Koolauloa
North Shore
Central O'ahu
Waianae
Ewa
Koolaupoko
Primary Urban Center
East Honolulu
Indicator: Children Amongst Total Popluation (%)
0 - 15
15 - 18
18 - 22
22 - 26
26 - 51
No Data
Map Index
O'ahu
Resilient O'ahu: Children by Census Tract
City and County of Honolulu
Hawai'i, USA
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983
0 2.5 5 7.5 10
Miles

ELDERLY

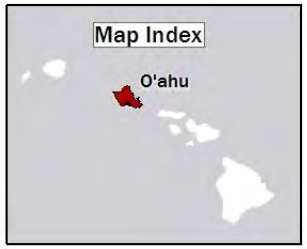

Koolauloa
North Shore
Central O'ahu
Waianae
Ewa
Koolaupoko
East Honolulu
Primary Urban Center
Primary Urban Center
Indicator: Elderly Amongst Total Population (%)
0.0 - 9.7
9.7 - 15
15 - 19
19 - 24
24 - 54
No Data
Map Index
O'ahu
Resilient O'ahu: Elderly by Census Tract
City and County of Honolulu
Hawai'i, USA
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983
0
2.5
5
7.5
10
Miles

SINGLE PARENTING



Indicator: Single Parents per 100 People

- 0.0 - 2.8
- 2.8 - 3.9
- 3.9 - 4.6
- 4.6 - 5.6
- 5.6 - 11.3
- No Data



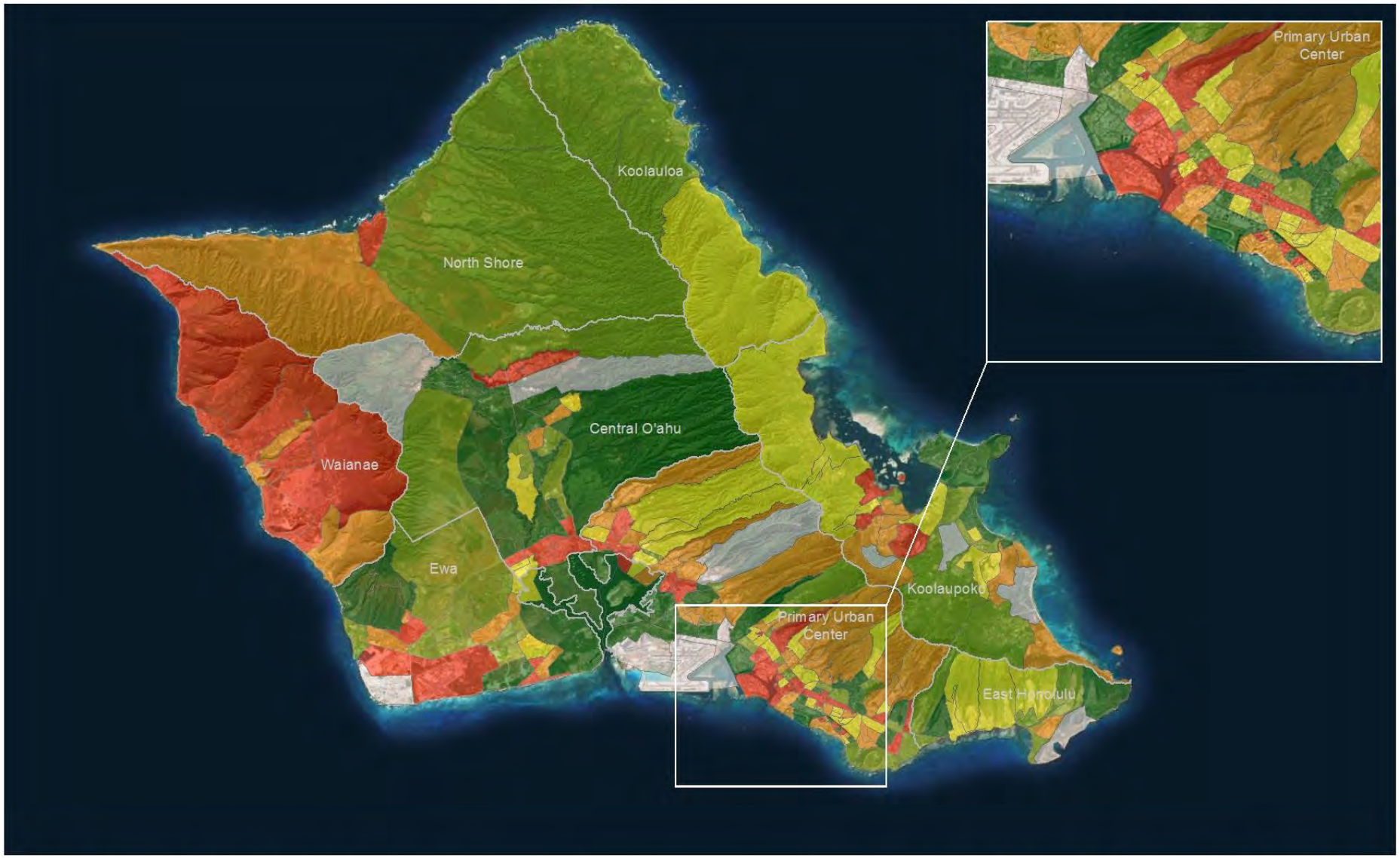
Resilient O'ahu: Single Parents per 100 People by Census Tract

City and County of Honolulu
Hawai'i, USA

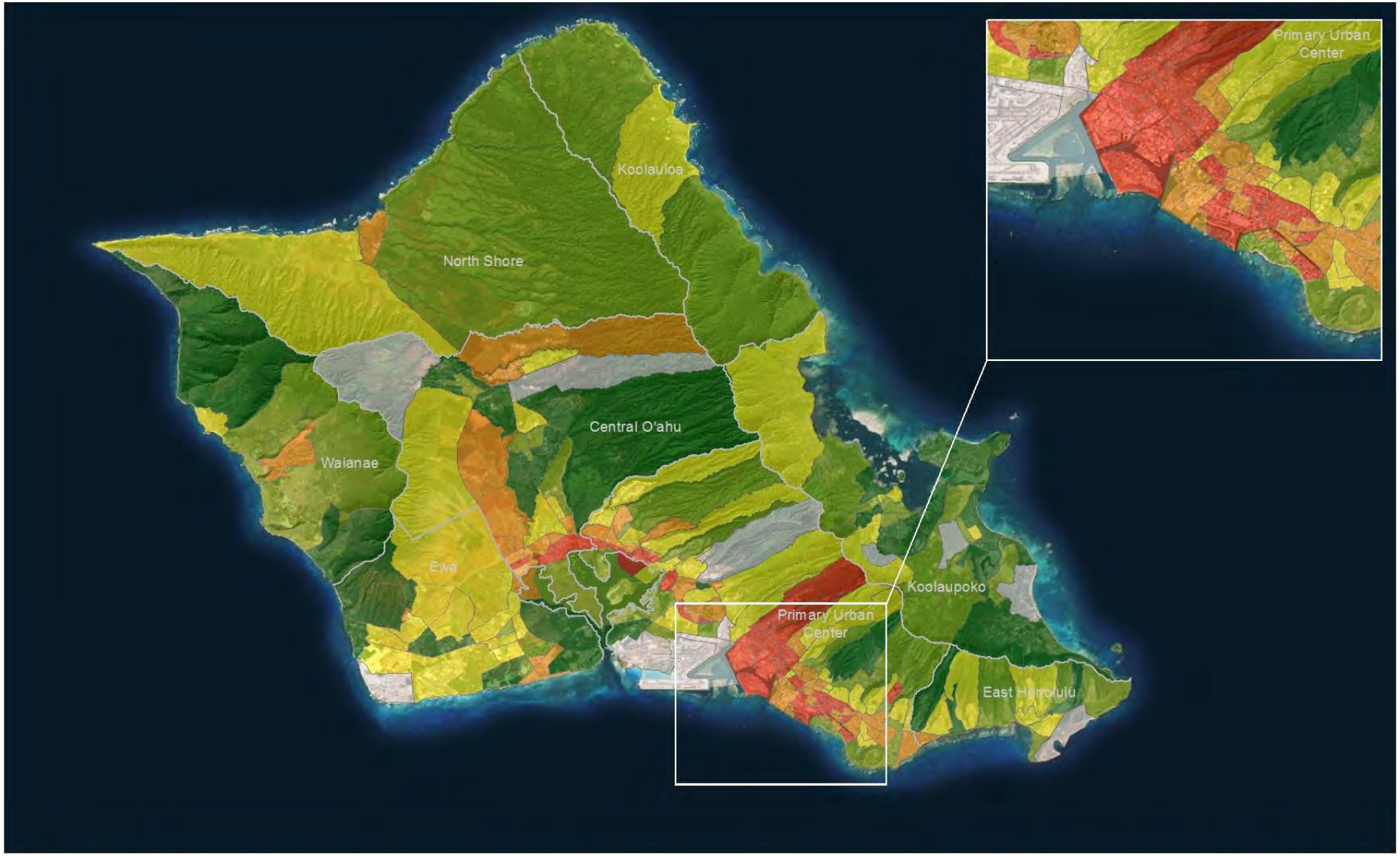
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983

0 2.5 5 7.5 10 Miles

DISABILITY


Primary Urban Center
Koolauloa
North Shore
Central O'ahu
Waianae
Ewa
Koolaupoko
Primary Urban Center
East Honolulu
Indicator: Individuals with Disabilities per 100 People
0.0 - 7.6
7.6 - 9.5
9.5 - 11.0
11.0 - 13.7
13.7 - 23.1
No Data
Map Index
O'ahu
Resilient O'ahu: Indivuduals with Disabilities per 100 People by CT
City and County of Honolulu
Hawai'i, USA
Map Date: January 11, 2019
Map Projection:
GCS_North_American_1983
0
2.5
5
7.5
10
Miles

SPEAK ENGLISH LESS THAN "VERY WELL"



NO VEHICLE AVAILABLE