Mission-Aransas Watershed Social Vulnerability Analysis

Using Principal Component Analysis as an Indexing Tool for Social Vulnerability

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EXECUTIVE SUMMARY

Climate change will impact the human communities of the Mission-Aransas National Estuarine Research Reserve, resulting in adverse impacts to local economies, development, and infrastructure. In order to improve the resiliency of communities in the Mission-Aransas Estuary watershed, adaptation strategies that address the major climate change threats must be developed. Vulnerability assessments are a key tool for developing these strategies, and they provide the necessary information for creating adaptation plans that improve resiliency. Social vulnerability to climate change is the degree to which a community is susceptible to, and unable to cope with, the adverse effects of climate change. It is a function of (1) the sensitivity of the community to climate change impacts, (2) its exposure to those changes, and (3) its adaptive capacity or resilience to the consequences. Specifically for this project, Texas Sea Grant and the Mission-Aransas Reserve collaborated on the development of a social sensitivity index for the Census block groups located in the Mission-Aransas Estuary watershed. The goal of the index is to provide communities with valuable information on their sensitivity and increase their ability to plan for and respond to upcoming environmental changes and potentially disastrous episodic events associated with climate change.

The social sensitivity index was developed by performing a Principal Component Analysis (PCA), using resulting factor scores to create a sensitivity index by Census block group, and translating the index scores into a Geographic Information System. The PCA was conducted using 36 socioeconomic, demographic, and infrastructure variables at the Census block group level. Components were chosen for inclusion in the social sensitivity index based on examination of their eigenvalues. The selected components were then evaluated to determine which attributes they broadly represented (e.g., wealth, cultural barriers) and what their influence was on overall social sensitivity (i.e., increase or decrease vulnerability). Cardinality adjustments were made (i.e., positive, negative, absolute value) as necessary to ensure that higher positive values represented higher social sensitivity and lower values represented lower social sensitivity. Factor scores were then put into an additive model and summed for each Census block group. Index scores for Census block groups were grouped into quantiles based on the additive score and were conveyed in GIS (Figure 1). This approach allows the user to identify areas of the landscape where there is uneven capacity for preparing for and responding to potential climate change impacts.

The PCA resulted in ten principal components that were included in the social sensitivity index (i.e., additive model). Principal components 1 (Age and Housing) and 2 (Demographics) explained 22 and 16 percent of the PCA variation, respectively. Variables with high loadings on Component 1 included age and housing, but variables related to the number of Hispanic individuals in the population also loaded heavily on this component. The age of housing units had the highest loading on Component 2. However, several demographic variables also had high loadings on this component, including gender, age, ethnicity, and family composition. All remaining components explained less than 10 percent of the variance and were dominated by variables that described population density, cultural barriers, wealth, natural resource dependency, Asian ethnicity, housing tenancy, social dependency, and workforce. Eight block groups resulted in social sensitivity index scores greater than 2.9. Two of these block groups are located in Aransas County, two in Refugio County, and four in Bee County (Figure 1).

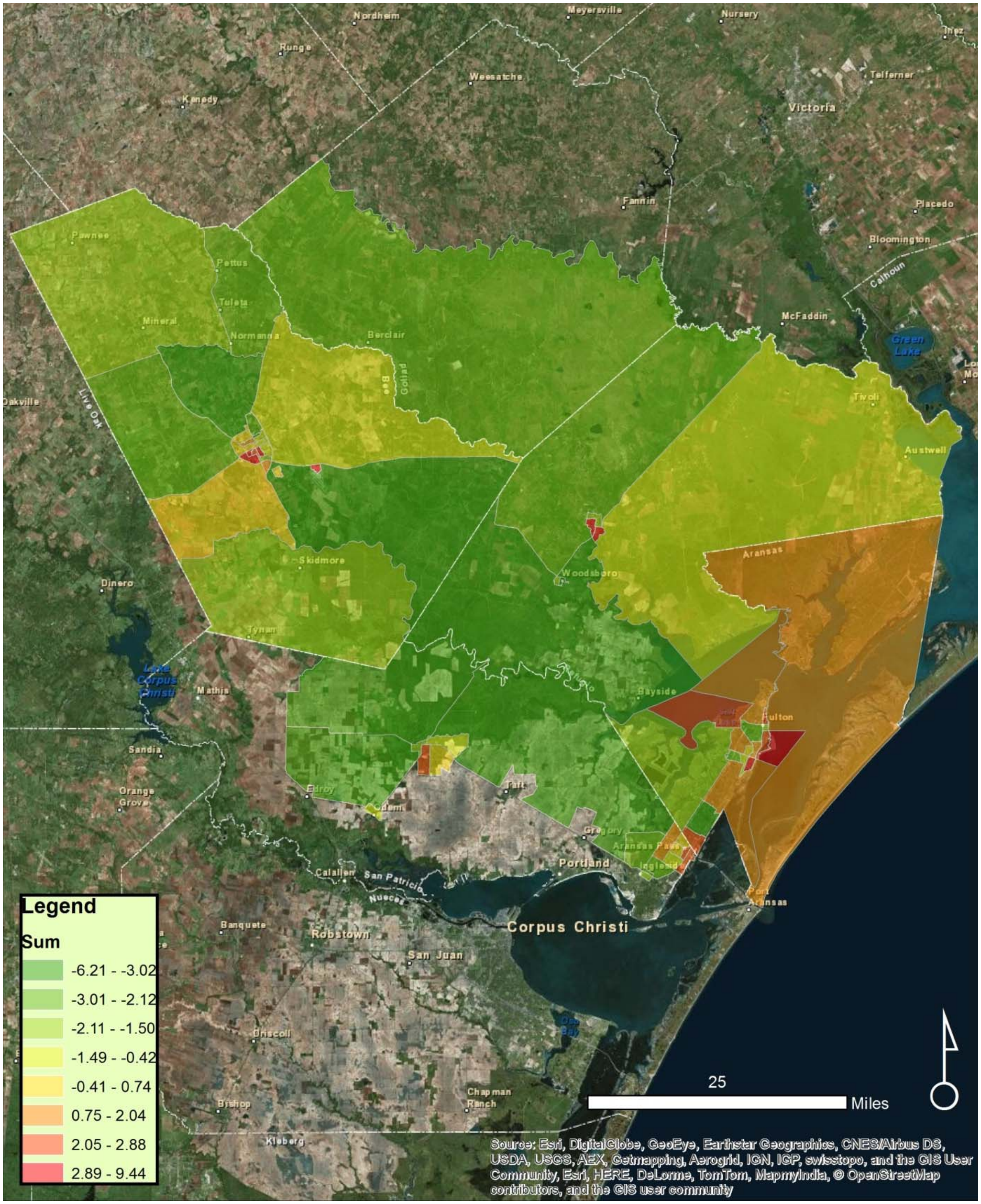

Figure 1. Social sensitivity index scores for Census block groups in the Mission-Aransas Estuary watershed. Green colors indicate block groups that are less socially sensitive and red colors indicate block groups that are more socially sensitive.

Climate change is occurring and its societal impacts are projected to expand. As a result, communities must strive to develop strategies that will allow them to adapt to the impacts of climate change that they will not be able to avoid. Planning for future environmental changes will enable local communities to reduce risks to people and infrastructure, as well as natural resources. Development of climate change adaptation plans requires the following basic steps: (1) identify and assess potential climate impacts for a specific geographic area; (2) define goals, objectives, and actions to best minimize impacts; and (3) develop an implementation strategy to meet these goals, objectives, and actions (NOAA 2010a).

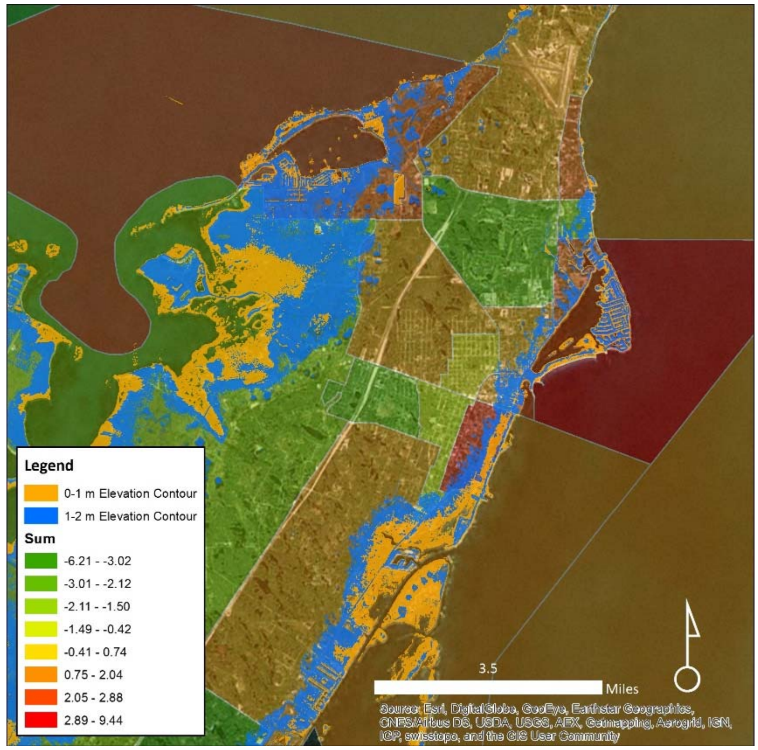

Figure 2. Map of social sensitivity index scores overlaid with 0-1 m (orange) and 1-2 m (blue) elevation contours.

This study provides an easy-to-use index that can be utilized by communities in the Mission-Aransas Estuary watershed to identify their sensitivity to environmental hazards, including climate change. Social sensitivity information can be combined with climate change exposure data to help evaluate the vulnerability of a particular location within the Mission-Aransas estuary watershed. For example, maps of elevation contours can be used to provide an indication of which coastal areas are more likely to be exposed to sea-level rise impacts. When the social sensitivity index results are overlaid with these elevation contours, it is easy to see how sea-level rise may affect several of the more socially sensitive areas within an area (Figure 2). Similarly, maps of the floodplain can be used as an indication of potential exposure to future flooding resulting from increases in the number of heavy rain events (Figure 3). Special flood hazard zones can be overlaid on the social sensitivity index

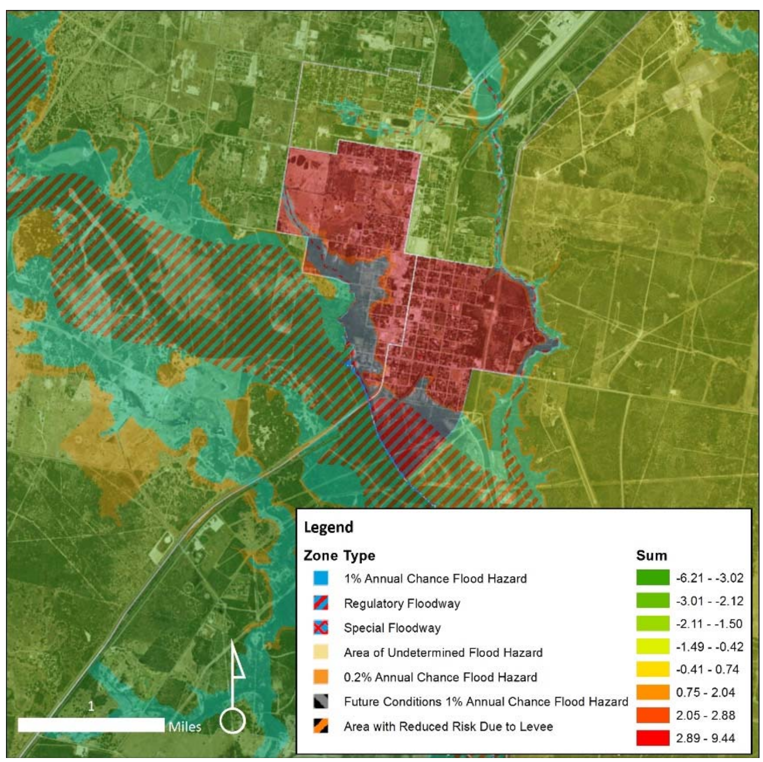

Figure 3. Map of social sensitivity index scores overlaid with special flood hazard zones.

results to indicate areas that will be more vulnerable due to their increased exposure to flooding impacts associated with heavy precipitation events and their high social sensitivity. Although GIS presents a valuable tool for combining sensitivity and exposure data, it is not always necessary for a community to have this type of information when conducting a vulnerability assessment and developing adaptation strategies. A variety of different types of exposure information could be combined with the social sensitivity index results in order to evaluate climate change vulnerability.

In order to fully understand social vulnerability, communities must go beyond examining their exposure and sensitivity, and they must also evaluate their adaptive capacity. Communities may already have plans, laws, and regulations in place that increase their ability to respond to the impacts of climate change, but in most cases, steps will need to be taken to modify existing or create new measures that increase a community's resilience to climate change. Identifying and assessing potential climate impacts for a specific geographic area will help communities as they develop adaptation strategies that reduce either their exposure and/or sensitivity to climate change impacts. The social vulnerability index developed for this project can directly assist communities in the Mission-Aransas Estuary watershed with the latter by identifying which factors make their community more or less sensitive. For example, several of the block groups in this study were identified as being more sensitive to environmental hazards due to a high number of non-English speaking individuals within the population, high levels of public assistance, and large numbers of renters and new residents. In order to increase resiliency to climate change, communities must acknowledge these inequalities in social sensitivity and prioritize the development of adaptation strategies that help those with a higher degree of sensitivity to become more resilient.

Although the development of a full climate change vulnerability assessment and adaptation plan was outside the scope of this document, the study provides valuable data about the social sensitivity of communities in the Mission-Aransas Estuary watershed. This report also provides ideas about how the data can be used in combination with information about exposure and existing plans, policies, and regulations to begin developing relevant adaptation strategies that address potential climate change hazards. Communities can use their knowledge of environmental, social, and infrastructure vulnerability with local plans and regulations to address climate hazards, develop various alternative scenarios for the future, and collectively aim towards a common vision of community functioning and sustainability in a changing environment.

INTRODUCTION

Coastal ecosystems contain a rich diversity of species and habitat types that provide many of the world's natural resources (WRI, 2000). These coastal ecosystems also support a wealth of economic activity associated with recreation and tourism, waterborne commerce, and energy and mineral production. This economic activity has been one of the driving forces behind increased population growth in coastal communities, and as the populations of coastal areas grow, the vulnerability of coastal communities and environments to natural hazards will continue to increase.

A growing body of knowledge shows that climate change poses major threats to our nation's estuaries. Impacts on coastal systems are among the most costly and most certain consequences of a warming climate (Nicholls et al., 2007). Changes in sea level, shifts in salinity and pH, changes in air and water temperature, and alterations in precipitation threaten both the health of coastal ecosystems and the resilience of the coastal communities that rely on them for so many important ecosystem services. The warming atmosphere is expected to accelerate sea-level rise due to the decline of glaciers and ice sheets and the thermal expansion of sea water. As mean sea-level rises, coastal shorelines will retreat and low-lying areas will be inundated more frequently, if not permanently, by the advancing sea. As atmospheric temperature increases and rainfall patterns change, soil moisture and runoff to the coast are likely to be altered. An increase in the intensity of climatic extremes such as storms and heat spells, coupled with other impacts of climate change and the effects of human development, could affect the sustainability of many existing coastal communities and natural resources (Burkett and Davidson, 2012).

Social vulnerability to climate change is the degree to which a community is susceptible to, and unable to cope with, the adverse effects of climate change. It is a function of (1) the sensitivity of the community to climate change impacts, (2) its exposure to those changes, and (3) its adaptive capacity or resilience to the consequences. (IPCC, 2007; Glick et al., 2011). The environmental consequences of climate change will interact with existing social stresses within communities and influence the level of societal impact (Karl et al. 2009; NOAA 2010). Societal vulnerability of U.S. coasts is comprised of the vulnerabilities of economic sectors and associated livelihoods, water resources, energy, transportation, national defense, investments in homes and other buildings, and the health and well-being of a diverse concentration of people from natives to recent immigrants and from the very poor to the tremendously wealthy. Because coastal watershed counties house a majority of U.S. cities, a significant percentage of the nation's population may be more vulnerable to impacts under climate change and face loss of jobs, supply chain interruptions, and threats to public health, safety, and well-being as a result (Burkett and Davidson, 2012).

The Mission-Aransas Estuary is located in an area known as the Texas Coastal Bend and contains open water habitats, as well several types of wetlands (freshwater, brackish, and salt marshes) and mangrove habitat. The wetland and open water habitats support benthic and nektonic populations, as well as large areas of oyster reefs. Seagrass and tidal flats are also found throughout significant portions of the Estuary. The upland areas surrounding the Estuary contain several maritime forests, coastal prairies, oak notes, and riparian woodlands. All of these habitats support endangered species and culturally and economically important species, such as shrimp, fish, and crabs (Evans et al., 2012).

The Mission-Aransas Estuary watershed can primarily be characterized as rural. However, many areas are experiencing an increase in urban development (Morehead et al., 2007), and as the human communities surrounding the Mission-Aransas Estuary continue to grow, more and more people are at risk from potential climate change impacts. These communities will be forced to deal with climate change hazards, such as more frequent droughts, hurricane force winds, coastal flooding, and sea-level rise. Social variables, including income, age and ability to speak English, will affect the ability of these communities to prepare, respond, and recover from climate change impacts when they occur. Evaluating the social sensitivity of populations living in the Mission-Aransas Estuary watershed will help communities determine which of their populations are most at risk from climate change and will improve community resiliency by allowing for better planning related to future development and infrastructure, hazards, and resource management.

To understand sensitivity to environmental hazards associated with climate change, it is important to first determine what the underlying social, cultural, and economic demographics are of the population. In 2007, the Mission-Aransas Reserve completed a *Community Characterization of the Mission-Aransas National Estuarine Research Reserve and Surrounding Areas* with assistance from the NOAA Coastal Services Center (Morehead et al., 2007). This document provides a broad-scale assessment of the social, cultural, economic and political characteristics of the Reserve and its surrounding watershed. However, this document is based on outdated U.S. Census information and did not incorporate any overall assessment of social sensitivity to environmental hazards, such as those posed by climate change. The current study expanded on the previous "community characterization" by using the most recent socioeconomic, demographic, and infrastructure data to develop an index that could be used to examine relative social sensitivity across the landscape.

METHODS

In order to assess the sensitivity of local communities to climate change, a combination of socioeconomic, demographic, and infrastructure data was used to develop a "social sensitivity index" for the Census block groups located in the Mission-Aransas Estuary watershed. The project analysis was based on the Social Vulnerability (SoVI) methodology developed by Cutter et al. (2003) and modified by Robinson et al. (2013). The SoVI uses the aggregated individual characteristics of an area's population to assess the susceptibility of communities to harm and their ability to respond (Cutter et al., 2003). The social vulnerability captured by the index is applicable to any hazard imposed on the population and, therefore, is relevant to environmental hazards associated with climate change (Robinson et al., 2013). The demographic and socio-economic data used in this study was taken from the 2006-2010 American Community Survey and the 2010 Census (Table 1). In addition to the conditions of the population, the characteristics of communities and the built environment also contribute to inequalities and social sensitivity. Therefore, Robinson et al. (2013) chose to incorporate measures of infrastructure into their social sensitivity index. The infrastructure variables were based on an analysis completed by Shepard et al. (2012) which analyzed community vulnerability with a focus on the built environment.

Both approaches result in a metric that can be used to compare relative social sensitivity across the landscape. Briefly, the methodology involves using Principal Component Analysis (or PCA) to reduce the number of social, cultural, economic, and infrastructure variables into principal components with factor scores that can be monitored over time to assess any changes in overall sensitivity. The factor scores are then placed in an additive model to produce a composite social sensitivity score for each geographic area of interest (e.g., county, Census block group). By using an additive model, no a priori assumptions have to be made about the importance of each factor in the overall score, and each factor is viewed as having an equal contribution to the overall sensitivity. Cutter et al. (2003) suggest this approach when there is no defensible method available for assigning weights.

For the purpose of this study, the PCA was conducted using 36 socioeconomic, demographic, and infrastructure variables at the Census block group level (Table 1). Excel and XLStat were used to perform all statistical analyses.

The Pearson method was used for the PCA, and a varimax rotation was applied to better identify the principal components. Components were chosen for inclusion in the additive model based on examination of their eigenvalues, with values greater than 1.0 being incorporated into the index. The selected components were then evaluated to determine which attributes they broadly represented (e.g., wealth, cultural barriers) and what their influence was on overall social sensitivity (i.e., increase or decrease vulnerability). Cardinality adjustments were made (i.e., positive, negative, absolute value) as necessary to ensure that higher positive values represented higher social sensitivity and lower values represented lower social sensitivity (Table 2). Factor scores were then put into an additive model and summed for each Census block group.

Index scores for Census block groups are grouped into multiple categories (i.e., quantiles) based on the additive score and are conveyed in GIS. This approach allows the user to identify areas of the landscape where there is uneven capacity for preparing for and responding to potential climate change impacts. When developing adaptation plans, social sensitivity index maps can be used in conjunction with additional map layers (e.g., flood plain, sea-level rise projections, predicted temperature and precipitation) to examine the overlap between the most socially sensitive areas and potential future climate change hazards.

Table 1. Variables used in study (adapted from Robinson et al, 2013)

Variable Name	Description	Reason	Increase or Decrease Sensitivity
Less than high school education	Percentage of population over age 25 less than high school educated	Lower education level correlates with poverty and limited access to resources and infrastructure, thereby indicating higher potential need for assistance	+
Non-English speaking	Percentage of the population whose primary language is not English	Imposes language and cultural barriers that affect access to post-disaster funding and residential locations in high hazard areas. Constrains the ability to understand warning information and access to recovery information	+
Limited English proficiency	Percentage of the population that speak English less than very well	Imposes language and cultural barriers that affect access to post-disaster funding and residential locations in high hazard areas. Constrains the ability to understand warning information and access to recovery information	+
Below poverty	Percentage of the people or families that are below the poverty level	Individuals living below the poverty rate have limited access to resources and infrastructure, thereby indicating higher potential need for assistance	+
Rich households	Percentage of households earning greater than $200,000 annually	The ability to absorb losses and enhance resilience to hazard impacts; wealth enables communities to absorb and recover from losses more quickly due to insurance, social safety nets	-

Variable Name	Description	Reason	Increase or Decrease Sensitivity
Median income	Median income of all individuals (age 16+) in the household	Wealthy communities have more assets that can be used to absorb or recover from hazards	-
Social security receipt	Percentage of households receiving Social Security	Those people who are totally dependent on social services for survival are already economically and socially marginalized and require additional support in the post-disaster period	+
Public assistance	Percentage of households supported by public assistance	Vulnerable population that require additional assistance related to a disaster	+
Per capita income	Total income divided by the size of the population	Wealthy communities have more assets that can be used to absorb or recover from hazards	-
Female labor force participation	Percentage of female population in the labor force	Women can have a more difficult time during disaster recovery than men, often due to sector-specific employment, lower wages, and family care responsibilities	+
Not working	Percentage of working-age population (age 16-64) who did not work in the past 12 months	May lower the community's preparedness and resilience thereby exacerbating potential losses	+
Mobile homes	Percentage of households that live in mobile homes	Reflects housing quality; mobile homes can be more easily destroyed by hazards	+
Housing unit year built	Median year home was built	Newer housing units are usually less sensitive to damage from hazards	+
Without vehicle	Percentage of households without a vehicle	Lack of vehicle can limit mobility in a disaster scenario	+
Median gross rent	Median rental rate	Reflects housing quality; higher cost rental units are more likely to be insured and less likely to be compromised structures	-
Median house value	Median value of owned homes	Proxy for assets and the quality of housing stock, which affect potential losses and recovery	-
Length of residency	Percentage of population residing in home for less than one year	Less likely to have experienced a disaster in current location and are less familiar with local resources	+
Employment in service industry rate	Percentage of population employed in professional, scientific, management, administrative, education, arts and other services	Workers engaged in some service jobs may suffer following disasters as communities devote resources towards disaster recovery	+

Variable Name	Description	Reason	Increase or Decrease Sensitivity
Employment in extractive industry	Percentage of civilian population (age 16+) employed in agriculture, forestry, fishing, hunting, and mining (i.e., extractive industries)	These industries are dependent on natural resources and may be severely impacted by climate change hazards	+
Population density	Number of people per square mile	Highly populated areas may require additional infrastructure and assistance to react to both climate change impacts and disasters (e.g., flooding from sea-level rise)	+
Housing density	Number of housing units per square mile	Captures the infrastructure at risk and reflects both permanent and seasonal residency	+
Renter occupied housing units	Percentage of occupied housing units designated as rental units	Reflects housing quality; renter occupied housing units are less likely to be insured and more likely to be compromised structures	+
Seasonal housing units	Percentage of vacant housing units designated as seasonal	Vacant home may be less prepared for disaster, and if occupied, vacationers are less likely to have experienced a disaster in current location and are less familiar with local resources	+
Renters	Percentage of occupied housing units designated as rental units	Reflects housing quality; renter occupied housing units are less likely to be insured and more likely to be compromised structures	+
Persons per occupied housing unit	Number of persons per occupied household	Overcrowded living conditions may require additional infrastructure and assistance to react to both climate change impacts and disasters (e.g., flooding from sea-level rise)	+
Hispanic	Percentage of the population who listed their race and ethnicity as Hispanic or Latino	May be more vulnerable due to racial disparity-induced social, economic, and political marginalization	+
Non-Hispanic white	Percentage of the population who listed their race and ethnicity as non-Hispanic White	May be less vulnerable due to racial disparity-induced social, economic, and political marginalization	-
Asian	Percentage of the population who listed their race and ethnicity as non-Hispanic Asian	May be more vulnerable due to racial disparity-induced social, economic, and political marginalization	+

Variable Name	Description	Reason	Increase or Decrease Sensitivity
Black	Percentage of population who listed their race and ethnicity as non-Hispanic Black	May be more vulnerable due to racial disparity-induced social, economic, and political marginalization	+
Age 5 and under	Percentage of population 5 years of age or younger	Dependents are usually socially and economically marginalized and may require additional assistance in emergency situations	+
Age 65 and over	Percentage of population 65 years of age or older	Dependents are usually socially and economically marginalized and may require additional assistance in emergency situations	+
Female	Percentage of the population that are female	Women are more susceptible to sector-specific employment, lower wages, and family care responsibilities, thereby increasing potential vulnerability	+
Median Age	Median age of population	Extremes of the age spectrum are usually socially and economically marginalized and may require additional assistance in emergency situations	+
Single parent	Percentage of households headed by single parent	Single parents may be the sole provider of childcare and household income, thereby increasing potential vulnerability	+
Married couple families with children	Percentage of children living in households with married couples	Dependents are usually socially and economically marginalized and may require additional assistance in emergency situations	+
Senior group quarters	Percentage of the population 65 and over living in group quarters	Dependents are usually socially and economically marginalized and may require additional assistance in emergency situations	+

Results

Principal Component Analysis

The PCA resulted in ten principal components with an eigenvalue greater than one (Table 2). Principal components 1 and 2 explained 22 and 16 percent of the PCA variation, respectively. Variables with high loadings on Component 1 included age and housing, but variables related to the number of Hispanic individuals in the population also loaded heavily on this component. The age of housing units had the highest loading on Component 2. However, several demographic variables also had high loadings on this component, including gender, age, ethnicity, and family composition. All remaining components explained less than 10 percent of the variance and were dominated by variables that described population density, cultural barriers, wealth, natural resource dependency, Asian ethnicity, housing tenancy, social dependency, and workforce.

Table 2. Principal components and dominant variables

Principal Component	Name	Cardinality	Percent Variation Explained	Dominant Variables (Component Loading)
1	Age and Housing	+	22	Median age (0.905) Persons per occupied housing unit (-0.877) Age 65 and over (0.857) Seasonal housing units (0.842) Percent Hispanic (-0.839) Percent non-Hispanic white (0.828) Age 5 and under (-0.74)
2	Demographic	+	16	Housing unit year built (-0.969) Percent female (-0.947) Senior group quarters (0.883) Percent black (0.78) Married couple families with children (0.771)
3	Density	+	6	Housing density (0.876) Population density (0.622)
4	Cultural Barriers	+	5	Percent mobile homes (-0.597) Non-English speaking (0.519)
5	Wealth	-	9	Median income (-0.774) Per capita income (-0.714) Rich households (-0.682) Median house value (-0.673) Below poverty (0.577)
6	Natural Resource Dependent	+	5	Employment in extractive industry (-0.815) Employment in service industry (0.648)
7	Asian	+	4	Percent Asian (-0.803) Median gross rent (-0.639)
8	Tenancy	+	8	Renter occupied housing (0.775) Renters (0.769) Single parent (0.56) Length of residency (0.527)
9	Socially Dependent	+	5	Public assistance (0.844) Limited English proficiency (0.498)
10	Workforce	+	4	Percent not working (0.786) Female labor force participation (-0.702)

Table 3 on the next page provides the factor scores and the composite social sensitivity index value (i.e., additive model) for each block group included in the analysis. It is important to note that scores in the table are relative, meaning that index scores for a Census block group can only be compared to other Census block groups included in this analysis. To better understand social sensitivity across the landscape, GIS was used to map index scores for every block group (Figure 1).

Table 3. Component scores and social sensitivity index (SSI) value by block group.

Geoid	County	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	SSI
480259502011	Bee County	-0.152	7.886	0.199	0.164	0.471	0.3	0.247	0.706	-0.45	0.073	9.444
480079504001	Aransas County	1.398	-0.342	0.862	-0.081	1.326	-0.741	0.698	2.421	2.932	0.157	8.63
483919502003	Refugio County	0.927	0.26	-0.254	1.572	1.5	0.102	0.11	1.146	0.838	0.927	7.128
483919502004	Refugio County	0.518	-0.005	-1.435	1.382	1.158	0.61	0.812	1.489	1.686	0.846	7.062
480259505005	Bee County	-0.68	-0.151	1.389	2.49	1.319	1.534	1.048	-1.037	0.297	0.394	6.604
480079502001	Aransas County	2.648	-0.108	2.951	0.73	-5.201	0.753	2.147	-0.305	0.589	1.285	5.49
480259505002	Bee County	-1.197	0.056	0.077	1.437	-0.412	0.456	0.988	-0.744	2.089	0.44	3.191
480259505003	Bee County	-0.714	-0.838	2.371	-0.138	1.524	-2.216	0.564	0.92	0.147	1.291	2.91
480259505004	Bee County	-1.307	-0.534	1.207	1.08	0.746	-0.08	-0.071	0.023	-0.611	2.432	2.884
480079505003	Aransas County	0.786	-0.225	-0.158	-1.081	1.274	1.188	1.229	-0.304	0.472	-0.4	2.782
484090102013	San Patricio County	0.176	-0.221	1.657	-0.636	0.663	-0.634	0.364	0.719	0.448	0.201	2.736
480079501005	Aransas County	1.935	-0.259	0.774	-0.632	0.967	0.297	0.578	0.043	-0.518	-0.76	2.425
480079502002	Aransas County	2.168	-0.294	-0.012	0.406	0.089	1.215	-0.099	0.098	-0.96	-0.241	2.369
484090102012	San Patricio County	1.983	0.033	0.77	0.567	0.104	-0.286	0.645	0.913	-0.256	-2.201	2.274
480079501002	Aransas County	1.577	0.083	-0.116	-0.769	-0.407	0.89	0.332	-0.258	0.211	0.631	2.173
484090110004	San Patricio County	-1.23	-0.272	-0.304	1.346	0.237	0.392	-0.282	0.166	1.899	0.129	2.081
480079501001	Aransas County	2.146	-0.242	-0.696	-0.146	0.616	-0.162	0.43	-0.117	-0.495	0.705	2.04
480079501003	Aransas County	1.149	-0.398	-0.512	-0.76	0.422	1.783	0.215	-0.138	-0.613	0.675	1.823
480259503005	Bee County	-0.696	-0.396	1.686	1.604	1.184	0.714	-0.24	-0.086	-0.628	-1.686	1.456
480079503002	Aransas County	0.954	-0.099	0.38	-0.368	-0.286	0.188	0.193	0.639	-0.98	0.813	1.433
480259505001	Bee County	-1.854	0.052	0.975	-2.78	0.232	0.536	0.566	2.612	-1.7	2.611	1.252
484090102022	San Patricio County	0.237	-0.17	-0.88	-1.073	0.447	1.505	0.076	-0.043	0.428	0.516	1.044
480079505001	Aransas County	1.018	-0.193	-0.381	-0.001	0.499	1.024	0.058	-0.789	-0.304	-0.038	0.893
480079503003	Aransas County	0.28	-0.128	0.272	-1.193	0.98	0.66	-0.41	-1.454	1.702	0.145	0.852
484090102023	San Patricio County	-0.017	0.344	0.288	0.569	-0.147	-0.175	-0.129	0.032	-0.01	-0.017	0.738
480079503004	Aransas County	-0.05	0.017	0.554	-2.09	0.645	1.219	0.381	-0.415	0.409	0.051	0.722
484090102021	San Patricio County	-0.758	-0.483	0.211	-0.465	0.226	0.028	-0.367	0.581	1.641	-0.068	0.545
480259504001	Bee County	-0.414	-0.298	-0.799	0.944	-0.425	0.431	0.451	1.31	-0.687	-0.473	0.04
480259502021	Bee County	-0.585	-0.032	-0.573	0.262	0.142	-0.155	0.718	-1.187	0.595	0.808	-0.006
480259503001	Bee County	-0.692	-0.313	-0.317	1.004	0.185	1.261	-0.373	0.03	-0.432	-0.377	-0.024
484090110001	San Patricio County	-1.182	-0.232	-0.026	0.579	0.33	0.856	0.119	-1.149	0.945	-0.633	-0.393
480259505006	Bee County	-0.946	0.04	-0.12	0.483	-0.29	0.258	-0.605	1.604	-0.064	-0.784	-0.425
484090102011	San Patricio County	0.036	-0.354	-1.063	-0.217	-0.607	0.514	-0.086	1.054	-0.209	0.479	-0.454
483919504002	Refugio County	0.506	-0.258	-0.877	1.355	1.26	-1.893	0.789	-0.707	-1.218	0.344	-0.7
480259504002	Bee County	-0.756	-0.195	0.911	0.669	-0.018	0.746	-0.293	-0.096	-1.258	-0.702	-0.992

Table 3. Component scores and social sensitivity index (SSI) value by block group.

Geoid	County	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10	SSI
480079504002	Aransas County	-0.31	0.112	0.405	0.145	0.275	1.153	-0.521	-1.12	-0.035	-1.098	-0.993
484090110002	San Patricio County	-0.447	-0.268	-1.59	1.058	-0.409	-0.137	-0.645	1.542	0.008	-0.15	-1.037
484090111001	San Patricio County	-1.761	0.016	0.264	1.213	-1.453	1.253	-0.333	-1.317	-0.02	1.037	-1.101
480259502022	Bee County	0.191	-0.036	-0.551	-0.251	0.504	-2.077	-0.107	-0.952	-0.414	2.481	-1.214
480259503003	Bee County	-0.659	-0.111	0.63	0.592	-0.875	-0.23	0.322	0.236	-1.025	-0.175	-1.294
483919504003	Refugio County	-0.137	-0.06	1.367	-0.071	0.869	-0.352	-0.179	-0.93	-0.727	-1.281	-1.501
484090103012	San Patricio County	-0.595	-0.128	0.49	-0.459	-1.026	-0.576	-0.203	0.256	0.619	-0.006	-1.627
483919502002	Refugio County	-0.193	0.21	-0.221	0.201	-0.116	0.234	0.107	-0.418	-0.515	-0.947	-1.657
480259501002	Bee County	0.529	-0.092	-0.636	0.254	0.488	-0.69	0.4	-0.784	-1.111	-0.141	-1.782
480079501004	Aransas County	1.491	0.113	0.689	0.738	-0.128	-0.489	-4.89	0.172	0.165	0.339	-1.8
480259506001	Bee County	-0.386	-0.03	-0.792	0.238	0.005	-0.336	0.361	-1.029	-0.686	0.809	-1.845
480259505007	Bee County	-0.828	-0.42	1.363	-0.721	0.327	-1.22	0.69	1.771	-1.052	-1.77	-1.86
480079505004	Aransas County	0.461	0.022	-0.972	-2.119	0.298	0.28	0.104	-0.633	-0.132	0.771	-1.921
484090110003	San Patricio County	-0.927	0.412	-0.119	-0.036	-1.123	-1.942	-1.073	0.123	2.729	-0.013	-1.968
480259502024	Bee County	-0.453	-0.339	-1.091	-0.128	0.473	1.177	-0.503	-0.736	-0.877	0.361	-2.117
480079504003	Aransas County	0.112	-0.135	0.494	-1.011	0.624	0.92	-1.004	-0.961	-0.214	-0.983	-2.157
484090103011	San Patricio County	-0.509	0.228	-0.435	-0.911	-1.361	-0.118	-0.642	-0.287	2.613	-0.799	-2.223
480259501001	Bee County	-0.304	-0.23	-0.845	-1.061	0.566	-0.256	-0.422	-0.463	-0.302	0.831	-2.487
480079503001	Aransas County	1.864	-0.003	-0.095	0.598	-0.507	-0.425	-4.268	0.117	-0.381	0.582	-2.518
481759602002	Goliad County	0.727	-0.056	-1.283	1.868	0.265	-2.43	1.4	-0.486	-0.852	-1.67	-2.518
480259503002	Bee County	-0.803	-0.88	-1.626	0.45	-1.498	1.256	-0.058	2.597	-1.214	-0.77	-2.546
483919502001	Refugio County	0.348	-0.032	-0.836	0.168	-0.489	-2.596	0.995	-0.55	-0.478	0.797	-2.674
484090103013	San Patricio County	-0.872	-0.458	-1.378	-0.265	-0.92	0.69	-0.415	2.073	-0.543	-0.635	-2.723
483919504004	Refugio County	-0.686	-0.003	0.077	-0.595	-0.622	-1.224	-0.755	0.323	-0.306	0.77	-3.021
484090109001	San Patricio County	-0.484	0.086	-0.397	-0.824	0.313	-0.103	0.024	-1.708	0.534	-0.55	-3.109
483919504001	Refugio County	0.536	-0.093	-0.982	-0.292	-0.21	-1.281	-0.181	-0.721	-0.301	0.28	-3.245
480259502023	Bee County	-0.057	0.414	-0.76	0.106	-1.924	-0.433	0.154	-0.787	-0.483	0.113	-3.656
480079505002	Aransas County	0.376	0.081	-0.529	-2.06	-0.348	-0.857	0.54	0.419	1.41	-2.799	-3.767
484090109002	San Patricio County	-0.948	0.007	-0.671	-0.883	-0.716	0.058	0.263	-1.444	-0.125	0.187	-4.272
484090107001	San Patricio County	-0.64	0.106	-1.08	-0.128	-1.164	-0.537	0.819	-0.474	-0.774	-0.547	-4.418
480259503004	Bee County	-1.23	-0.093	2.973	-0.879	-0.306	-0.79	-1.138	-0.861	-1.251	-1.187	-4.763
480259502013	Bee County	-0.617	-0.071	-0.875	-1.147	-0.565	-1.041	0.353	-0.642	-0.195	-1.409	-6.209

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Eight block groups resulted in social sensitivity index scores greater than 2.9. Two of these block groups are located in Aransas County, two in Refugio County, and four in Bee County (Table 4, Figure 1). In order to determine what variables contribute to the social sensitivity in these communities, it is helpful to look at the components with the highest loadings that contribute most to social sensitivity. Table 4 provides a summary of the components and variables which most contributed to the high index values for the eight most vulnerable block groups. Maps of each of these variables are provided in the Appendix.

Table 4. Results for most socially sensitive block groups within the Mission-Aransas Estuary watershed.

Geoid	County	Principal Components with High Loadings	Major Vulnerability	Index Score
480259502011	Bee	2, 8	Ethnicity, Families with Children, Renters	9.44
480079504001	Aransas	8,9	Public Assistance, Renters	8.63
483919502003	Refugio	4,8	Non-English Speaking, Renters	7.13
483919502004	Refugio	4,8,9	Non-English Speaking, Poverty, Renters	7.06
480259505005	Bee	4,6	Non-English Speaking, Employment in Service Industry	6.6
480079502001	Aransas	1,3	Age, Percent over 64, Housing Density	5.49
480259505002	Bee	4,9	Non-English Speaking	3.19
480259505003	Bee	3,5	Income and Poverty	2.91

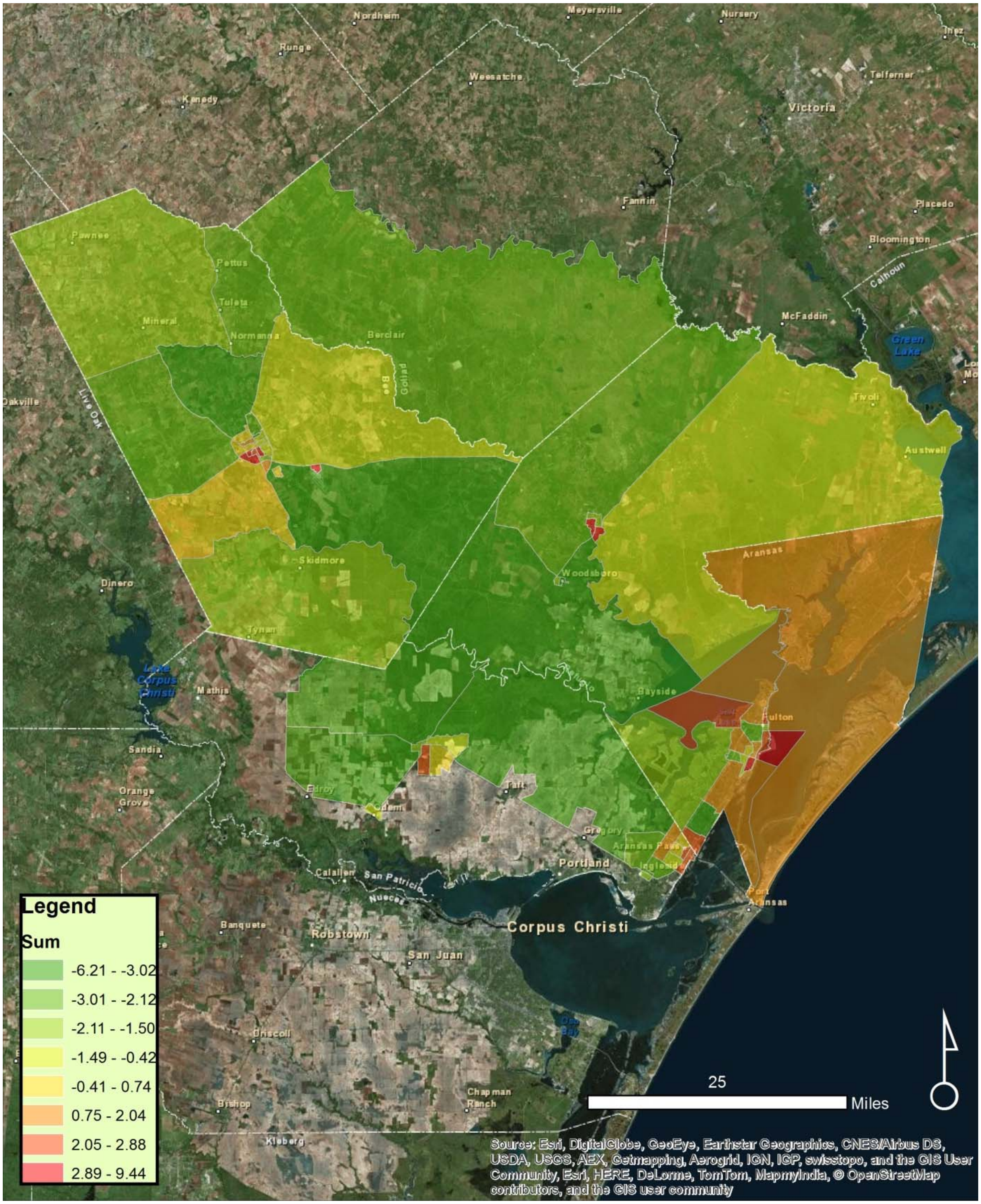
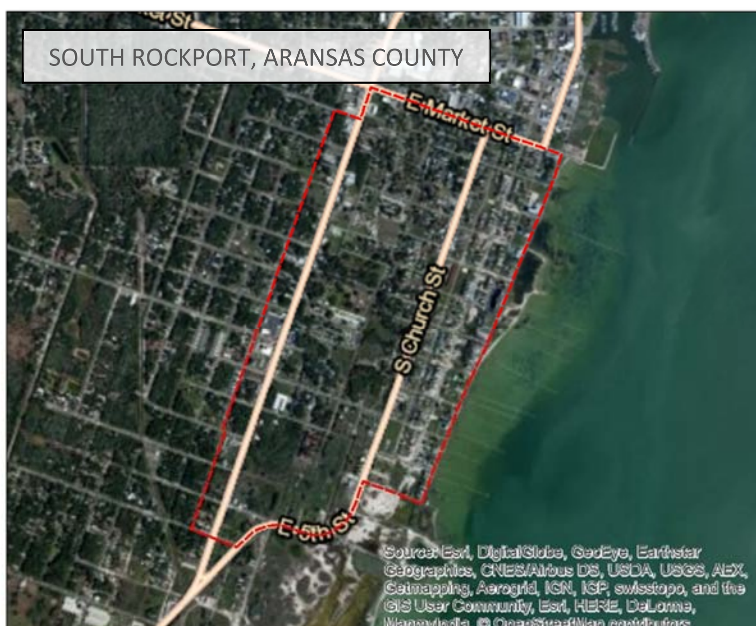


Figure 1. Social sensitivity index scores for Census block groups in the Mission-Aransas Estuary watershed. Green colors indicate block groups that are less socially sensitive and red colors indicate block groups that are more socially sensitive.

Chase Field Criminal Justice Center, Bee County

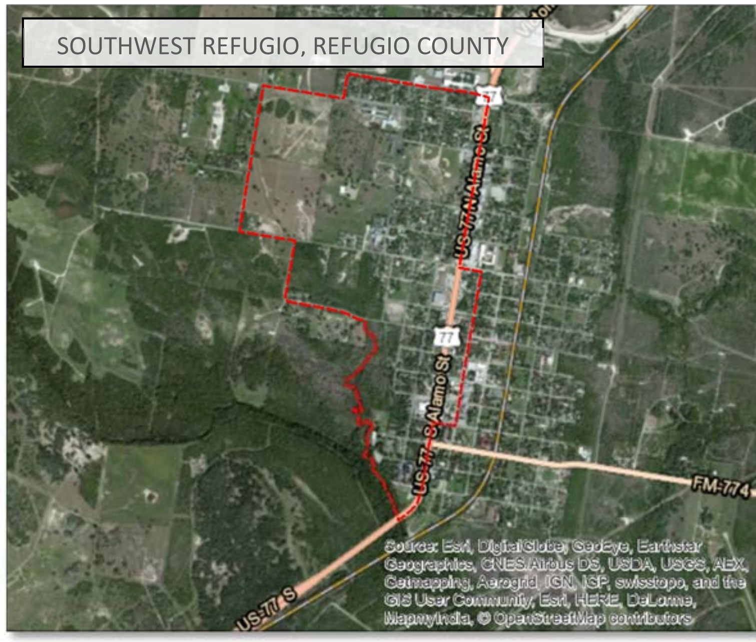
Component 2 has the highest loading for Block Group 480259502011 located in Bee County. The Chase Field Criminal Justice Center is located in this block group. The Center includes two correctional transfer units that temporarily house adult male inmates. When looking at the variables that load highly on Component 2, we see that percent black and percent married individuals with children are the most likely factors that contribute to the social sensitivity of this particular block group - 26% of the population is black and 62% are married individuals with children. Other variables that load heavily on Component 2 include percentage of population that is female, senior group quarters, and housing unit year built, but none of these variables contribute to social sensitivity for this particular block group. The second strongest component for this block group was Component 8, which includes renter-occupied housing, renters, single parents, and length of residency. Renters occupy 92% of housing units in this block group, renters make up 93% of the population, and 65% of individuals have been residents for less than one year. The percentage of single parents is low and does not likely contribute to sensitivity for this block group. When interpreting the results for this particular block group, it is important to remember that the socio-economic data was gathered from inmates residing at a temporary correctional facility. Therefore, special consideration will need to be taken when applying the concept of social sensitivity to adaptation planning for this particular area.

South Rockport, Aransas County



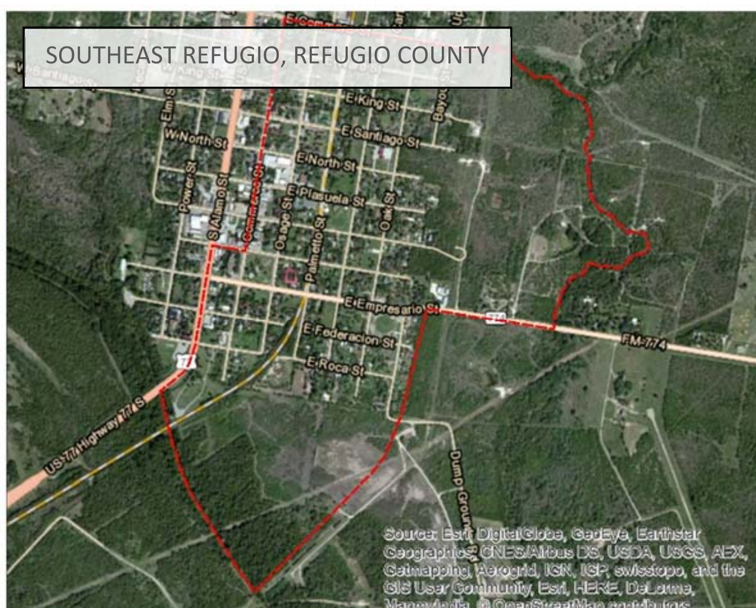
Components 8 and 9 have the highest loadings for Block Group 480079504001 in Aransas County. This block group is located in the southeast portion of the City of Rockport. When looking closer at the variables that load highly on these components, we see that that 58% of households in this area are occupied by renters, which subsequently leads to a large percentage of the population (61%) being composed of renters. In addition, many of the residents in this block group are new to the area, with 45% of the population having resided there for less than one year. In addition, the single parent population in this block group is relatively high (19%), some residents rely on public assistance (10%), and 47% of the population live below the poverty level. Finally, 34% of the population in this block group does not speak any English and 17% have limited English proficiency. All of these factors likely contribute to increased social sensitivity within this block group.

Southwest Refugio, Refugio County



Block Group 483919502003 in Refugio County is located in the southwestern portion of the City of Refugio. The components that contribute most to the vulnerability in this block group are Components 4 and 8. Non-English speaking individuals make up 42% of the population in this block group, and 43% have limited English proficiency. Furthermore, 47% of housing units are occupied by renters, 46% of the population is renters, and 34% of residents have lived in the area for less than one year. Single parents make up 16% of the population in this block group, which may also contribute to its social sensitivity. Although the percentage of households living in mobile homes loads highly on Component 4, this does not contribute to the vulnerability of this particular block group.

Southeast Refugio, Refugio County

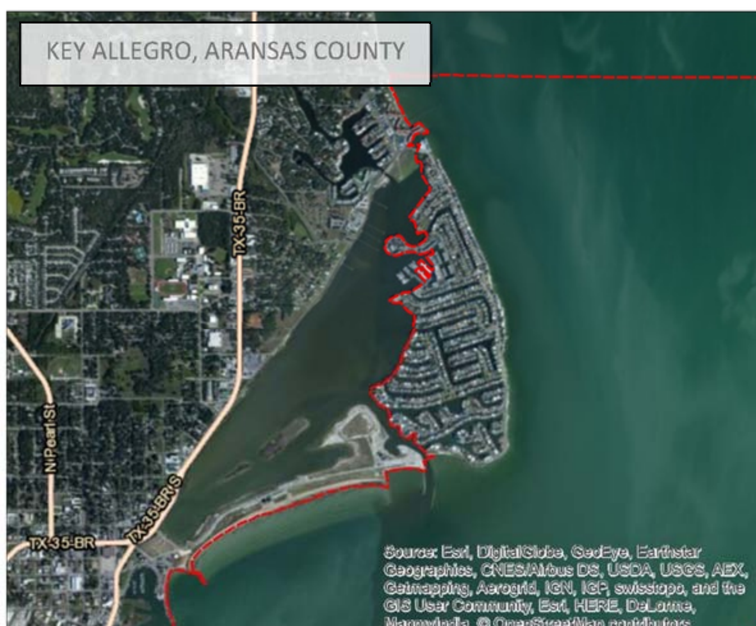


Block Group 483919502004 in Refugio County is located in the southeast portion of the City of Refugio. Components 4, 8, and 9 contribute most to the sensitivity of this block group. Specifically, 38% of the population does not speak English and 14% have limited English proficiency. Additionally, 39% of the housing units in this block group are occupied by renters, and subsequently, 38% of its population is composed of renters. Many of the residents in this block group (45%) have been residing in this area for less than one year, which also contributes to its high sensitivity. Single parents make up 13% of the population, 5% of the population is supported by public assistance, and 3% of the population lives in a mobile home. Although these three variables contribute somewhat to the sensitivity of this block group, they may not be as concerning as language barriers and tenancy issues.

Southwest Central Beeville, Bee County

Block Group 480259505005 in Bee County is located in the southwest central portion of the City of Beeville. Components 4 and 6 contribute most to the sensitivity of this block group. Specifically, these components represent the non-English speaking population, percentage of residents residing in mobile homes, and the percentage of people employed in extractive and service industries. In this block group, 77% of the population does not speak English, and 69% of this population works in the service industry. These two variables are the major contributors to the sensitivity of this block group. Although the percentage of households living in mobile homes loads highly for Component 4 and percentage of people employed in extractive industries loads highly on Component 6, both of these variables are extremely low for this block group and are not likely contributors to its sensitivity.

Key Allegro, Aransas County



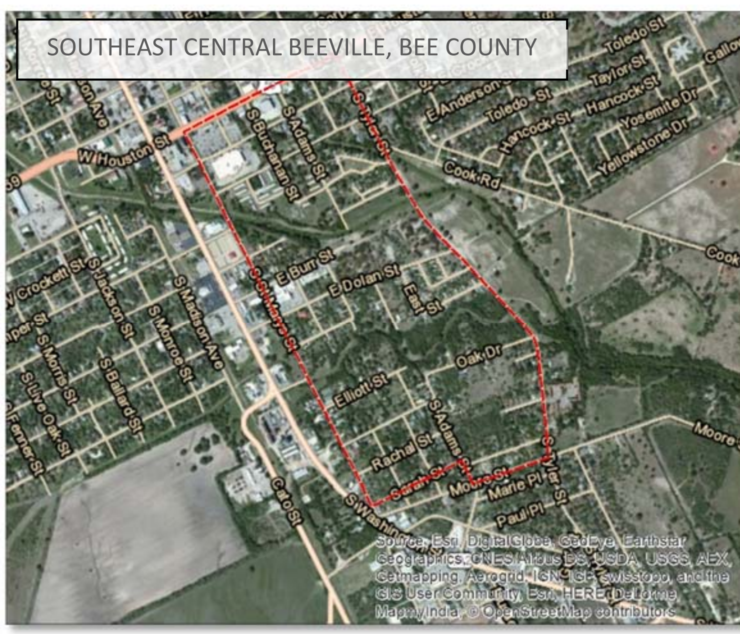
Block group 480079502001 is located on a small peninsula on the east side of Rockport and includes the Key Allegro housing development. Components 1 and 3 have the most significant impact on the vulnerability of this block group. Specifically, the median age (65 years old) and percent of population over the age of 64 (50%) contribute most to the vulnerability of this particular block group. As would be expected in an area with an older population, the percentage of individuals under the age of 5 in this block group is low (2%), and therefore does not affect sensitivity. Housing density (2,667 housing units per square mile) and population density (1,484 people per square mile) are also major contributors to the vulnerability of this block group. The number of persons per occupied housing unit

(1.9) is relatively low and is not likely a factor in sensitivity of this area. Similarly, the percentage of Hispanic individuals in this block group is low at 5% and does not contribute to sensitivity in this case.

Southwest Beeville, Bee County

Block Group 480259505002 is located in the southwest portion of the City of Beeville in Bee County. Components 4 and 9 contribute most to the sensitivity of this block group. The variables that have the most significant impact on sensitivity are the non-English and limited English proficiency populations. In this block group, 71% of the population does not speak English and 13% have limited English proficiency. Additionally, approximately 10% of this population is on public assistance. Although the percentage of households living in mobile homes loads highly on Component 4, this does not contribute to the vulnerability of this particular block group.

Southeast Central Beeville, Bee County



Block Group 480259505003 is located in Bee County in the southeast central area of the City of Beeville. Components 3 and 5 contributed most to the sensitivity of this group. Component 3 represents housing density and population density, while Component 5 represents wealth variables. In this block group, housing density is 1,397 housing units per square mile, while population density is 3,172 people per square mile. Additionally, 49% of the population in this block group lives in poverty, median income is $13,125, and per capita income is only $9,106. In addition, 40% of the population is non-working.

Discussion

Climate change is occurring and its societal impacts are projected to expand. Therefore, communities must strive to develop strategies that will allow them to adapt to the impacts of climate change that they will not be able to avoid. Planning for future environmental changes will enable local communities to reduce risks to people and infrastructure, as well as natural resources. Development of climate change adaptation plans requires the following basic steps: (1) identify and assess potential climate impacts for a specific geographic area; (2) define goals, objectives, and actions to best minimize impacts; and (3) develop an implementation strategy to meet these goals, objectives, and actions (NOAA 2010a).

When assessing social vulnerability to climate change, it is important to first consider a community's exposure to the different climate impacts that are most likely to affect a particular geographic area. In the Mission-Aransas Estuary watershed, the climate can be described as variable and extreme. The climate is sub-humid to semi-arid/sub-tropical with extreme variability in precipitation (Fulbright et al., 1990). Major climatic influences include temperature, precipitation, evaporation, wind, tropical storms, and hurricanes (Smith and Dilworth, 1999). Generally, the area experiences high temperatures along with deficiencies in moisture. One of the major impacts of temperature within the Mission-Aransas Estuary are freezes and radical changes with passing cold fronts (can reduce temperatures by 30-40°F within a few hours).

Along the Texas coast there is also a distinctive gradient of decreasing rainfall from northeast to southwest. The rainfall gradient decreases by a factor of two from 142 cm/year (56 in/year) near the Louisiana border to 69 cm/year (27 in/year) near the Mexican border (Larkin and Bomar, 1983). Due to extreme summer heat, annual precipitation values alone are not necessarily significant unless compared with precipitation deficiency caused by evapotranspiration (Orton, 1996). On average, gross annual evaporation exceeds precipitation in this region (Armstrong, 1982). Variability in weather patterns between years in South Texas is very high due to precipitation rates and climate patterns. Annual precipitation can change drastically between years due to tropical storms or hurricanes. El Niño, the warming of surface temperatures in the tropical eastern Pacific Ocean, is another important factor and causes cooler and wetter years in South Texas (NOAA, 2010b). La Niña years, the cooling of surface temperatures, are characteristically warmer and drier.

Climate change is expected to intensify the historical pattern of variable and extreme climate in Texas. Climate predictions for the Southern Great Plains, including Texas, show increasing temperatures in all seasons through the end of the century. The greatest increases are expected in the summer with a large increase in the number of "hot" days. Historically, maximum temperatures reach more than 100°F in the Southern Plains for an average of seven days per year. These high temperatures are projected to occur much more frequently, even under a scenario of substantial reductions in heat-trapping greenhouse gases emissions, with days over 100°F projected to quadruple in the south by mid-century. Similar increases are expected in the south in the number of nights with minimum temperatures higher than 80°F. These increases in extreme heat will have many negative consequences, including increases in surface water losses, heat stress, and demand for air conditioning. These negative consequences will more than offset the benefits of warmer winters, such as lower winter heating demand, less cold stress on humans and animals, and a longer growing season, which will be extended by mid-century by an average of 24 days relative to the 1971-2000 average. More overwintering insect populations are also expected (Schafer et al., 2014).

Predictions regarding future precipitation within the Great Plains show varied patterns across the region, but changing extremes in precipitation are projected across all seasons, including higher likelihoods of increasing heavy rain events. Average annual precipitation greater than 50 inches supports lush vegetation in eastern Texas and

Oklahoma, but for much of the southern portion of the Great Plains, average rainfall is less than 30 inches. Large parts of Texas and Oklahoma are projected to see longer dry spells (up to 5 more days on average by mid-century). Across much of the region, annual water loss from transpiration by plants and from evaporation is higher than annual precipitation, making these areas particularly susceptible to droughts (Schafer et al., 2014).

The Texas coast is relatively flat and low-lying and has one of the highest rates of subsidence in the world (Anderson 2007). As a result, changes in sea-level will be exacerbated on the Texas coast because the land is relatively flat and it is rapidly sinking (Montagna et al., 2009). The historical rate of sea-level rise within the Mission-Aransas Estuary (5.53 +/-0.55 mm/year at Rockport Tide Station) is substantially higher than the global average for the last 100 years (1.7 mm/year [IPCC 2007]), and this difference is likely due to land subsidence. Researchers have very high confidence (>9 in 10 chance) that global mean sea level will rise at least 0.2 meters (8 inches) and no more than 2.0 meters (6.6 feet) by 2100 (Parris et al., 2012). Future rates of relative sea-level rise for the central Texas coast will most likely be at the high end of these projections, if not greater, once local land subsidence is taken into consideration. Rising sea levels may result in tidal marsh submergence (Moorhead and Brinson, 1995) and habitat "migration" as salt marshes transgress landward and replace tidal freshwater and irregularly flooded marsh (Park et al., 1991). In addition to changes in natural resources, potential impacts of sea-level rise include increased erosion, elevated storm surge, coastal inundation, salt water intrusion, non-point source pollution, and introduction of toxins. Sea-level rise will not stop in 2100 because the oceans take a very long time to respond to warmer conditions at the Earth's surface. Ocean waters will therefore continue to warm and sea level will continue to rise for many centuries at rates equal to or higher than that of the current century. In the next several decades, storm surges and high tides could combine with sea-level rise and land subsidence to further increase flooding in many of these regions (Walsh et al., 2014).

Changes in hurricane activity and intensity are also predicted for U.S. coastal areas. There has been a substantial increase in most measures of Atlantic hurricane activity since the early 1980s, the period during which high-quality satellite data are available. These include measures of intensity, frequency, and duration as well as the number of strongest (Category 4 and 5) storms. The relative contributions of human and natural causes to these increases are still uncertain. Hurricane-associated storm intensity and rainfall rates are projected to increase as the climate continues to warm (Walsh et al., 2014). Historically, the Texas coast averages about three tropical storms or hurricanes every four years, generating coastal storm surge and sometimes bringing heavy rainfall and damaging winds hundreds of miles inland. The expected rise in sea level mentioned above will result in even greater potential damage from storm surge along the Gulf Coast of Texas (Schafer et al., 2014).

Not all climate impacts are evenly distributed throughout the watershed of the Mission-Aransas Estuary. Inland communities will be faced with climate impacts such as drought, extreme heat, changes in water resources, river-based flooding, and associated severe weather. Meanwhile communities close to the coast will have to deal with the factors listed above, as well as coastal-specific hazards such as sea-level rise, freshwater inflows, storm surge, and hurricanes. Communities that wish to understand their social vulnerability must take into consideration their exposure to potential impacts, but they must also consider the sensitivity of the areas that are likely to experience these impacts. In other words, both exposure and socioeconomic, demographic, and infrastructure characteristics must be evaluated together in order to determine the true vulnerability of the community to climate change.

This study provided an easy-to-use index that can be utilized by communities in the Mission-Aransas Estuary watershed to identify their sensitivity to environmental hazards, including climate change. Social sensitivity information can be combined with climate change exposure data to help evaluate the vulnerability of a particular location within the Mission-Aransas Estuary watershed. For example, maps of elevation contours can be used to provide an indication of which coastal areas are more likely to be exposed to sea-level rise impacts. When the social sensitivity index results are overlaid with these elevation contours, it is easy to see how sea-level rise may affect several of the more socially sensitive areas within a community. Figure 2 shows an example of what this type of vulnerability analysis might look like for the Rockport area – 0-1 m and 1-2 m elevation contours were overlaid on a map of social sensitivity index values. The resulting figure shows that several of the more socially sensitive areas within the Rockport region will have a high exposure to future sea-level rise. Increased exposure and high sensitivity will combine to make these areas more vulnerable to potential future impacts.

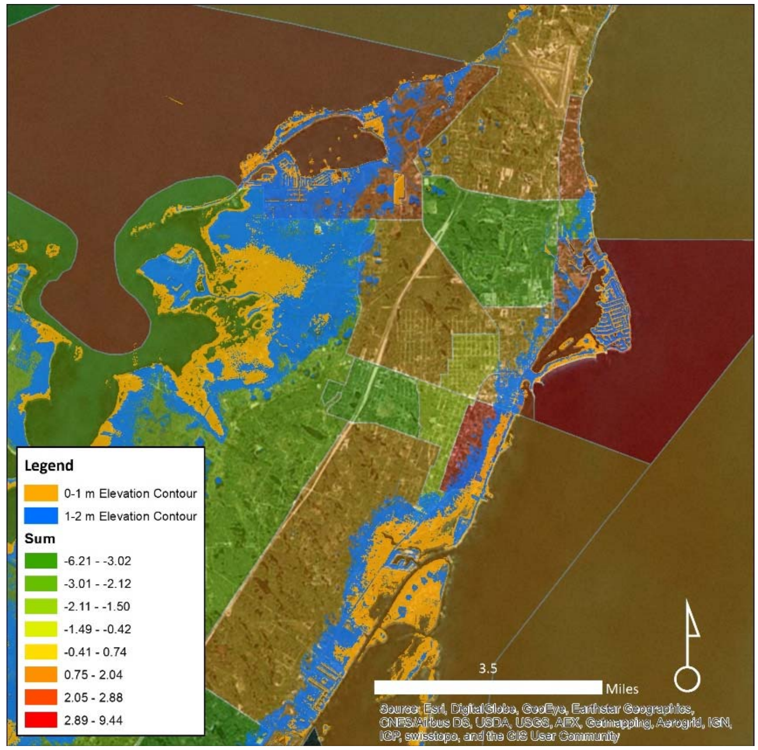


Figure 2. Map of social sensitivity index scores overlaid with 0-1 m (orange) and 1-2 m (blue) elevation contours.

Similarly, maps of the floodplain can be used as an indication of potential exposure to future flooding resulting from increases in the number of heavy rain events. Figure 3 shows the special flood hazard zones near the City of Refugio overlaid on the social sensitivity index results. Results indicate that portions of two highly sensitive block groups are situated in the flood plain. These areas will be more vulnerable due to their increased exposure to flooding impacts associated with heavy precipitation events and their high social

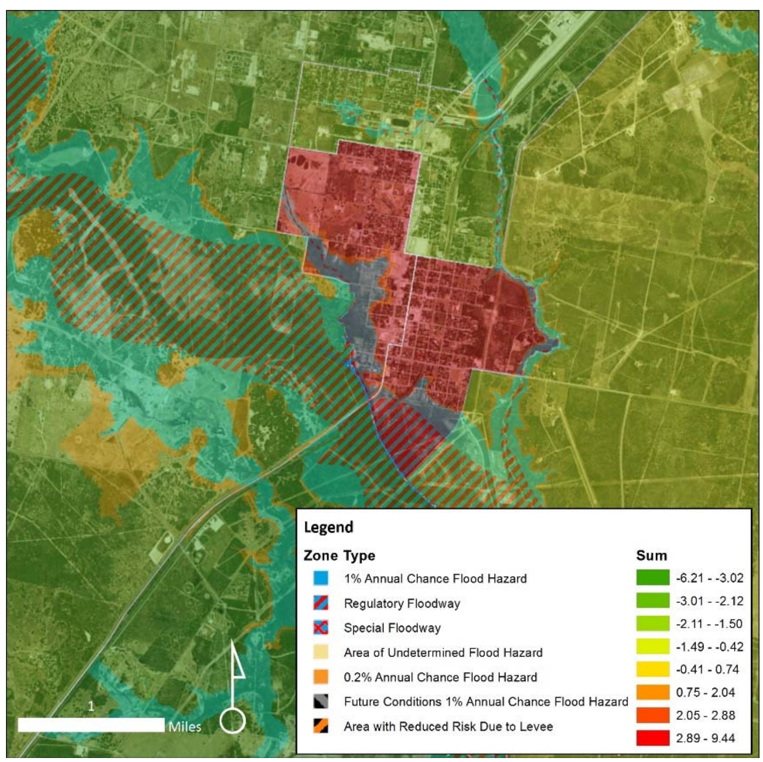


Figure 3. Map of social sensitivity index scores overlaid with special flood hazard zones.

sensitivity. Although GIS presents a valuable tool for combining sensitivity and exposure data, it is not always necessary for a community to have this type of information when conducting a vulnerability assessment and developing adaptation strategies. A variety of different types of exposure information could be combined with the social sensitivity index results in order to evaluate climate change vulnerability.

In order to fully understand social vulnerability, communities must go beyond examining their exposure and sensitivity, and they must also evaluate their adaptive capacity. Adaptive capacity refers to the opportunities that may exist to ameliorate the sensitivity or exposure of the community to climate change impacts (Glick et al., 2011). In general, coastal areas or communities with higher adaptive capacities will be better able to react to and accommodate the changes associated with climate change. Communities may already have plans, laws, and regulations in place that increase their ability to respond to the impacts of climate change, but in most cases, steps will need to be taken to modify existing or create new measures that increase a community's resilience to climate change (NOAA, 2010a).

Identifying and assessing potential climate impacts for a specific geographic area will help communities as they develop adaptation strategies that reduce either their exposure and/or sensitivity to climate change impacts. The social vulnerability index developed for this project can directly assist communities in the Mission-Aransas Estuary watershed with the latter by identifying which factors make their community more or less sensitive. For example, several of the block groups in this study were identified as being more sensitive to environmental hazards due to a high number of non-English speaking individuals within the population, high levels of public assistance, and large numbers of renters and new residents. Language and cultural barriers, such as low English proficiency, can affect access to post-disaster funding and can constrain the ability to understand warning information/recovery information. Areas that have large numbers of individuals that receive public assistance also tend to be more vulnerable and may require additional assistance related to a disaster. In addition, new residents are less likely to have experienced a disaster/environmental hazard in their current location and are less familiar with local resources, while rental properties are often more likely to be structurally compromised during a disaster and are less likely to be insured, which means renters may be slower to recover following a disaster.

In order to increase resiliency to climate change, communities must acknowledge these inequalities in social sensitivity and prioritize the development of adaptation strategies that help those with a higher degree of sensitivity to become more resilient. For example, the inability to speak English was identified for several block groups in the Mission-Aransas Estuary watershed as contributing to sensitivity. In areas where this is a source of sensitivity, communities should ensure that all climate change adaptation strategies that involve education and outreach materials (e.g., brochures on water conservation, public service announcement regarding evacuation routes, and presentations on flood insurance), are provided in multiple languages and in ways that reach non-English speaking residents. Renters and new residents (i.e., individuals that have lived in the area for less than one year) were also identified as contributing to sensitivity in several areas of the watershed. In these areas, communities could increase the effectiveness of climate change adaptation strategies by focusing on ways to better involve new residents in the community and those who are renting property (e.g., work with property management companies to provide environmental hazard information to renters, partner with Chamber of Commerce to provide climate change/environmental hazard seminars for new businesses, and encourage title companies to provide environmental hazard information to new home owners).

Many coastal communities are already preparing in some way for future environmental changes. A survey administered by Texas Sea Grant showed that several on-going planning efforts are already considering climate change impacts. The survey indicated that planning efforts are focused on future changes in sea-level rise, more frequent and intense storms, building setbacks, emergency preparations, community sustainability standards, increased flooding, storm water management, decreased impervious surfaces, and a variety of flood mitigation practices (Wade, 2013). As communities continue (or begin) to develop strategies that increase their adaptive capacity, it is important that they consider their exposure to climate change impacts, while also taking into account their social sensitivity to these impacts.

Although the development of a full climate change vulnerability assessment and adaptation plan was outside the scope of this document, the study provides valuable data about the social sensitivity of communities in the Mission-Aransas Estuary watershed. This report also provides ideas about how the data can be used in combination with information about exposure and existing plans, policies, and regulations to begin developing relevant adaptation strategies that address potential climate change hazards. Communities can use their knowledge of environmental, social, and infrastructure vulnerability with local plans and regulations to address climate hazards, develop various alternative scenarios for the future, and collectively aim towards a common vision of community functioning and sustainability in a changing environment.

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Appendix

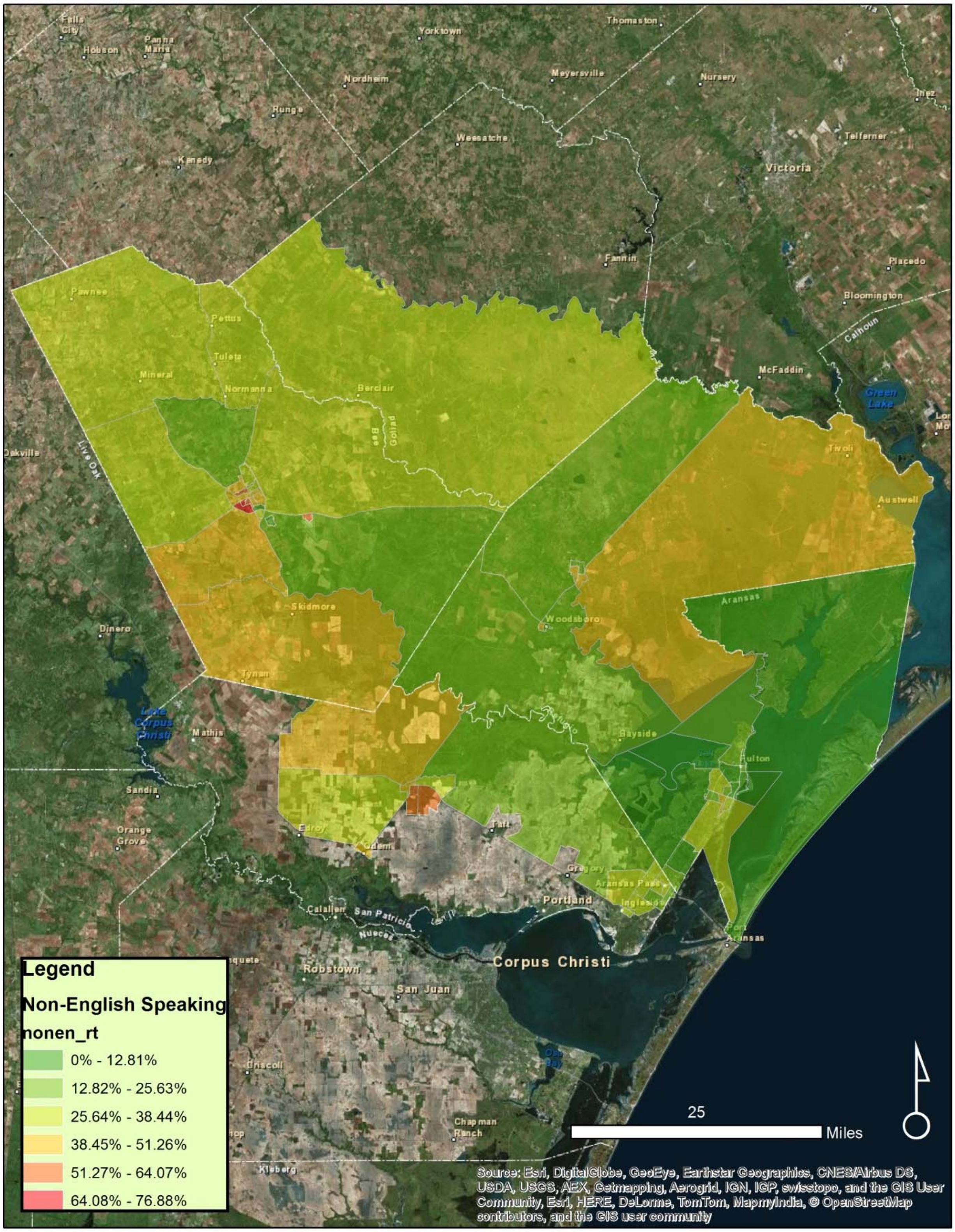
PCA Variables

Variable Name	Description	Variable Abbreviation
Less than high school education	Percentage of population over age 25 less than high school educated	hsls_rt
Non-English speaking	Percentage of the population whose primary language is not English	nonen_rt
Limited English proficiency	Percentage of the population that speak English less than very well	lep_rt
Below poverty	Percentage of the people or families that are below the poverty level	pov_rt
Rich households	Percentage of households earning greater than $200,000 annually	hinc_rt
Median income	Median income of all individuals (age 16+) in the household	mdn_inc
Social security receipt	Percentage of households receiving Social Security	ssr_rt
Public assistance	Percentage of households supported by public assistance	pbast_rt
Per capita income	Total income divided by the size of the population	prcp_inc
Female labor force participation	Percentage of female population in the labor force	flfp_rt
Not working	Percentage of working-age population (age 16-64) who did not work in the past 12 months	nowrk_rt
Mobile homes	Percentage of households that live in mobile homes	mblhm_rt
Housing unit year built	Median year home was built	mdn_yrblt
Without vehicle	Percentage of households without a vehicle	novh_rt
Median gross rent	Median rental rate	mdn_rnt
Median house value	Median value of owned homes	mdn_huvl
Length of residency	Percentage of population residing in home for less than one year	mov_rt
Employment in service industry rate	Percentage of population employed in professional, scientific, management, administrative, education, arts and other services	svcem_rt
Employment in extractive industry	Percentage of civilian population (age 16+) employed in agriculture, forestry, fishing, hunting, and mining (i.e., extractive industries)	extem_rt

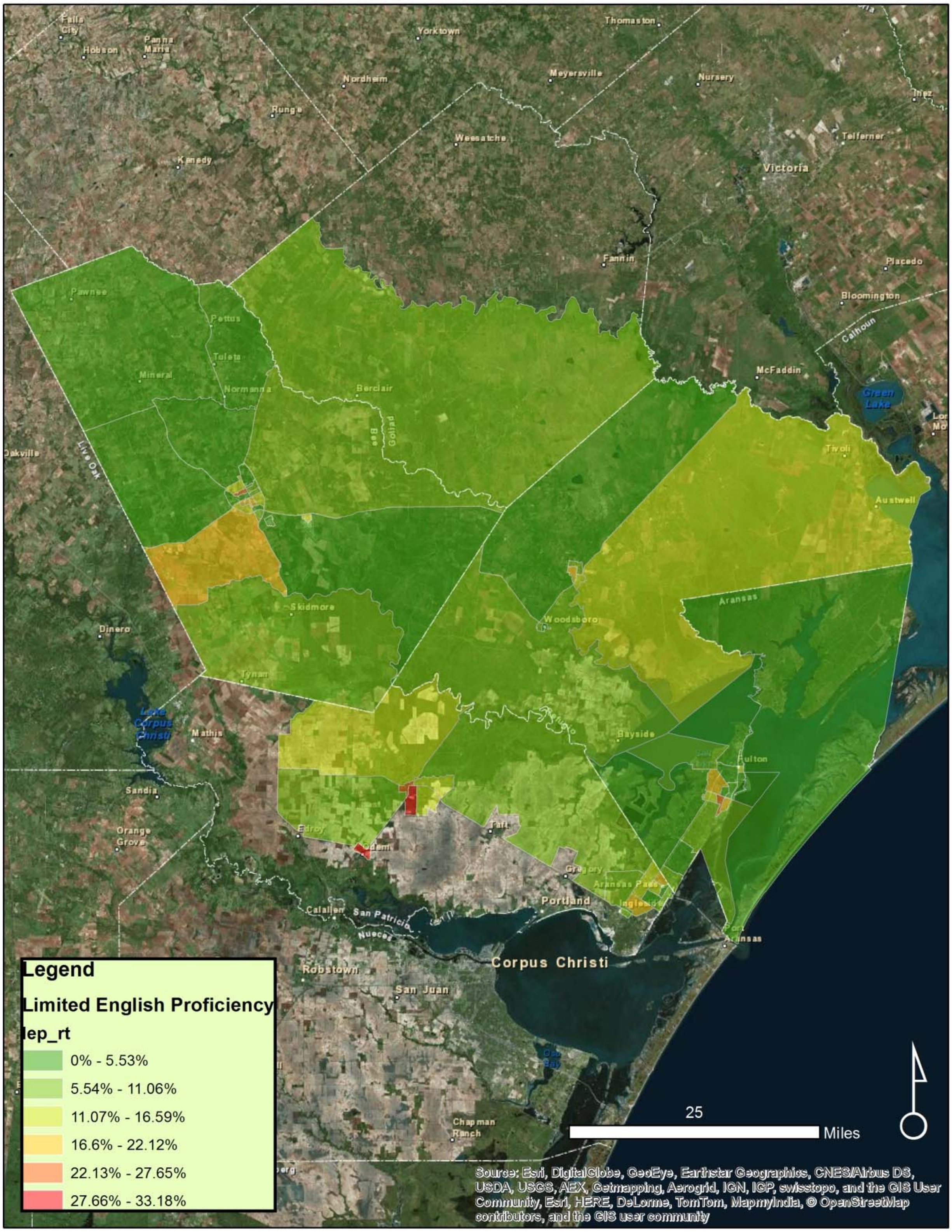
Variable Name	Description	Variable Abbreviation
Population density	Number of people per square mile	pop_dens
Housing density	Number of housing units per square mile	hu_dens
Renter occupied housing units	Percentage of occupied housing units designated as rental units	rent_rt
Seasonal housing units	Percentage of vacant housing units designated as seasonal	ssnl_rt
Renters	Percentage of occupied housing units designated as rental units	rntpop_rt
Persons per occupied housing unit	Number of persons per occupied household	prspunt
Hispanic	Percentage of the population who listed their race and ethnicity as Hispanic or Latino	hisp_rt
Non-Hispanic white	Percentage of the population who listed their race and ethnicity as non-Hispanic White	nhwht_rt
Asian	Percentage of the population who listed their race and ethnicity as non-Hispanic Asian	nhasn_rt
Black	Percentage of population who listed their race and ethnicity as non-Hispanic Black	nhblk_rt
Age 5 and under	Percentage of population 5 years of age or younger	und5_rt
Age 65 and over	Percentage of population 65 years of age or older	ovr64_rt
Female	Percentage of the population that are female	fml_rt
Median age	Median age of population	mdn_age
Single parent	Percentage of households headed by single parent	sglpar_rt
Married couple families with children	Percentage of children living in households with married couples	marwch_rt
Senior group quarters	Percentage of the population 65 and over living in group quarters	ovr64gq_rt

Maps

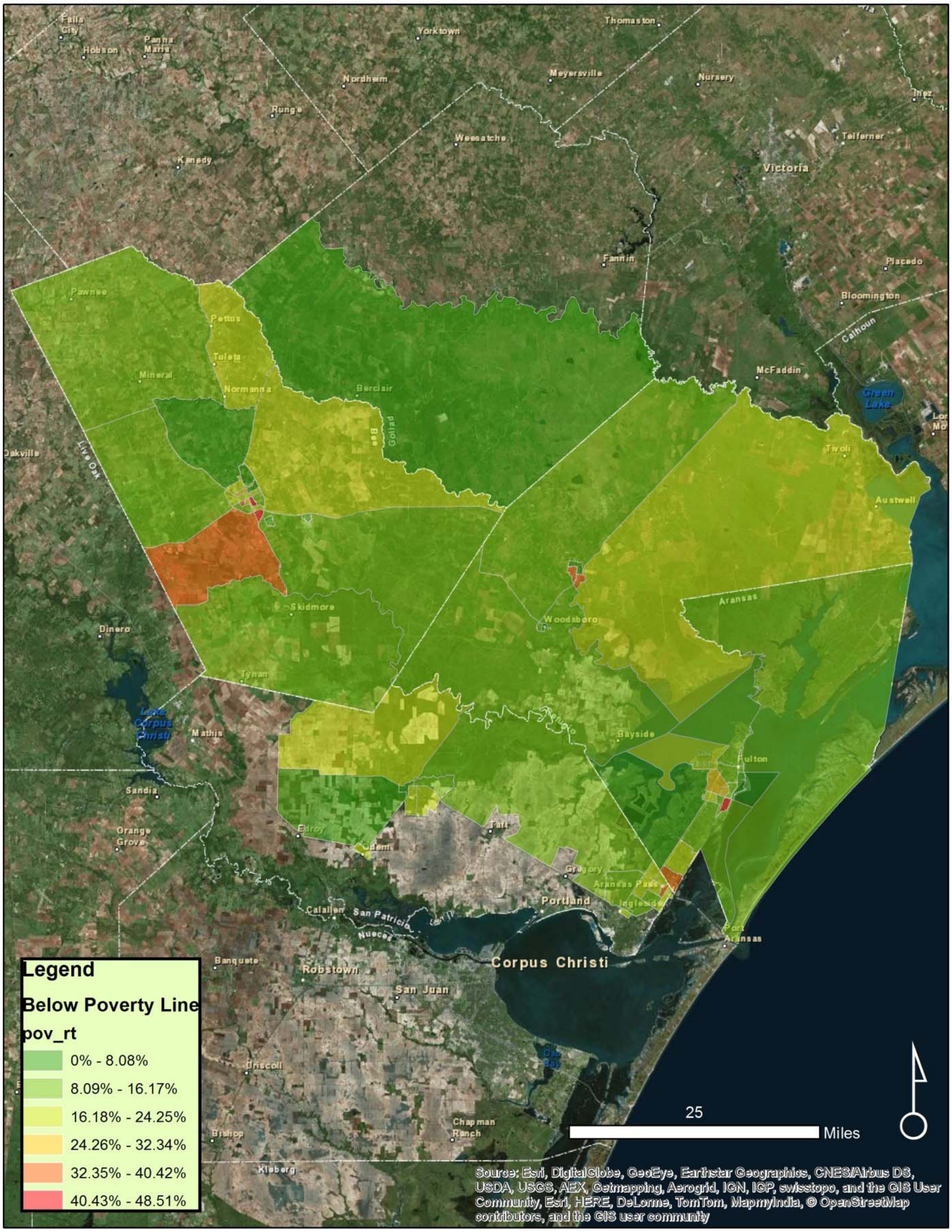
Non-English Speaking Population



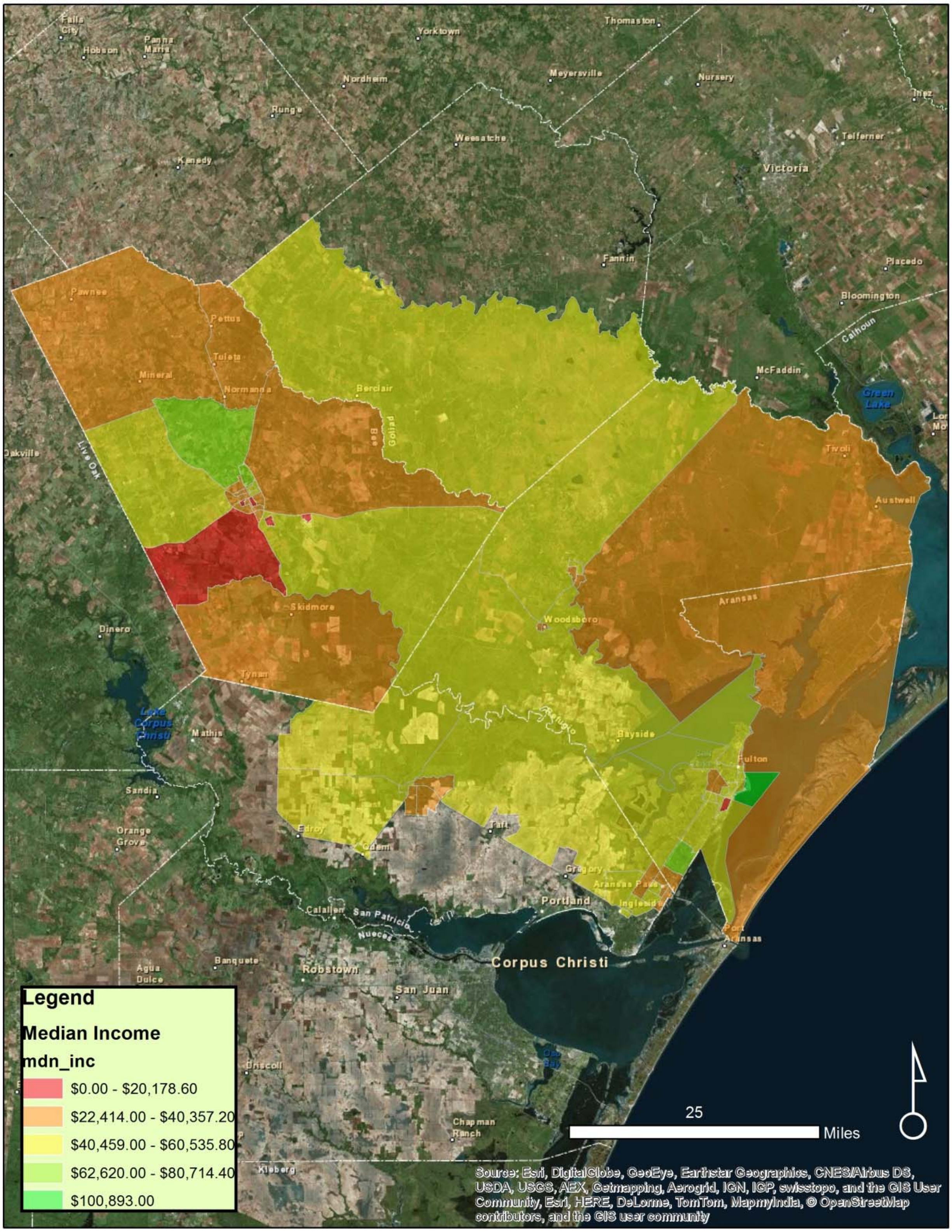
LIMITED ENGLISH PROFICIENCY



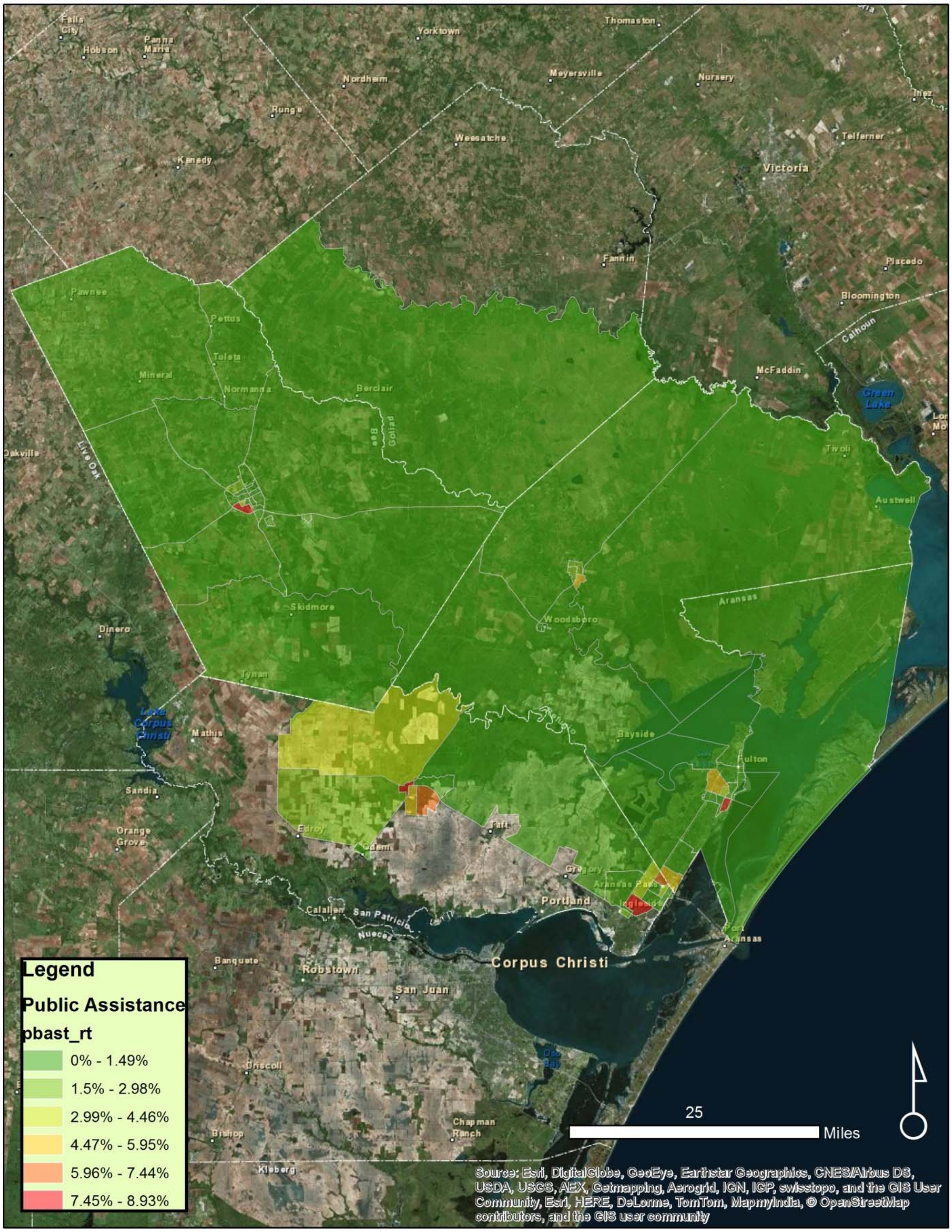
Below Poverty



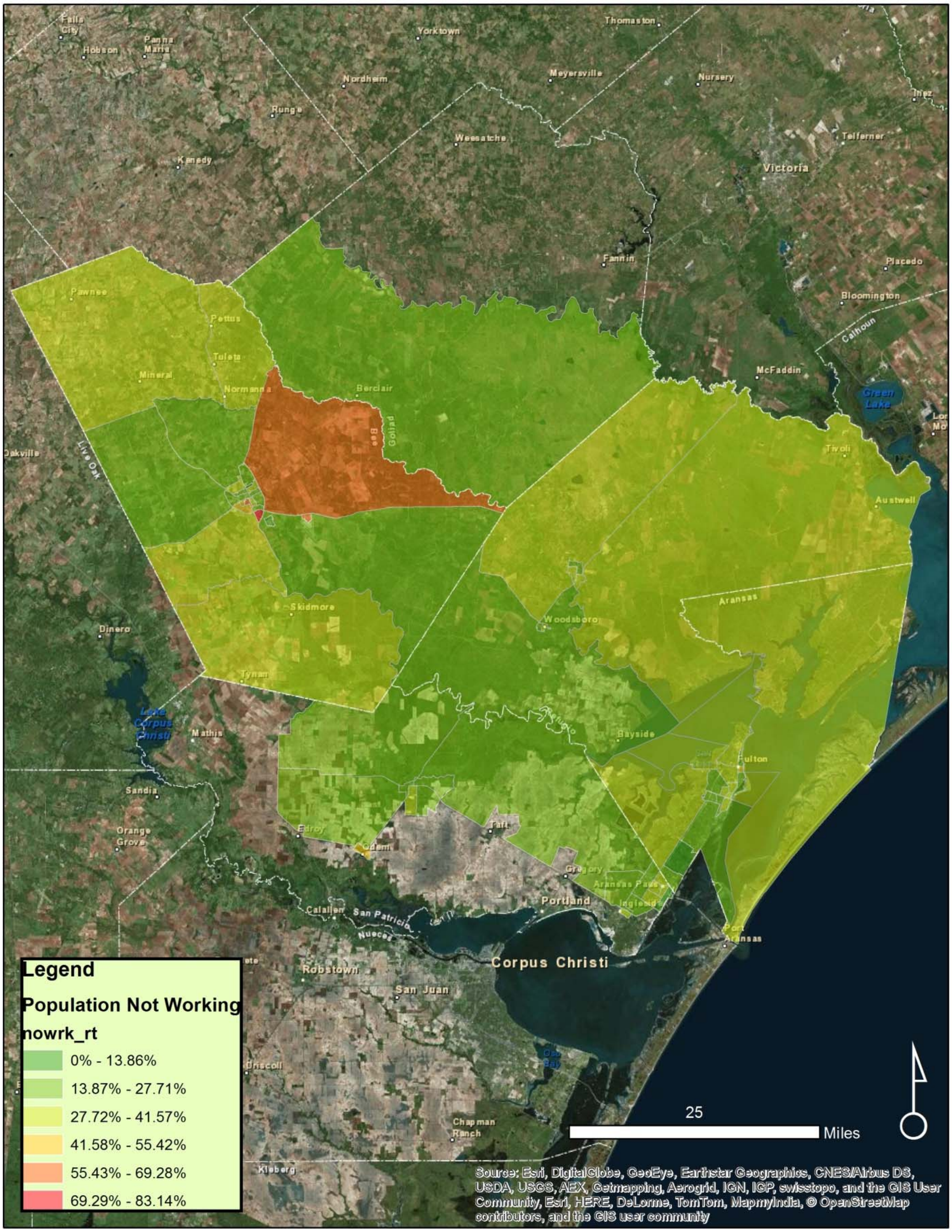
MEDIAN INCOME



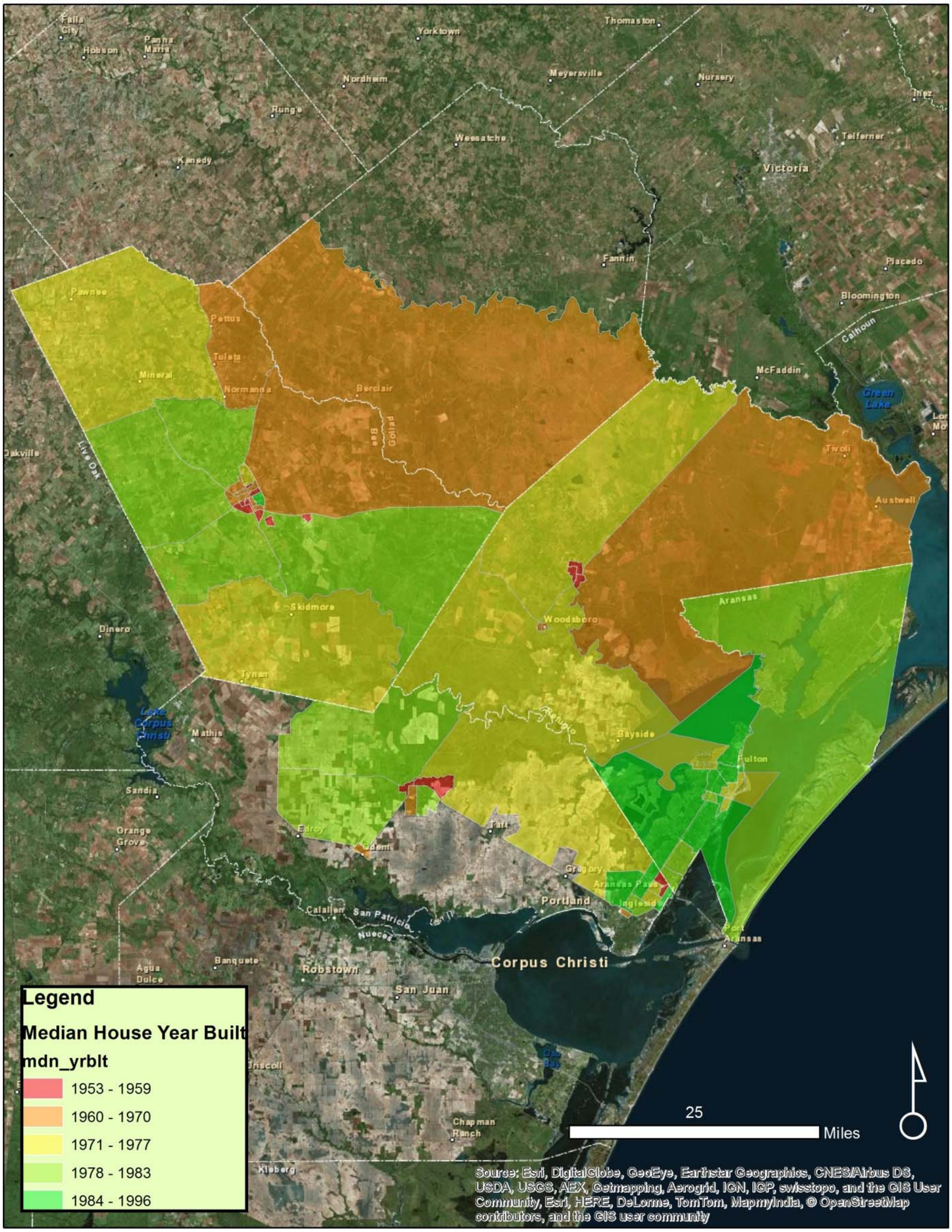
Public Assistance



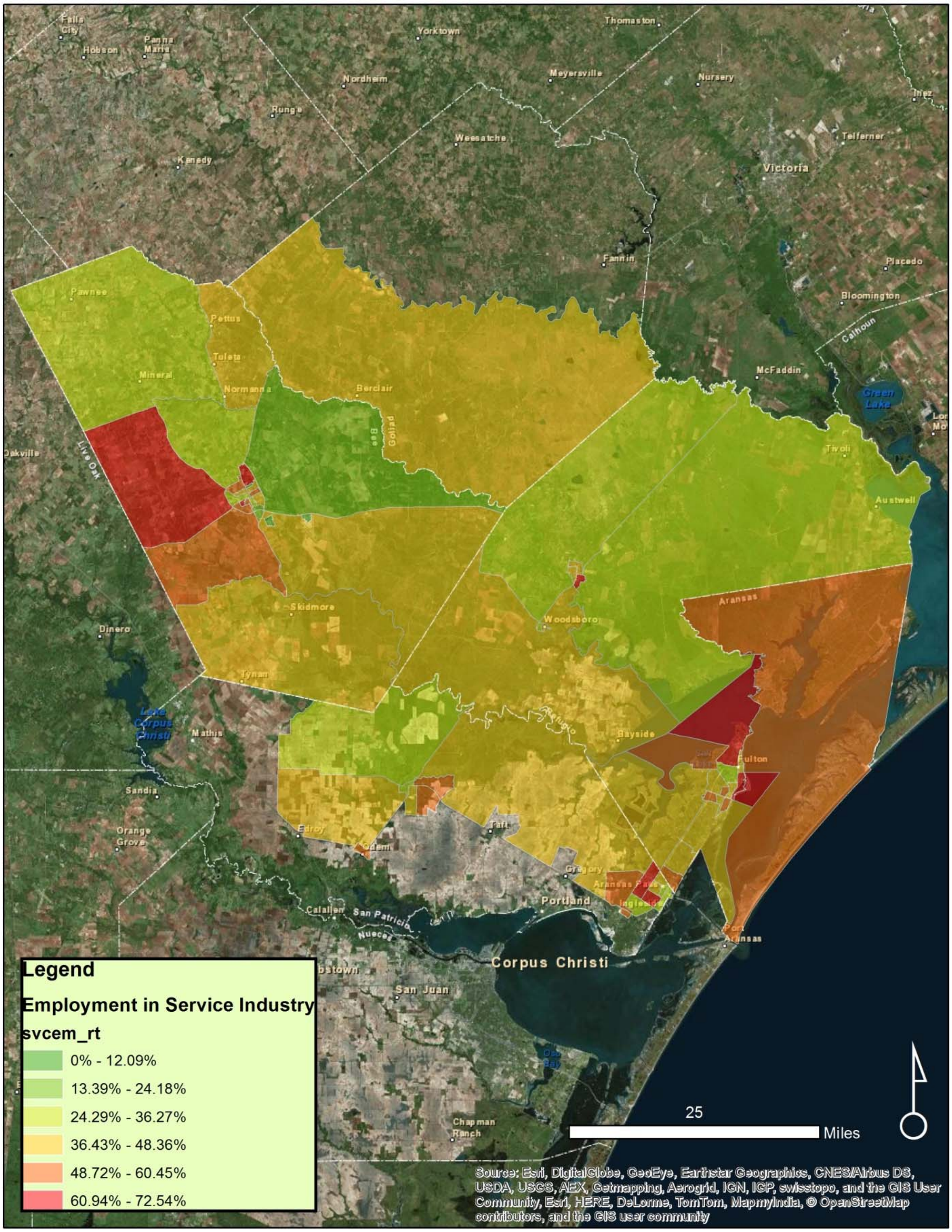
Population Not Working



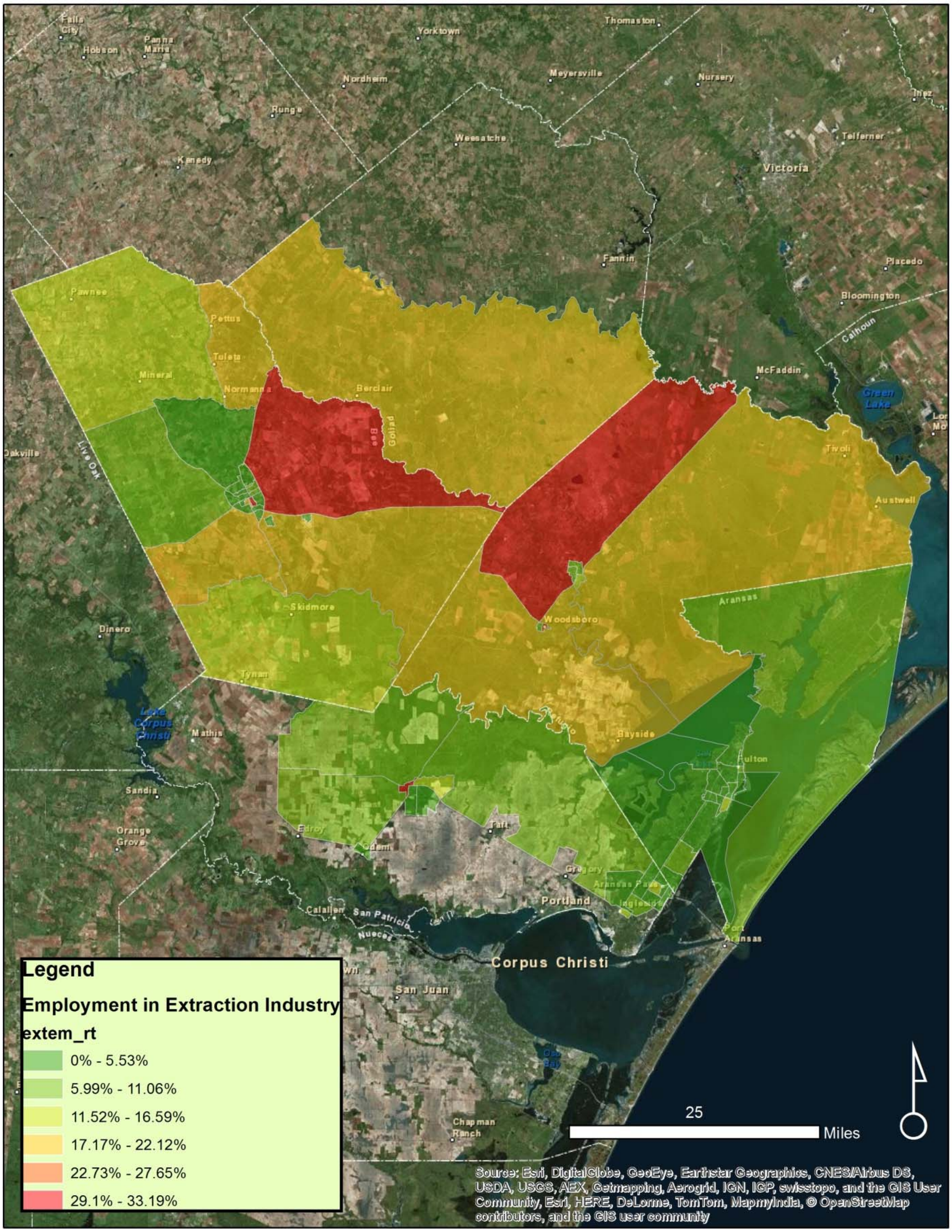
HOUSING UNIT YEAR BUILT



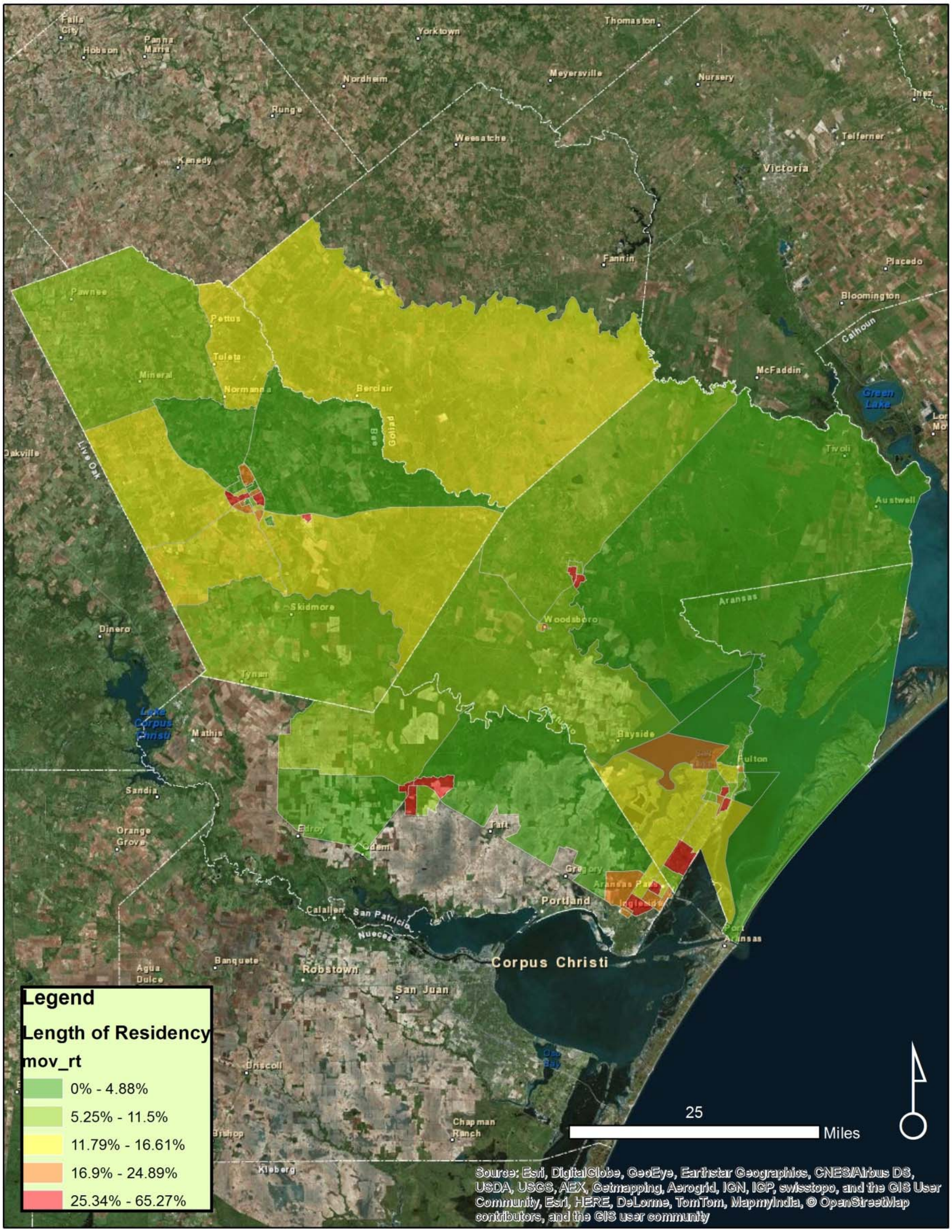
Employment in Service Industry



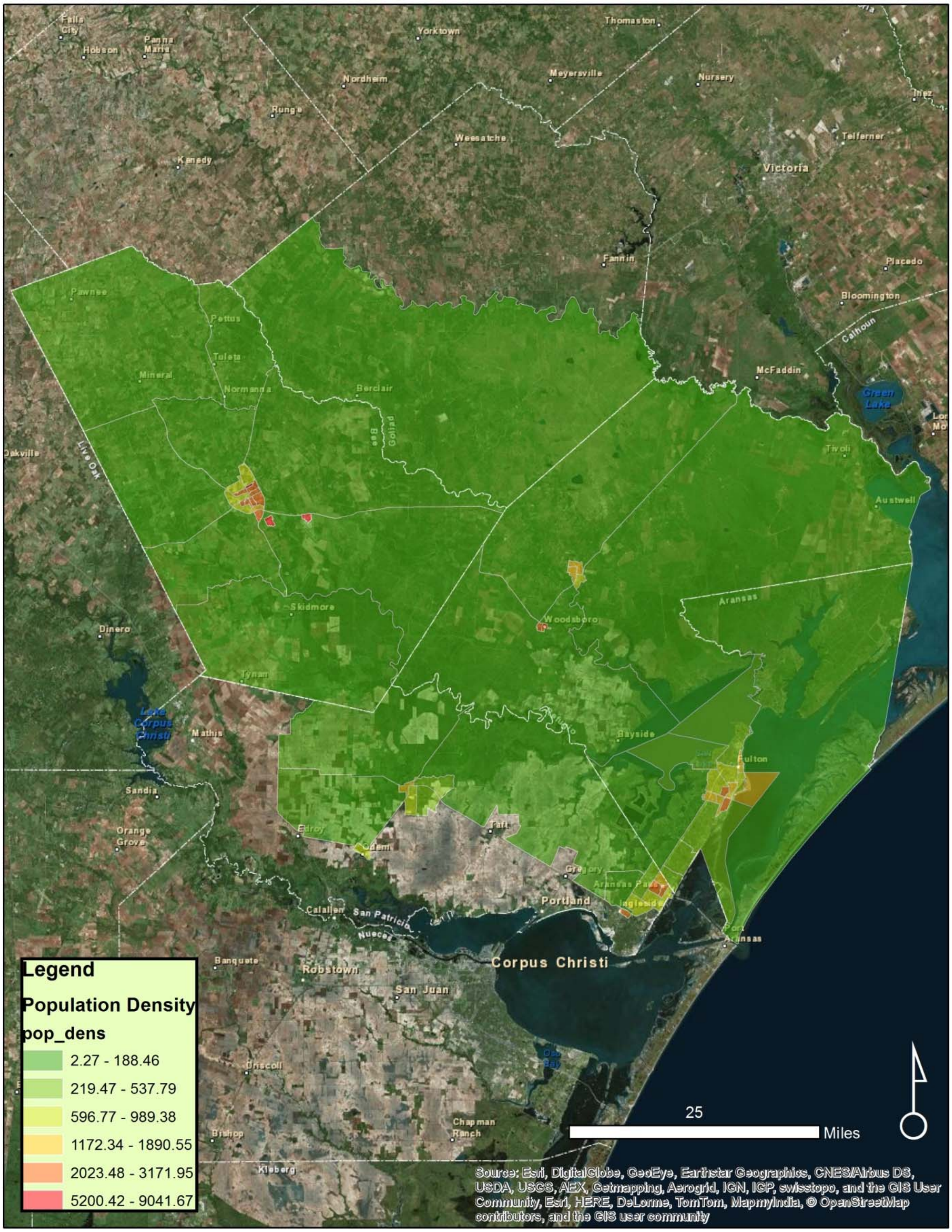
Employment in Extraction Industry



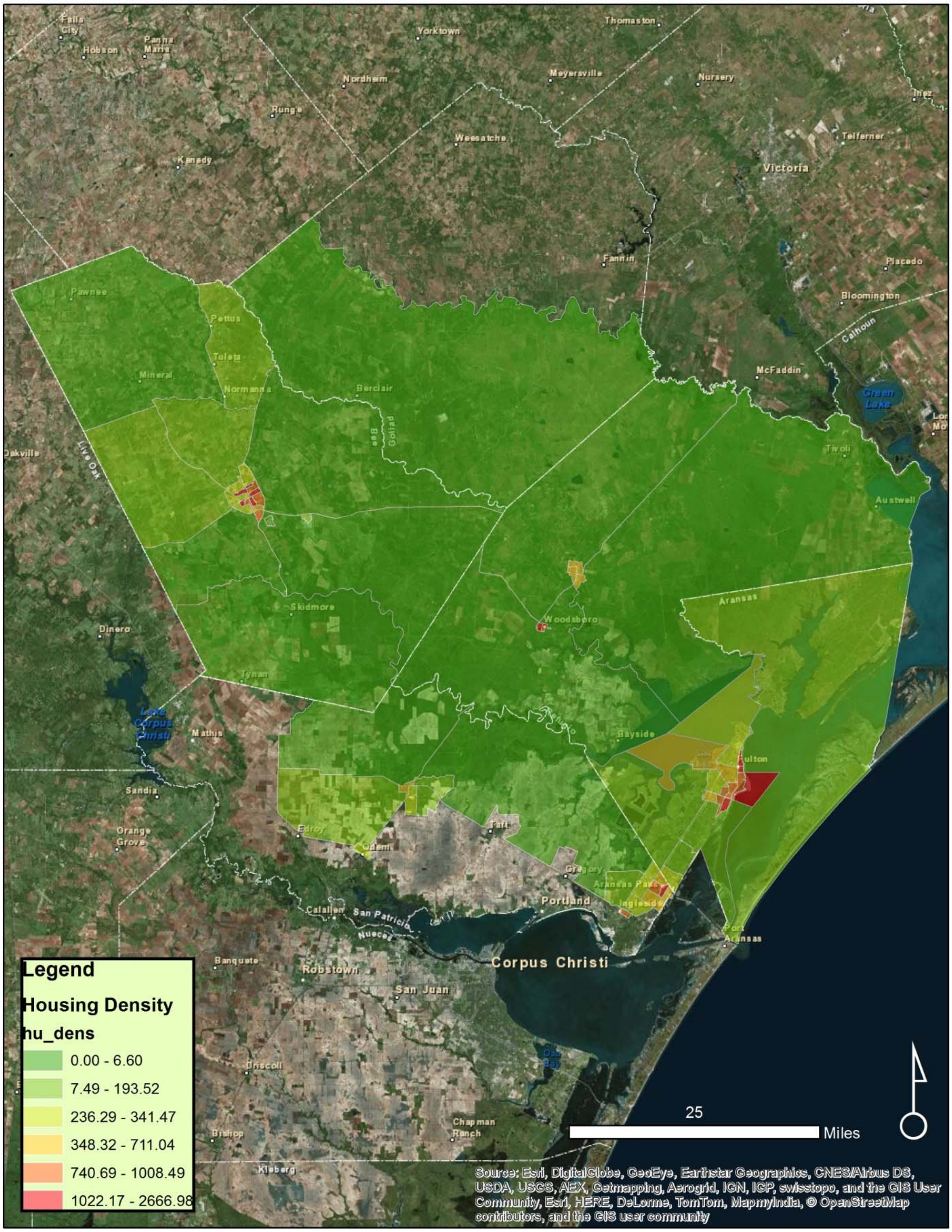
LENGTH OF RESIDENCY



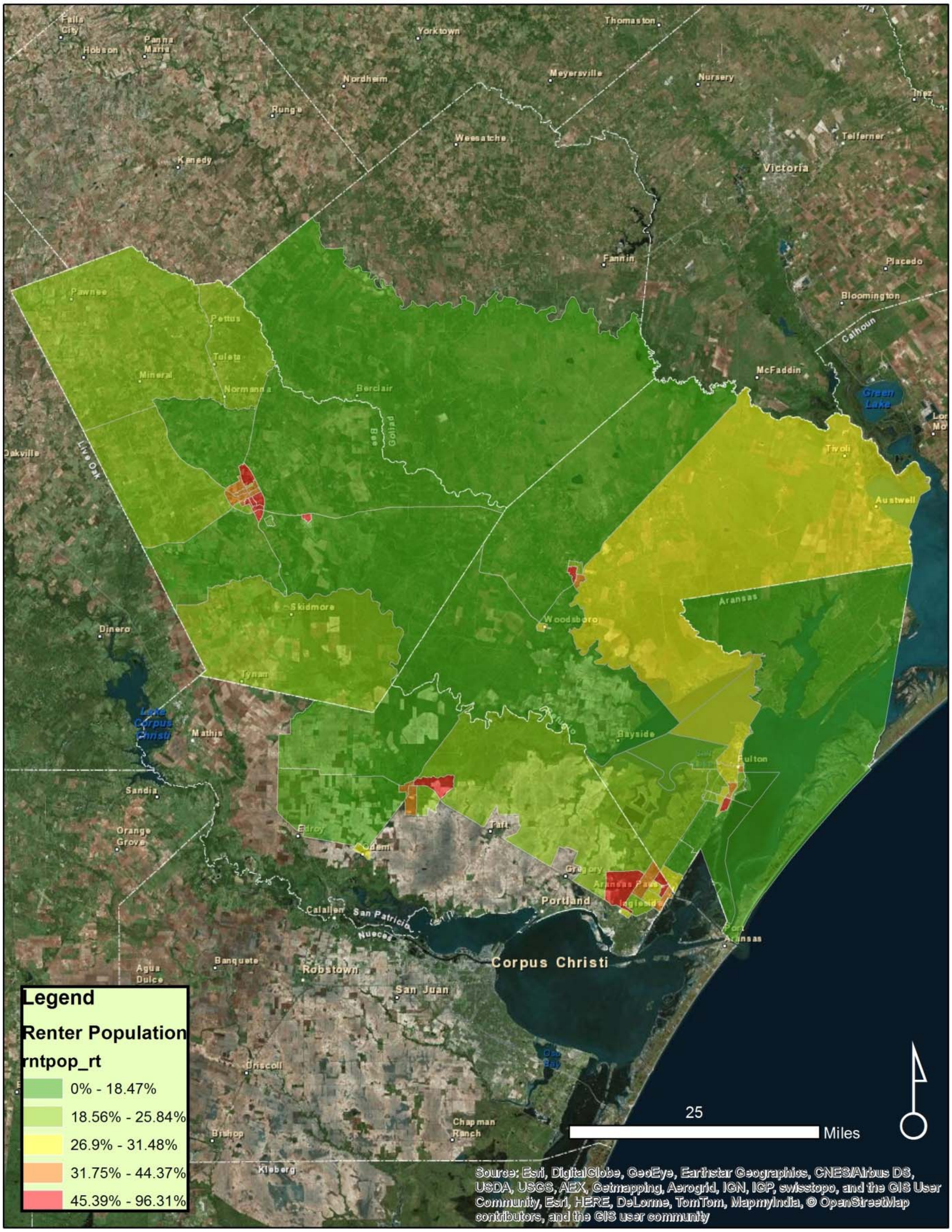
Population Density



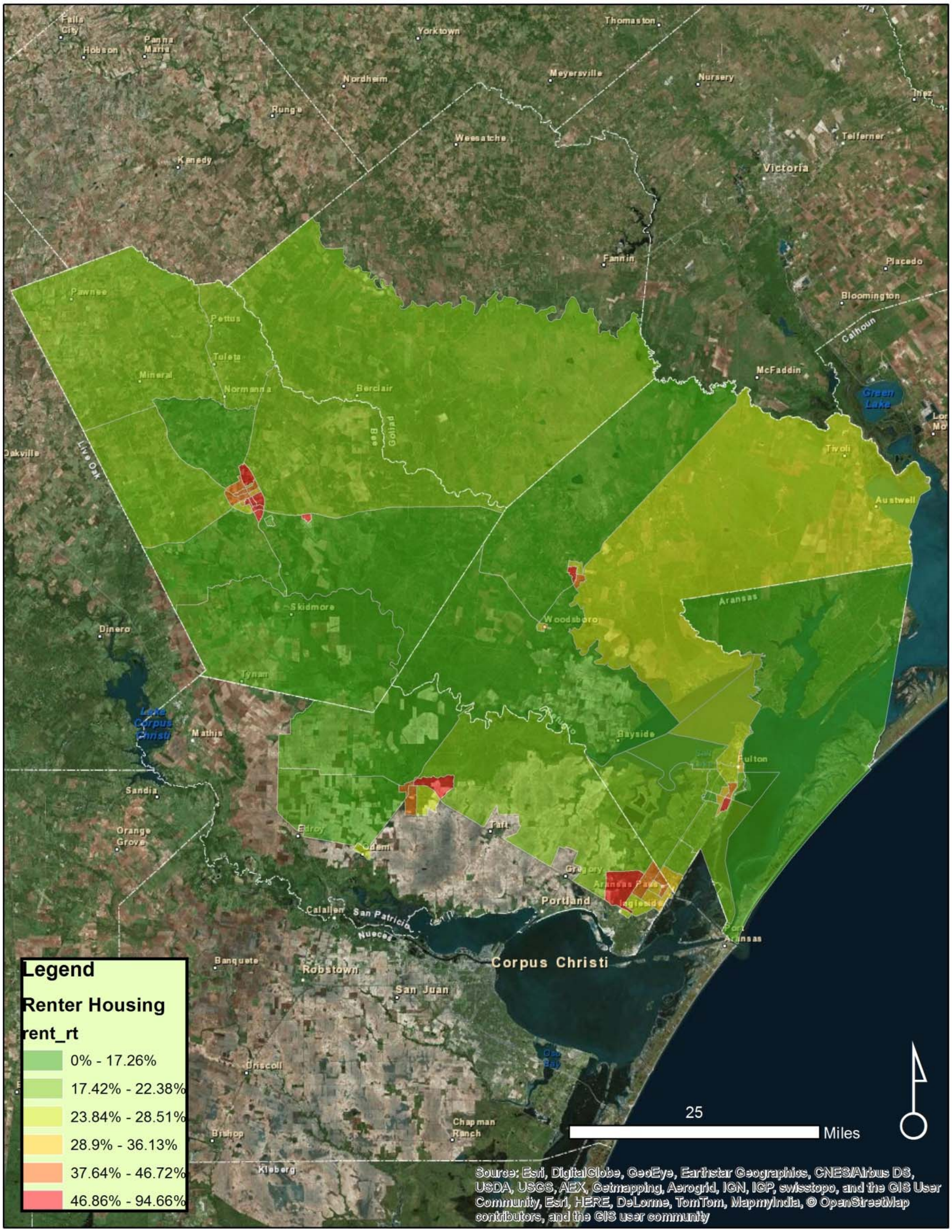
Housing Density



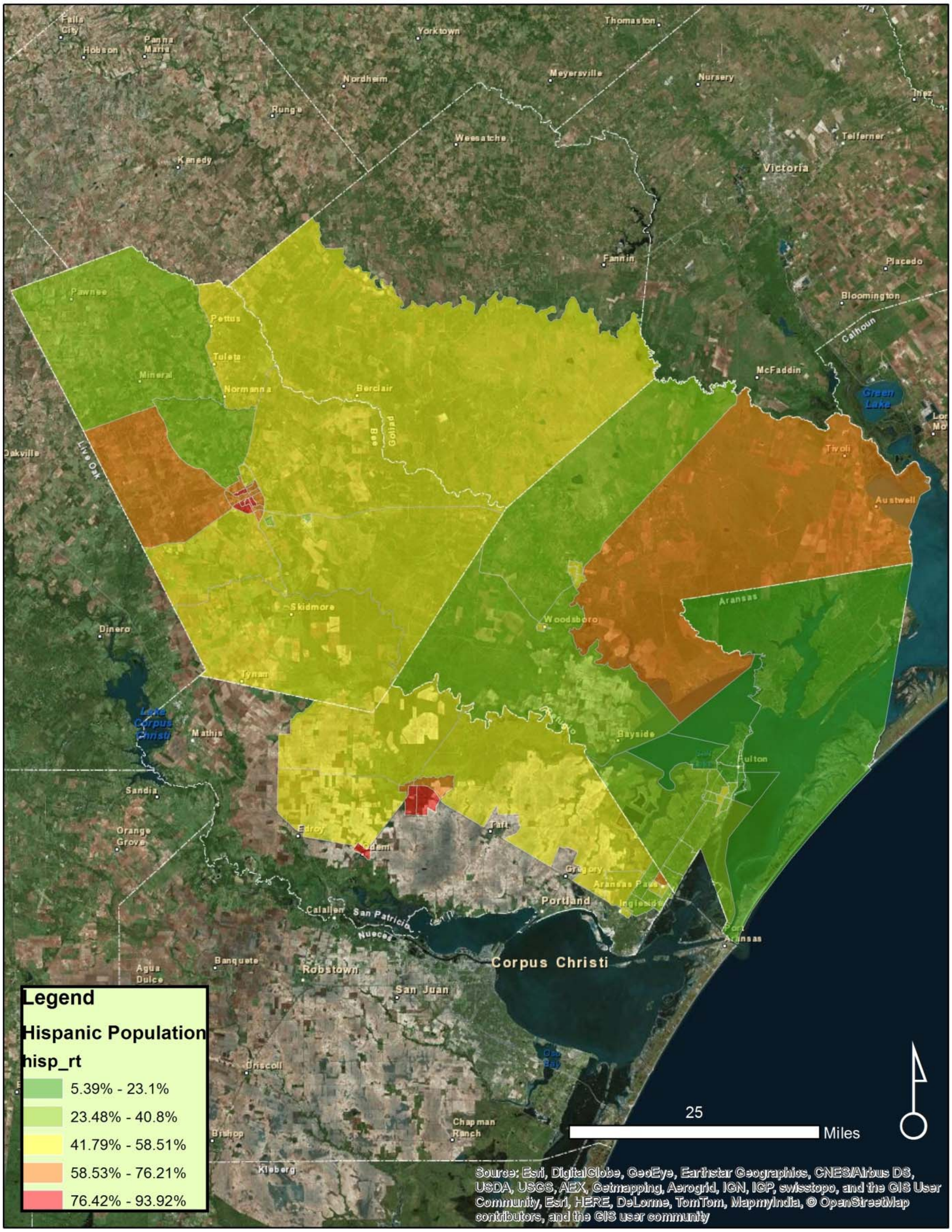
Renter Population



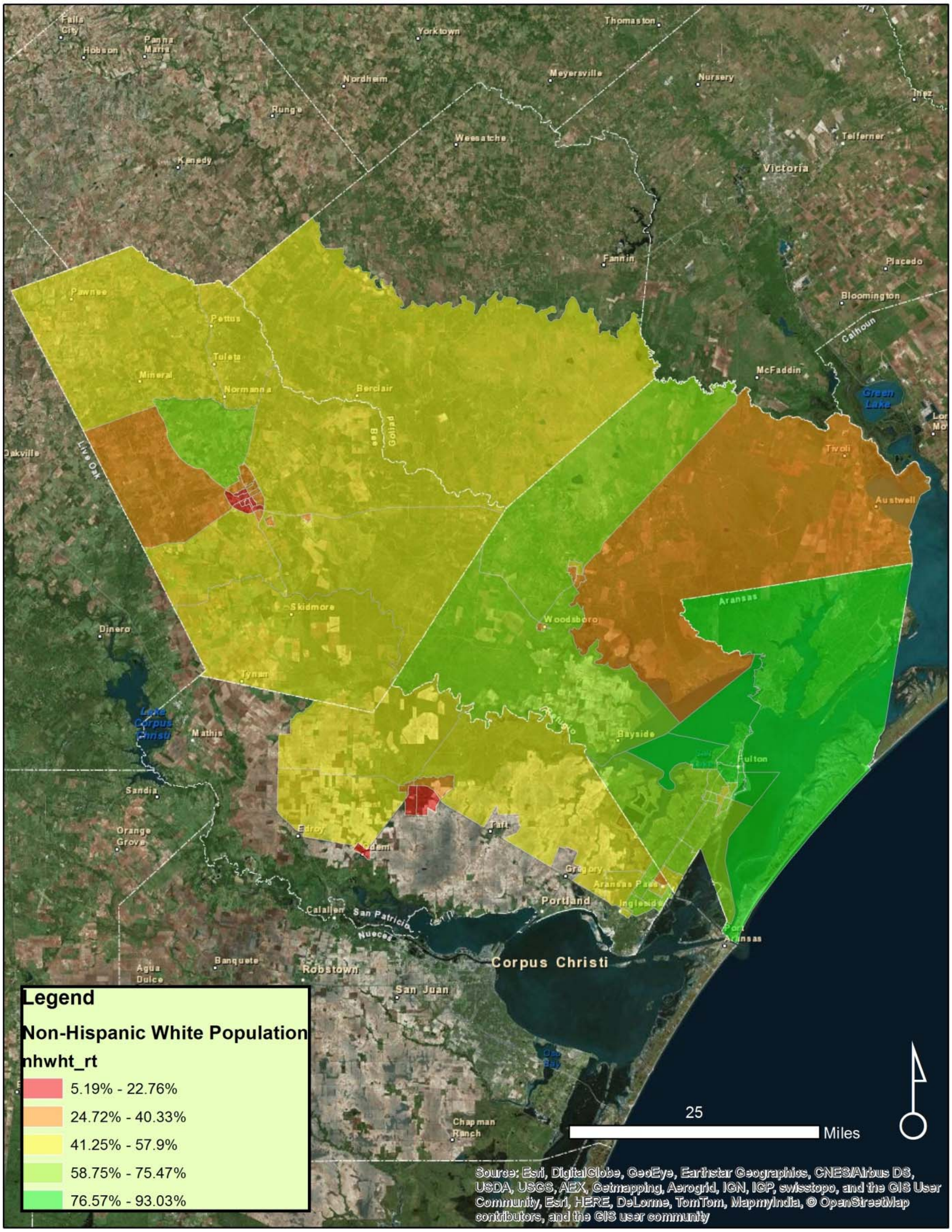
Renter Occupied Housing



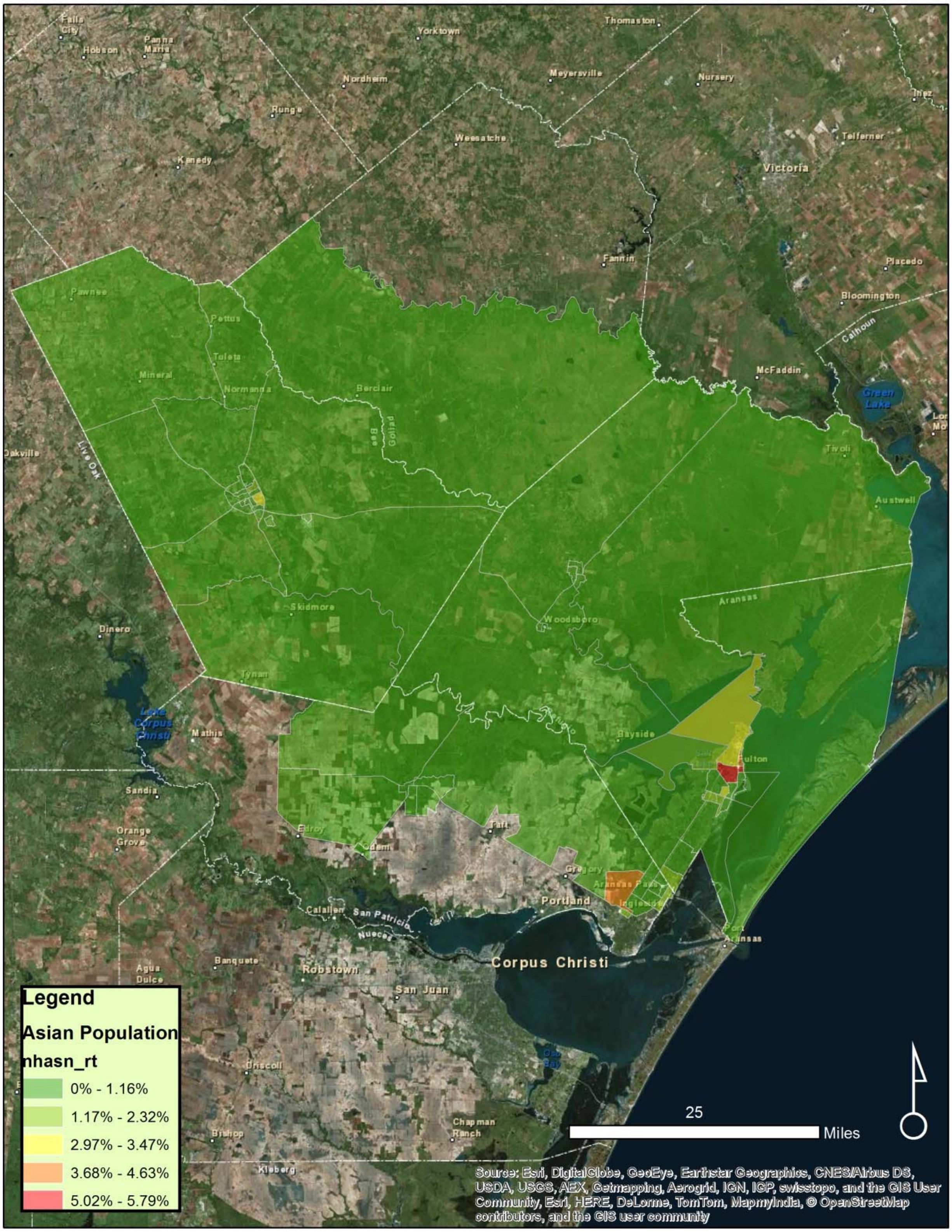
HISPANIC POPULATION



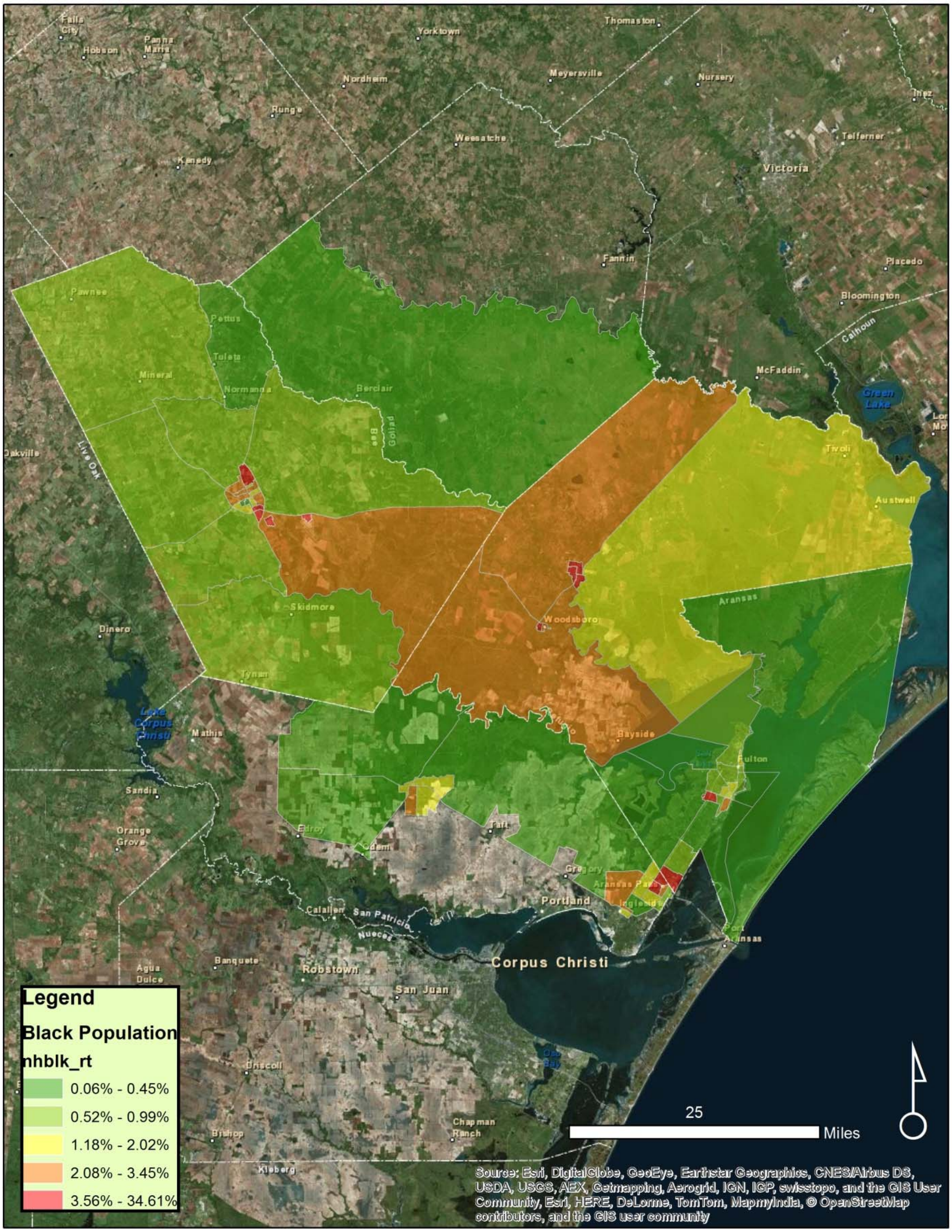
NON-HISPANIC WHITE POPULATION



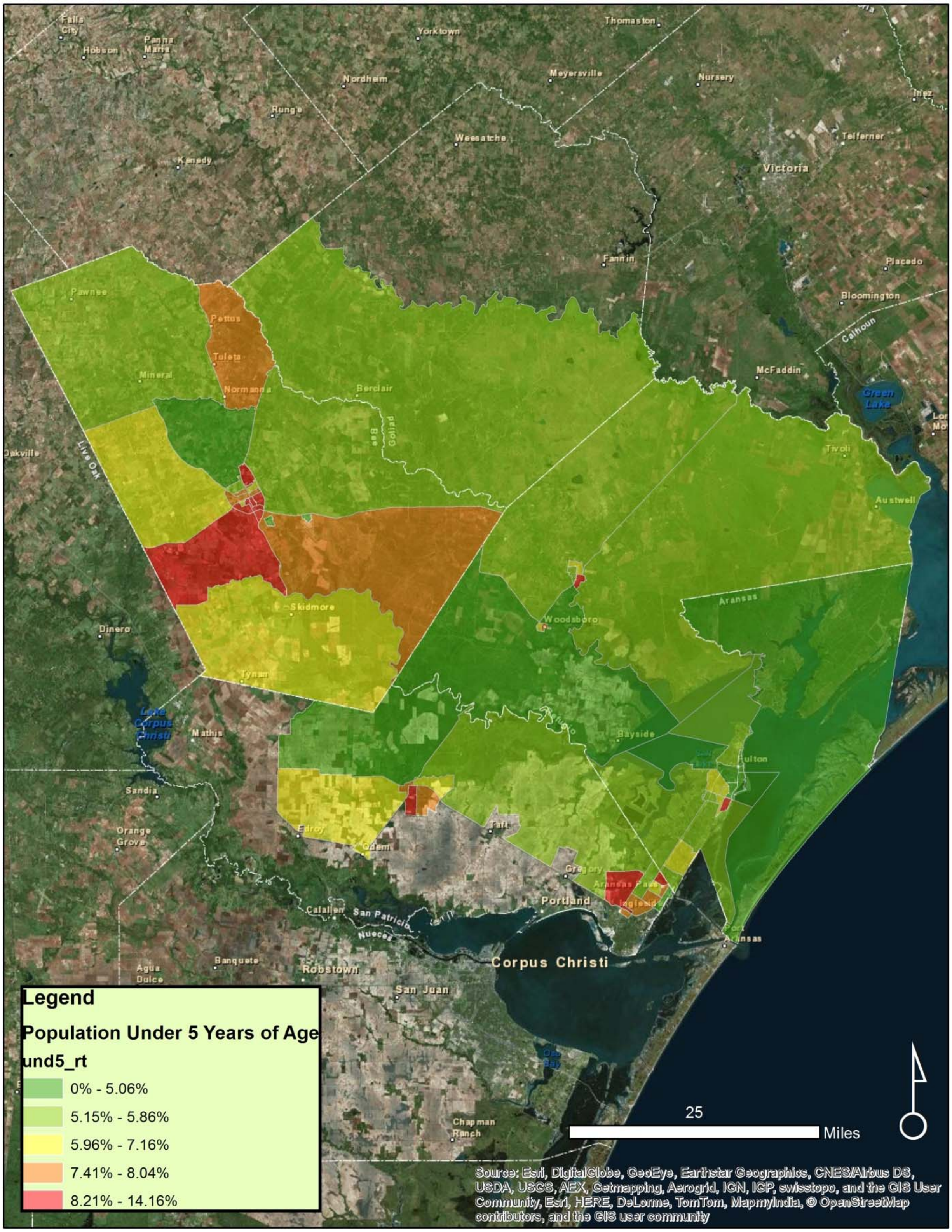
Asian Population



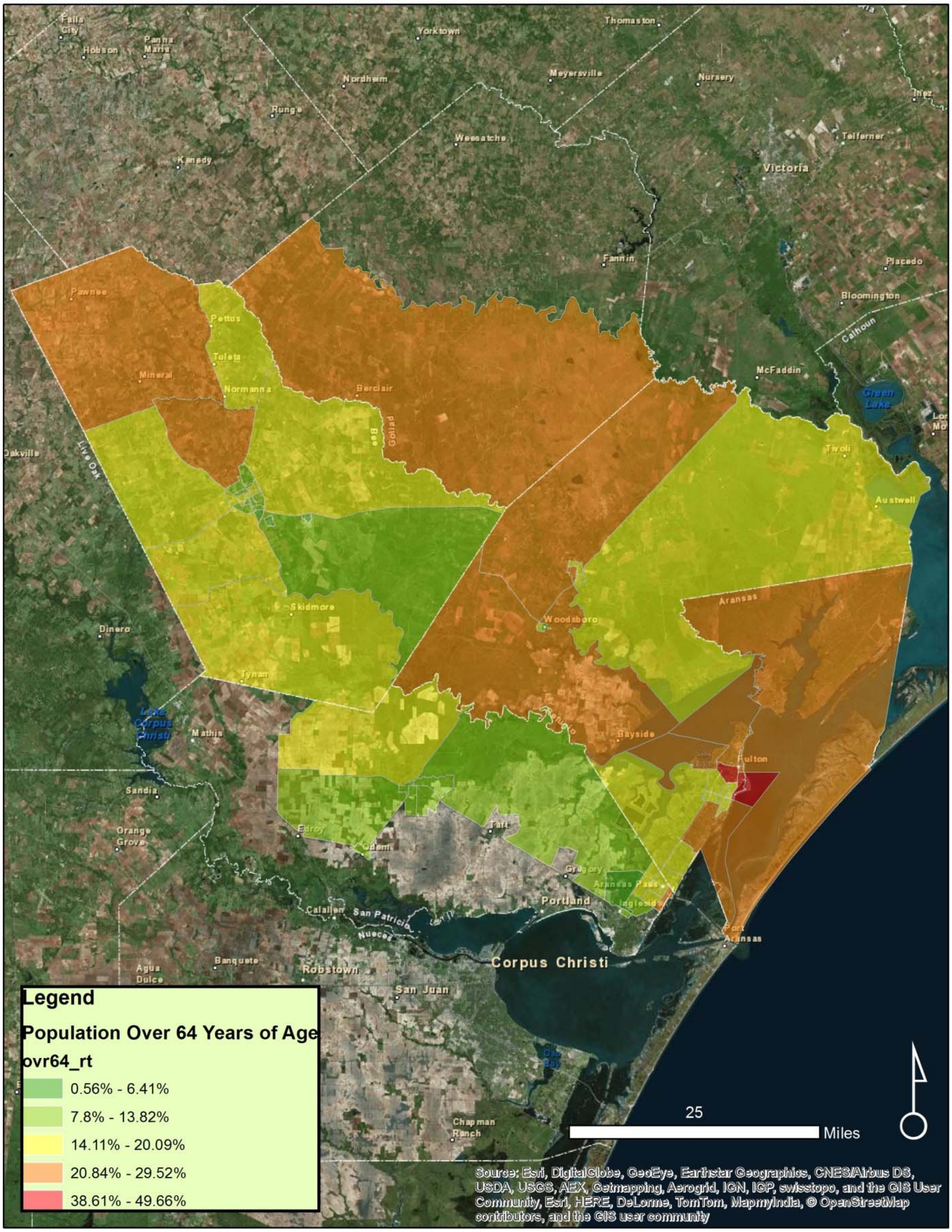
Black Population



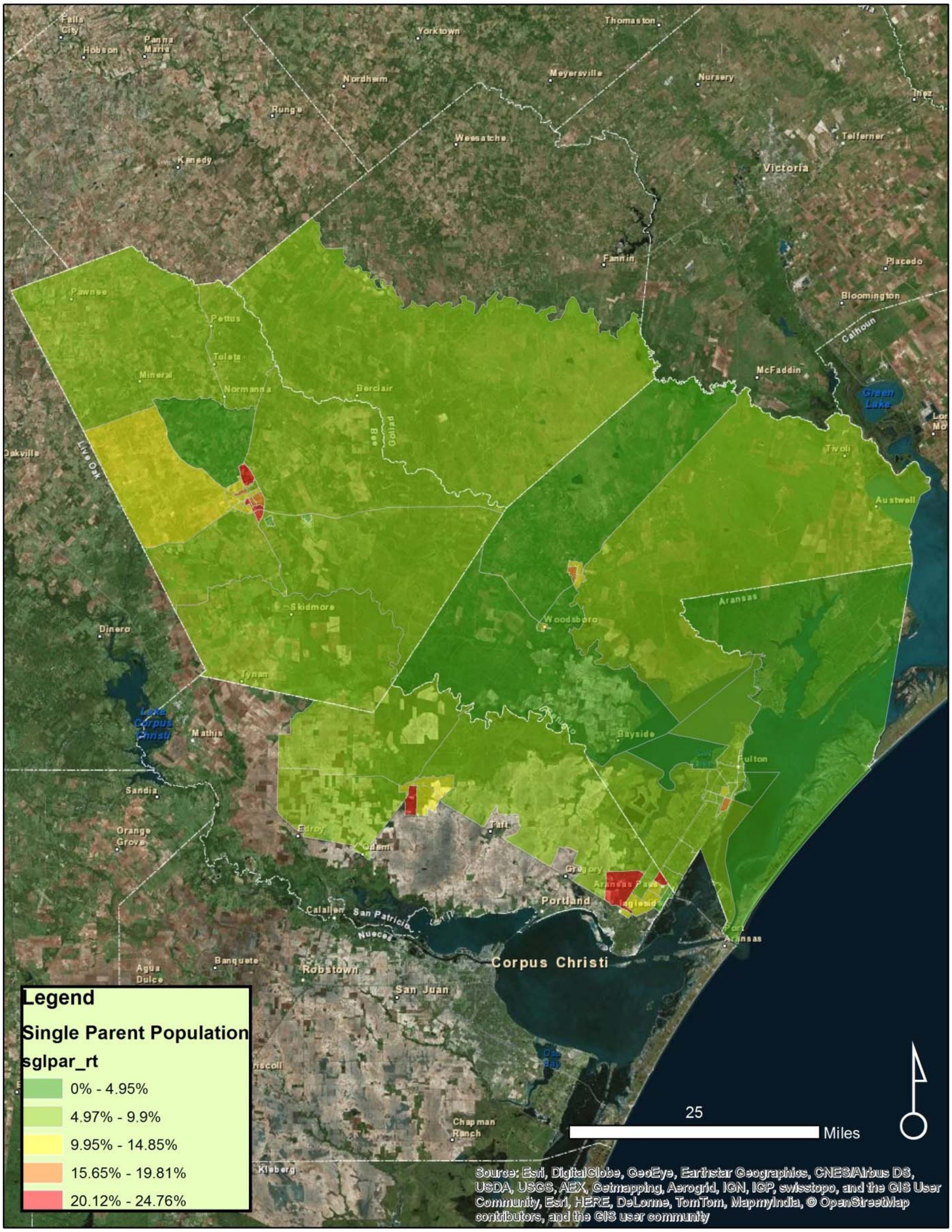
POPULATION 5 YEARS AND UNDER



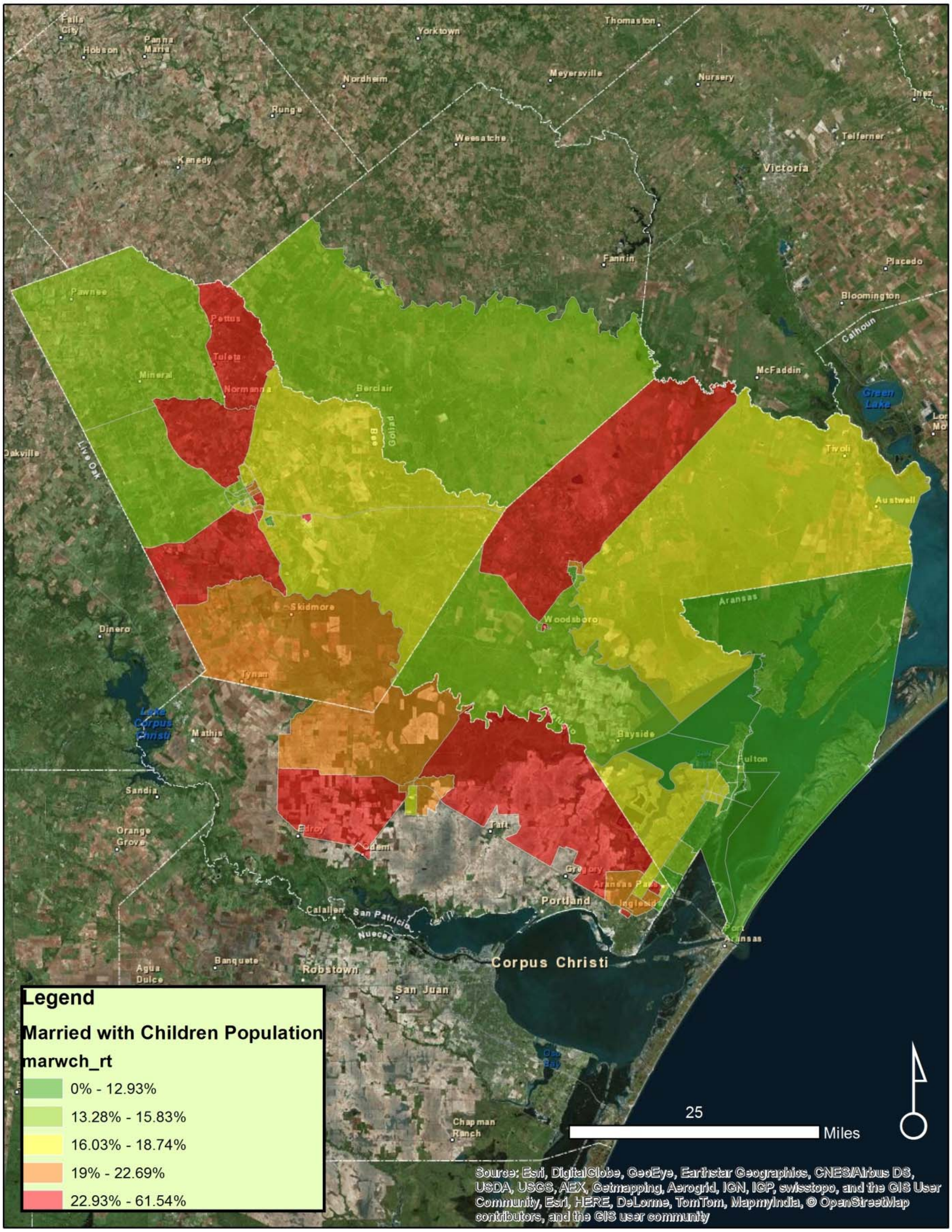
POPULATION 65 YEARS AND OLDER



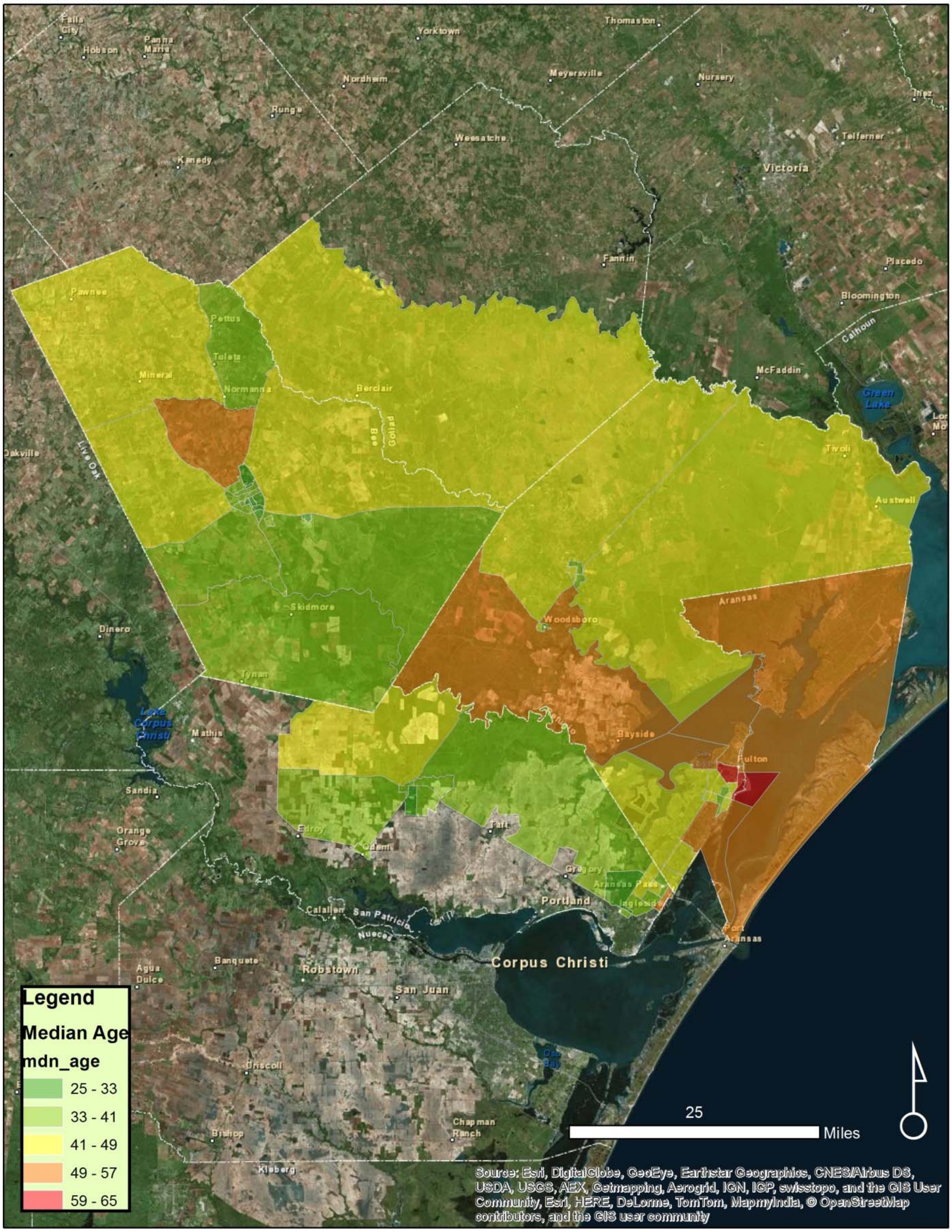
Single Parent Population



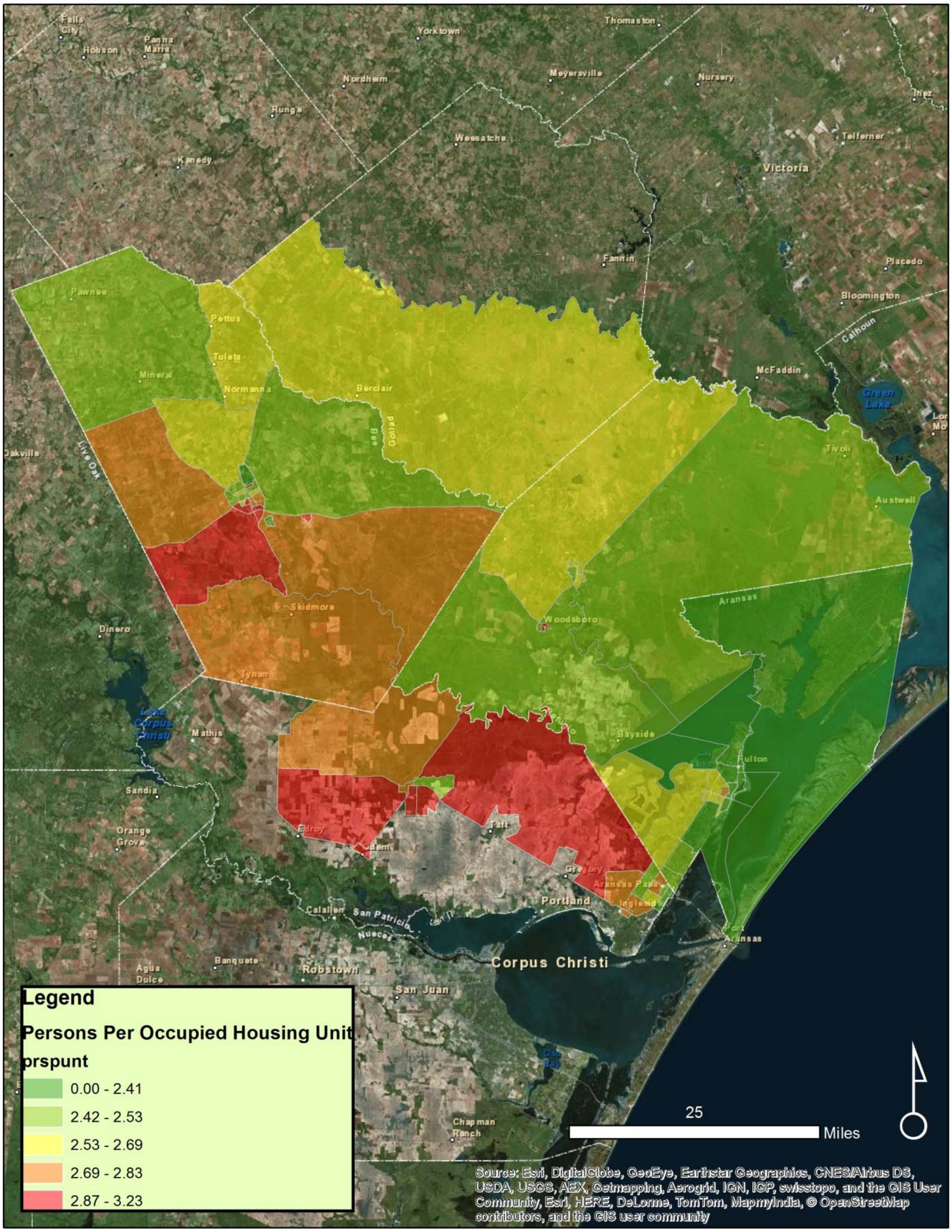
Married with Children Population



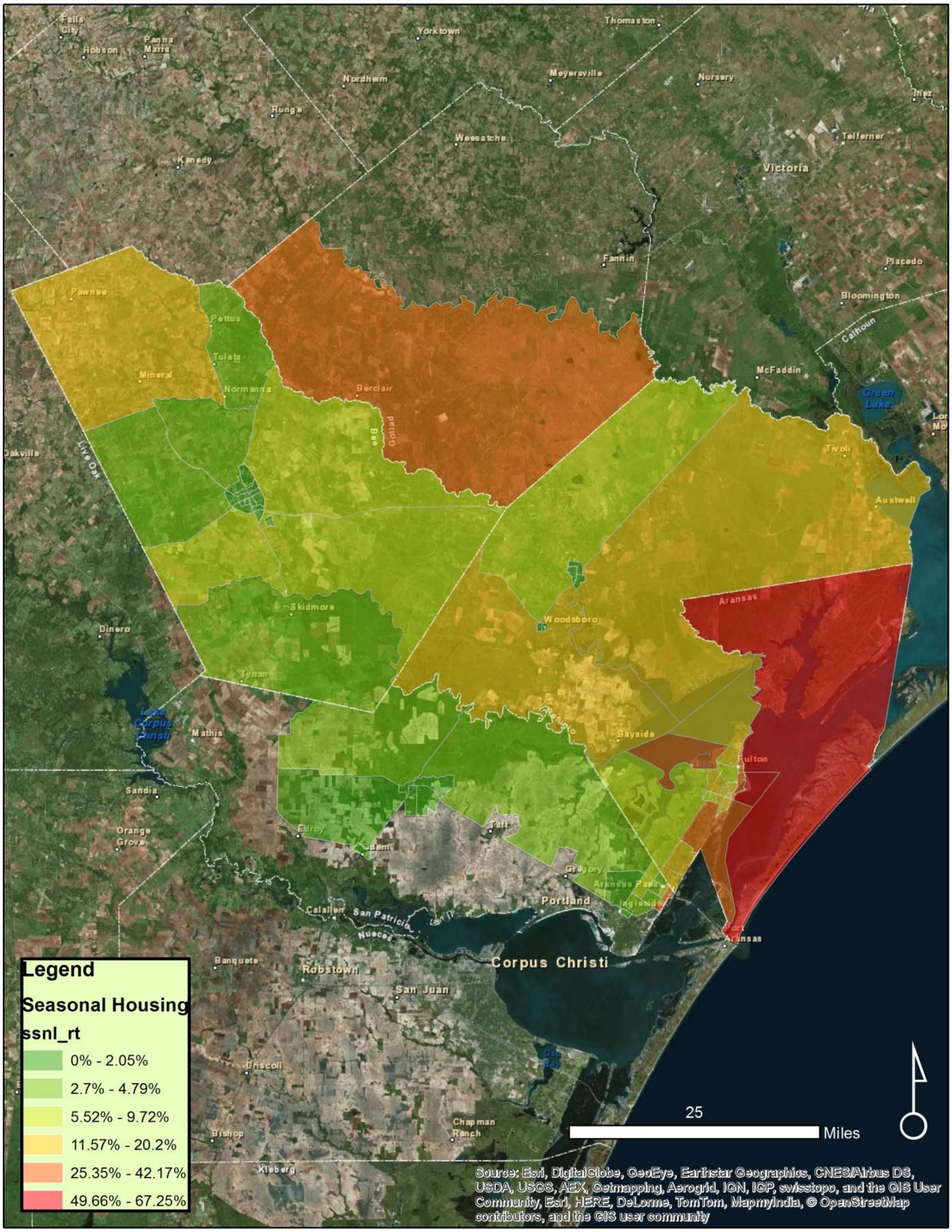
MEDIAN AGE


Legend
Median Age
mdn_age
25 - 33
33 - 41
41 - 49
49 - 57
59 - 65
25
Miles
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
Victoria
Corpus Christi
Portland
Robstown
San Juan
Fulton
Aransas
Bayside
Woodsboro
Skidmore
Tynan
Mathis
Sinton
Taft
Gregory
Aransas Pass
Ingleside
Port Aransas
Tivoli
Austwell
Berclair
Goliad
Pettus
Tuleta
Normanna
Mineral
Pawnee
Live Oak
Fannin
McFaddin
Bloomington
Placedo
Yorktown
Nordheim
Runge
Kenedy
Weesatche
Meyersville
Thomaston
Nursery
Telferner
Dinero
Sandia
Orange Grove
Agua Dulce
Banquete
Driscoll
Bishop
Kleberg
Chapman Ranch
Calallen
San Patricio
Nueces
Odem
Edroy

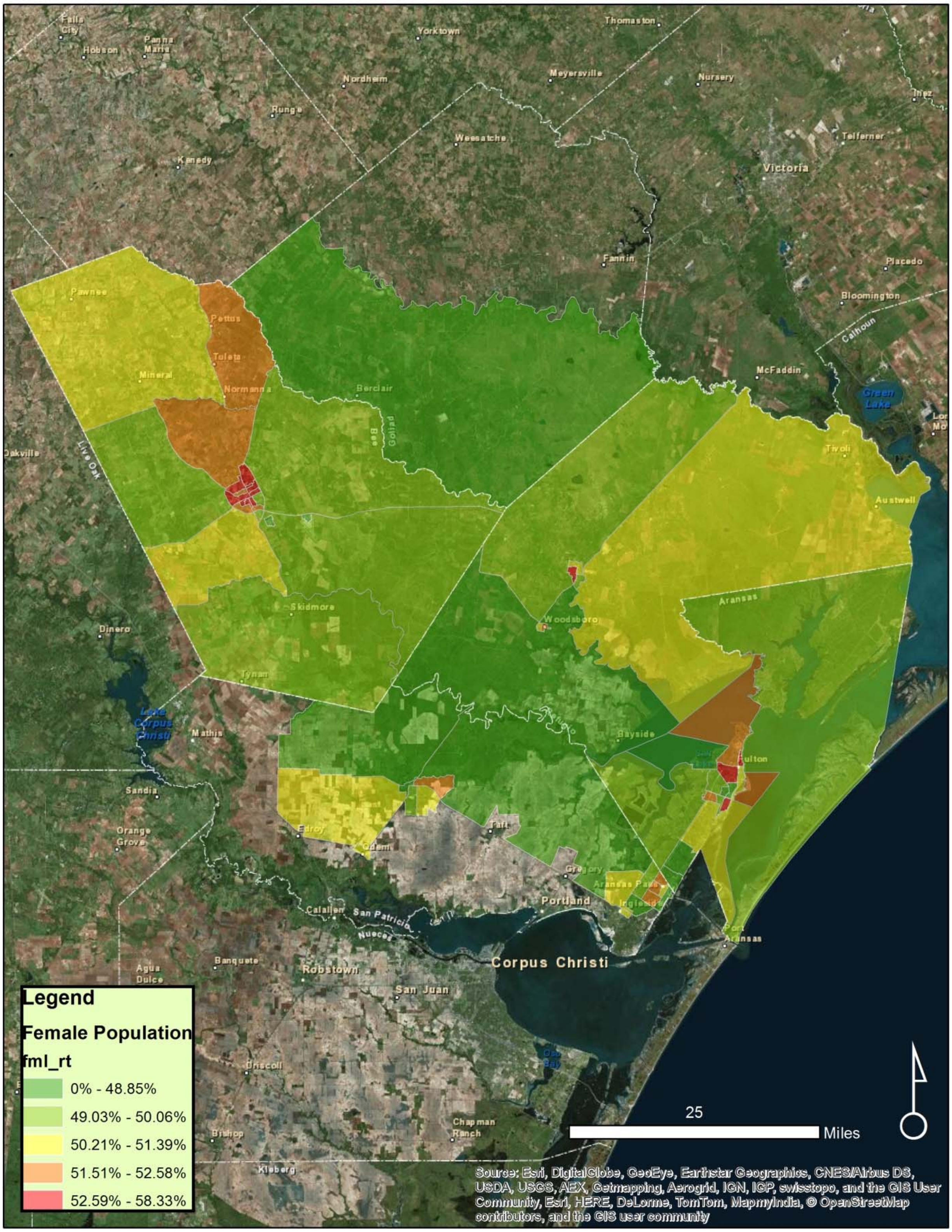
Persons per occupied housing unit



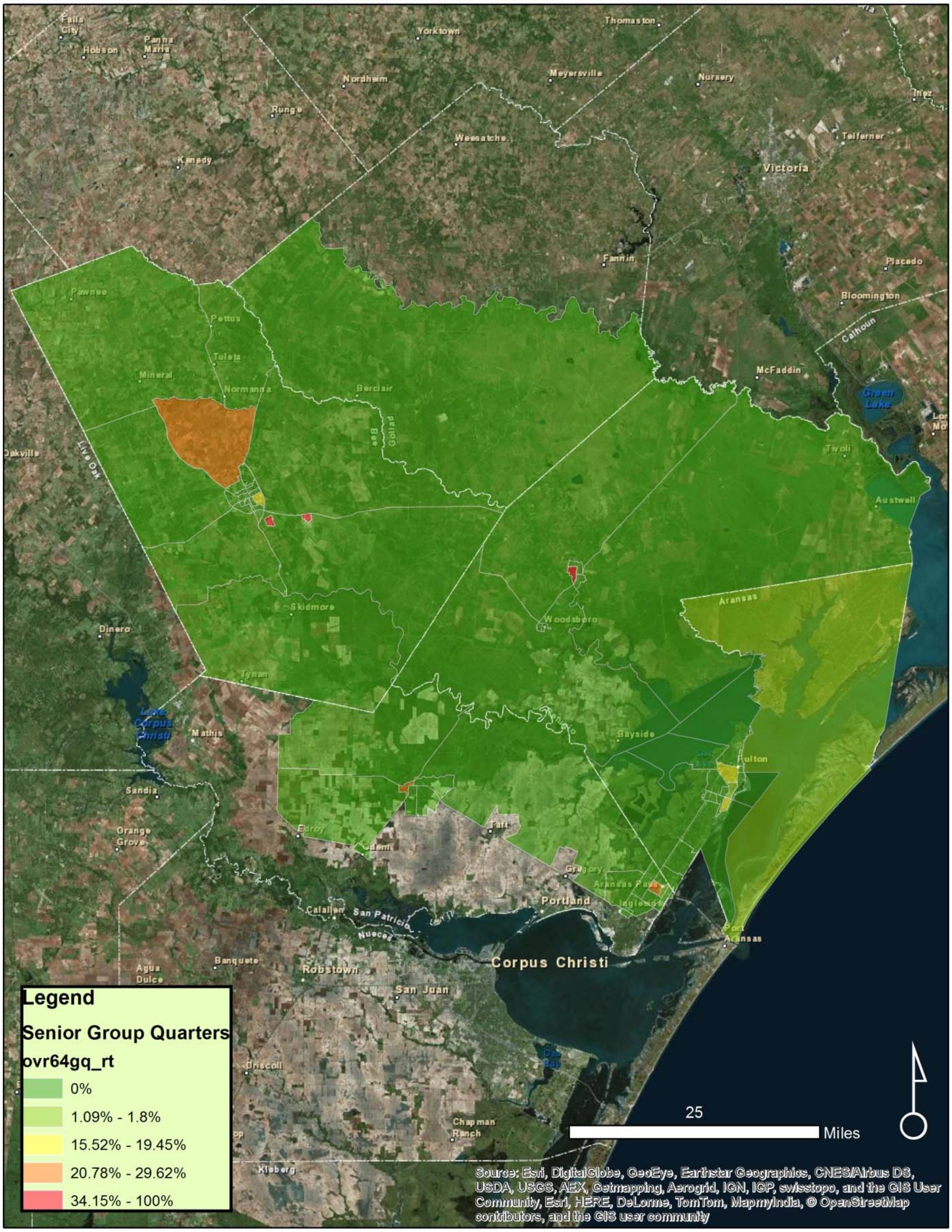
Seasonal Housing Unit



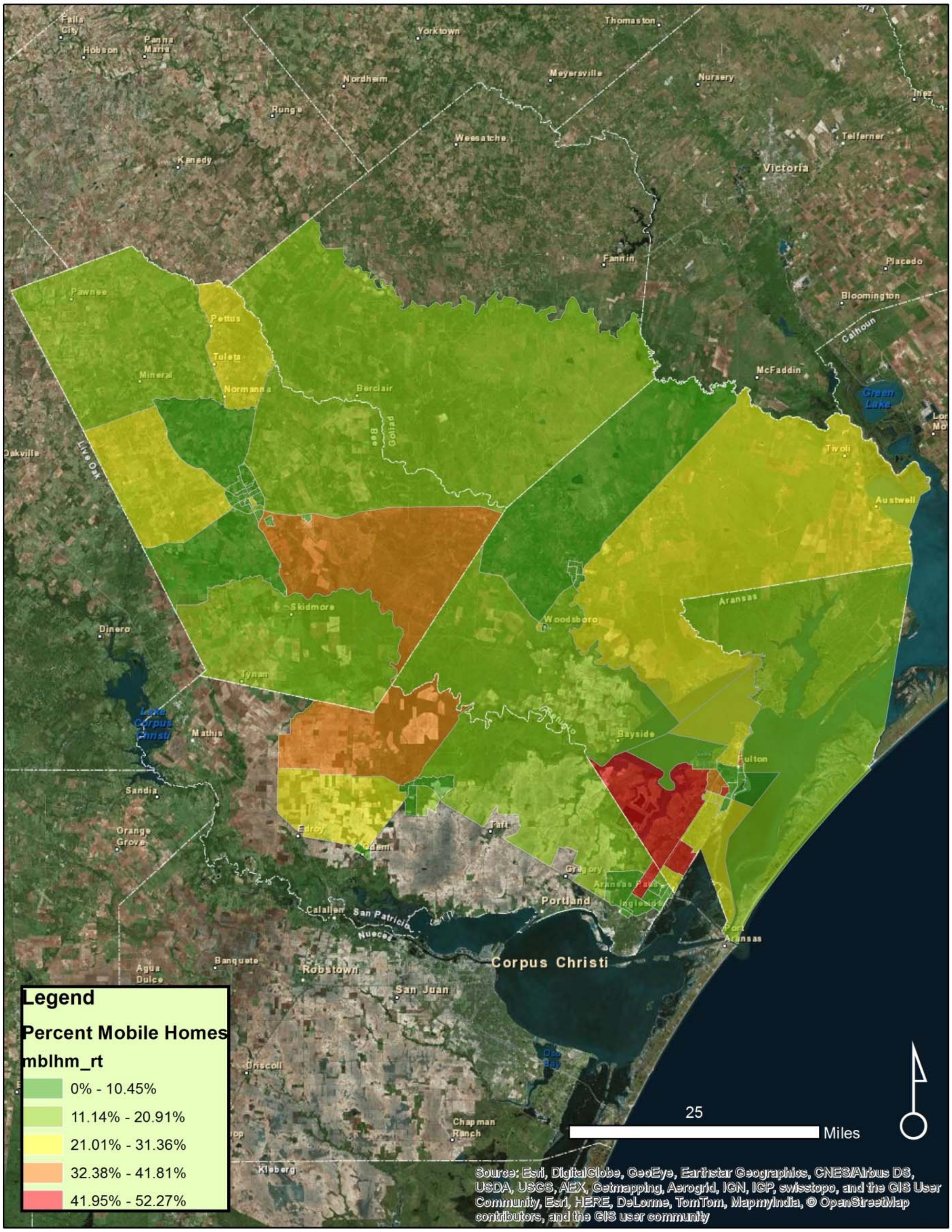
Percent Female



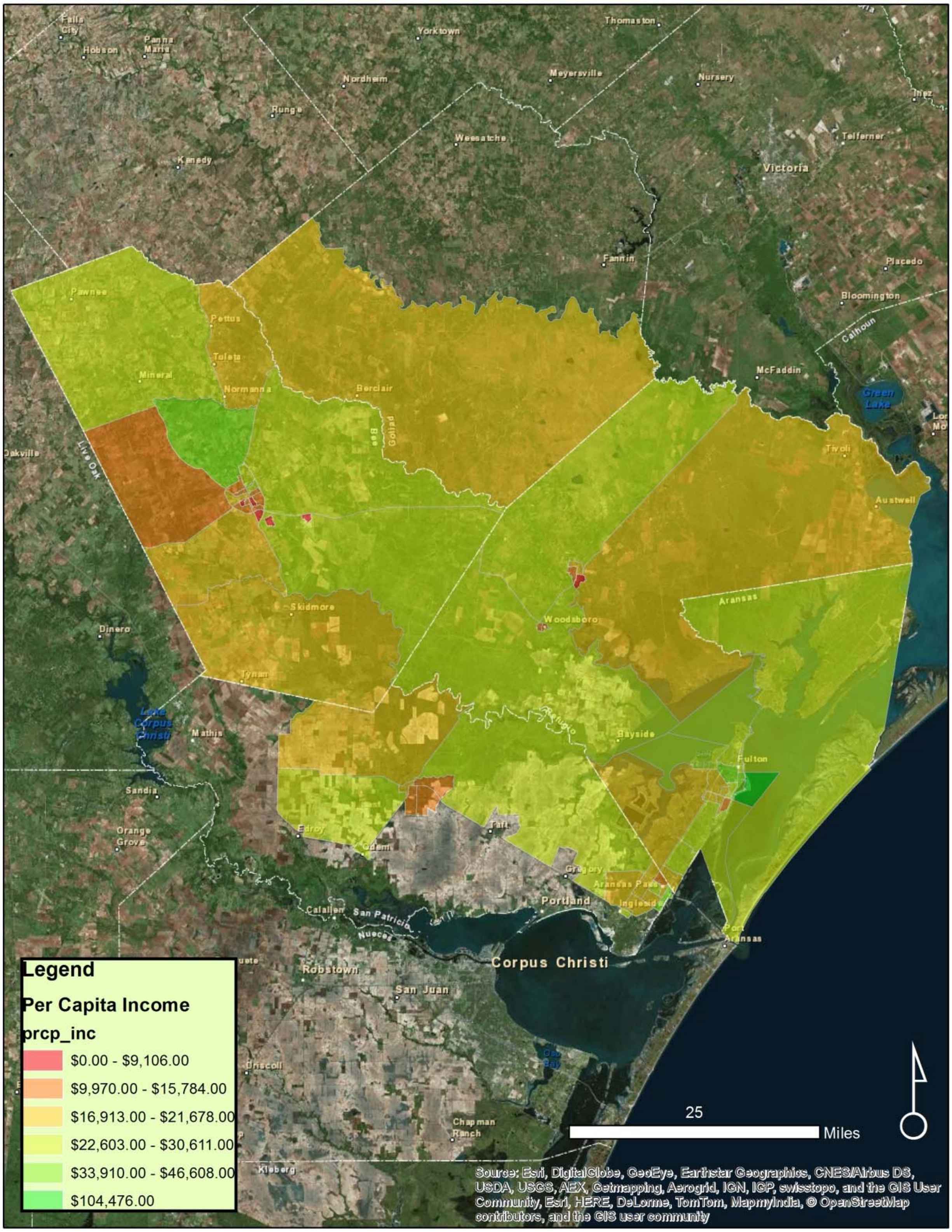
Senior Group Quarters



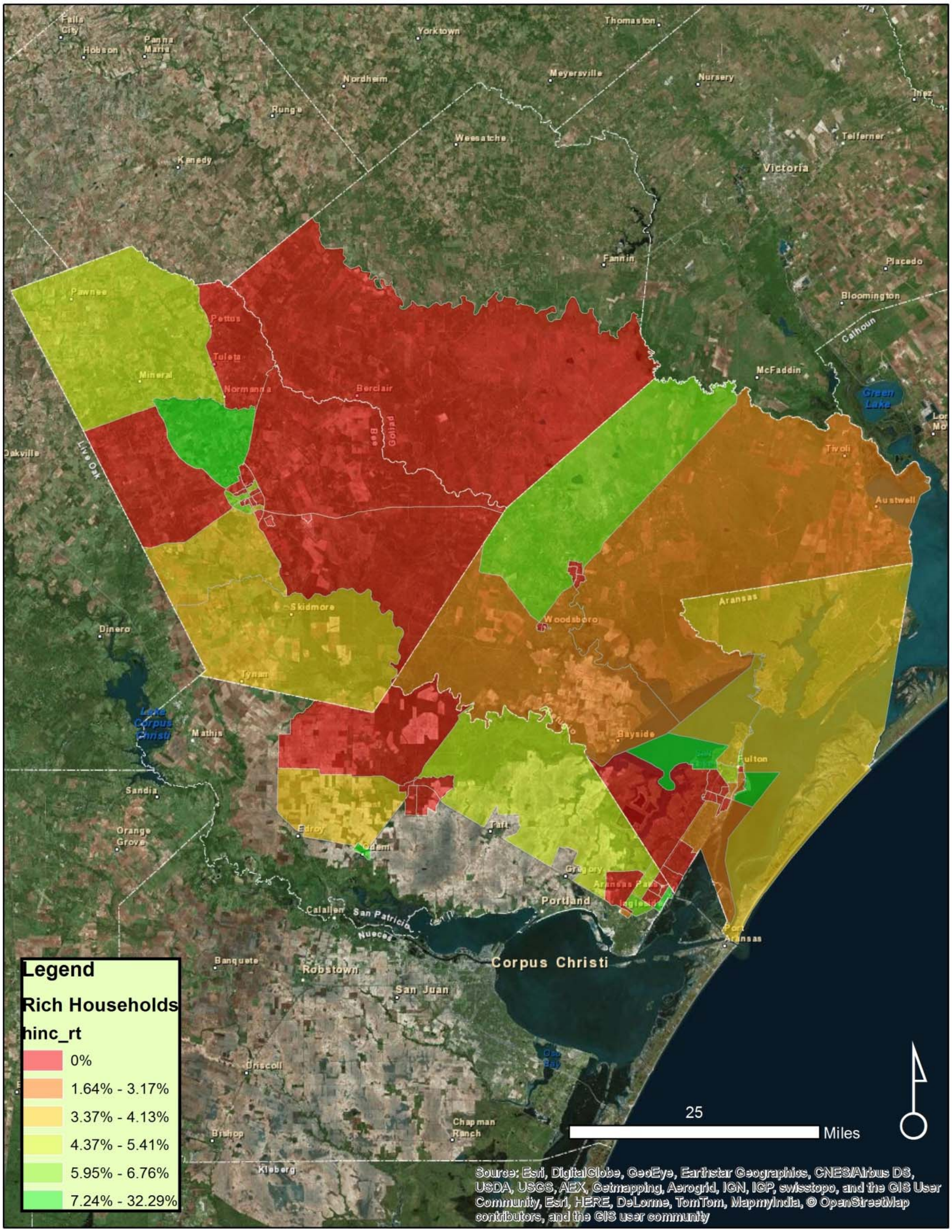
Percent Mobile Homes



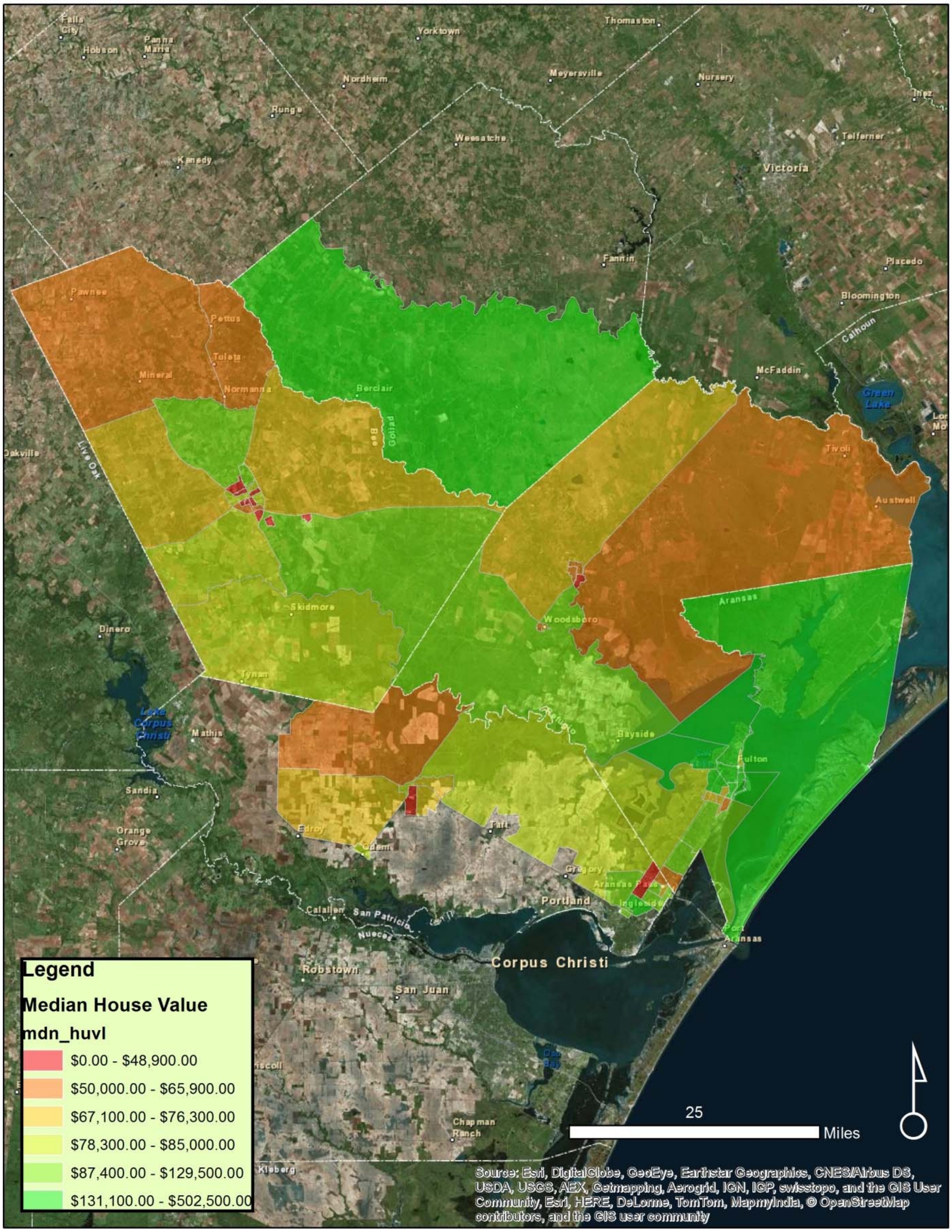
PER CAPITA INCOME



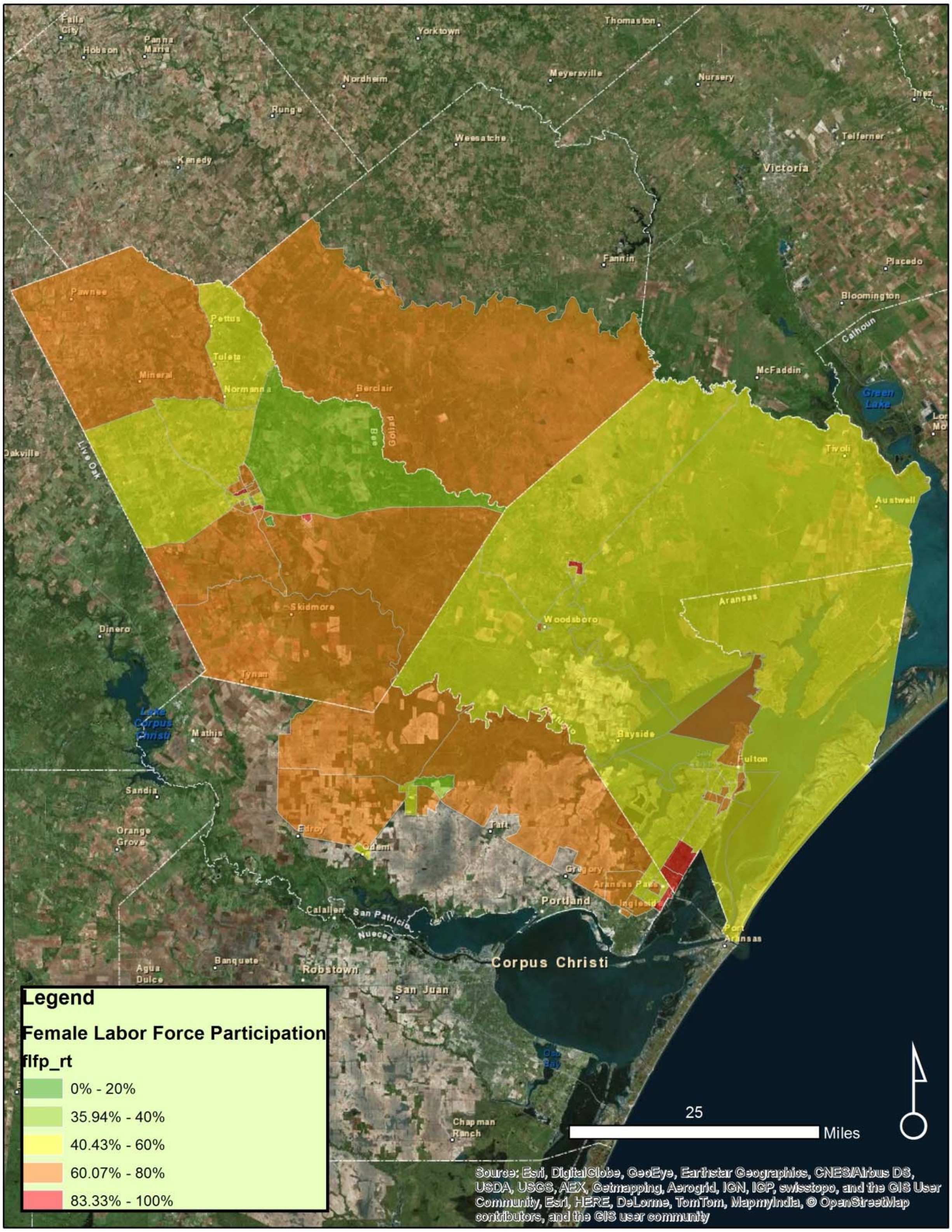
RICH HOUSEHOLDS



MEDIAN HOUSE VALUE



Female Labor Force in Population



PCA Results

Percentage of variance after Varimax rotation:

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
Variability (%)	21.51	16.21	5.79	4.84	9.32	4.85	4.29	8.24	4.67	4.29
Cumulative %	21.51	37.72	43.51	48.35	57.67	62.52	66.81	75.06	79.72	84.01

Factor loadings after Varimax rotation:

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9	PC10
hsls_rt	-0.477	0.149	0.230	0.357	0.473	-0.208	0.184	0.076	0.317	0.146
nonen_rt	-0.616	0.098	0.103	0.519	0.280	0.185	0.105	-0.133	0.210	0.122
lep_rt	-0.408	0.095	0.096	0.421	0.256	0.076	-0.126	-0.104	0.498	0.058
pov_rt	-0.148	-0.239	0.312	-0.038	0.577	0.044	0.211	0.211	0.286	0.223
hinc_rt	0.394	-0.030	0.231	0.113	-0.682	0.097	0.279	-0.116	0.006	0.127
mdn_inc	0.179	-0.253	-0.085	-0.177	-0.774	-0.014	-0.045	-0.219	-0.168	-0.114
ssr_rt	0.432	-0.300	-0.170	0.300	0.205	-0.060	0.271	-0.345	-0.071	0.344
pbast_rt	-0.153	-0.049	0.023	0.022	0.123	0.081	0.080	0.013	0.844	0.005
prcp_inc	0.581	-0.113	0.170	0.031	-0.714	0.020	0.108	-0.146	-0.080	0.010
flfp_rt	-0.058	0.375	0.194	-0.177	0.025	0.177	0.147	-0.088	-0.068	-0.702
nowrk_rt	-0.109	0.384	0.163	0.015	0.066	-0.076	0.044	0.104	-0.033	0.786
mblhm_rt	0.133	-0.094	-0.195	-0.597	0.271	0.045	0.123	-0.422	0.034	-0.192
mdn_yrblt	0.038	-0.969	-0.035	-0.036	-0.064	-0.028	-0.039	-0.096	0.056	-0.018
novh_rt	-0.105	-0.188	0.382	0.299	0.323	-0.275	0.085	0.408	0.324	-0.046
mdn_rnt	0.150	-0.272	0.088	-0.320	0.266	0.313	-0.639	0.063	-0.116	-0.063
mdn_huvl	0.599	-0.141	0.138	0.016	-0.673	0.071	-0.050	-0.080	0.053	0.059
mov_rt	-0.043	0.476	-0.131	0.052	0.136	0.040	-0.056	0.527	0.416	-0.206
svcem_rt	0.157	-0.436	-0.190	0.223	-0.025	0.648	0.074	-0.009	0.165	0.107
extem_rt	-0.166	-0.104	-0.115	0.034	0.061	-0.815	0.011	-0.085	0.031	0.260
sqmi_land	0.132	-0.041	-0.404	0.158	0.082	-0.547	0.251	-0.310	-0.282	-0.008
pop_dens	-0.193	0.631	0.622	0.048	0.114	0.021	-0.083	0.235	-0.065	-0.011
hu_dens	0.128	-0.139	0.876	0.100	-0.143	0.073	-0.042	0.201	0.041	0.011
rent_rt	-0.314	0.344	0.213	0.016	0.208	0.079	-0.028	0.775	-0.051	0.095
ssnl_rt	0.842	-0.028	0.134	-0.039	-0.206	0.085	0.149	-0.093	-0.027	-0.023
rntpop_rt	-0.283	0.347	0.234	0.016	0.226	0.092	-0.040	0.769	-0.054	0.116
prspunt	-0.877	0.272	-0.019	-0.089	0.032	-0.064	0.101	-0.119	0.054	0.103
hisp_rt	-0.839	-0.111	0.109	0.374	0.183	-0.032	0.174	0.012	0.035	0.029
nhwht_rt	0.828	-0.001	-0.097	-0.388	-0.197	0.003	-0.140	-0.094	-0.042	-0.042
nhasn_rt	0.294	0.010	0.052	0.117	-0.056	-0.080	-0.803	0.025	-0.019	0.081
nhblk_rt	0.043	0.780	-0.089	0.163	0.165	0.079	0.084	0.188	0.076	0.061
und5_rt	-0.740	-0.407	0.072	-0.099	0.123	-0.013	0.106	0.376	0.115	0.022
ovr64_rt	0.857	-0.196	0.079	0.139	-0.096	0.144	-0.076	-0.214	-0.057	0.119
fml_rt	-0.041	-0.947	0.059	0.099	-0.063	0.052	-0.102	0.012	-0.017	0.042
mdn_age	0.905	-0.071	-0.041	0.020	-0.142	-0.001	-0.025	-0.334	-0.047	0.026
sglpar_rt	-0.605	-0.318	0.129	0.040	0.197	0.096	0.004	0.560	0.173	0.039
marwch_rt	-0.521	0.771	-0.099	-0.119	-0.115	-0.081	-0.035	-0.028	-0.093	0.053
ovr64gq_rt	0.042	0.883	0.018	0.110	0.040	-0.041	-0.084	0.189	0.081	0.039

Block Group	hsls_rt (%)	nonen_rt (%)	lep_rt (%)	pov_rt (%)	hinc_rt (%)	mdn_inc ($)	ssr_rt (%)	pbast_rt (%)	prcp_inc ($)	flfp_rt (%)	nowrk_rt (%)	mblhm_rt (%)	mdn_yrblt (YYYY)	novh_rt (%)	mdn_rnt ($)	mdn_huvl ($)	mov_rt (%)	svcem_rt (%)
480079501001	9.18	8.57	4.90	14.69	3.47	36,852	49.31	0.00	28,450	54.88	38.95	11.63	1983	10.07	793	165,500	3.95	53.35
480079501002	8.06	12.06	6.08	20.01	11.99	41,713	40.28	0.00	29,857	56.10	28.38	16.85	1977	1.19	783	195,100	18.94	48.73
480079501003	14.10	18.47	4.35	15.93	4.13	41,597	50.49	0.00	23,485	67.00	34.82	24.51	1987	3.76	937	168,800	2.50	72.54
480079501004	10.94	19.41	14.02	8.47	0.00	42,315	20.48	0.00	26,446	55.56	43.82	0.00	1984	7.83	1,264	184,500	20.37	43.33
480079501005	17.88	10.40	0.36	11.31	6.76	32,292	45.91	1.42	25,214	67.55	21.70	32.38	1980	14.59	715	78,300	11.50	42.42
480079502001	0.00	6.10	0.00	0.00	32.29	100,893	43.23	0.00	104,476	57.94	38.27	0.00	1977	4.69	n/a	502,500	0.00	61.90
480079502002	9.80	11.09	1.35	1.78	1.64	52,375	57.17	0.00	33,910	64.08	23.65	2.66	1977	0.00	922	166,600	8.60	62.58
480079503001	4.84	4.69	1.17	9.73	4.66	53,493	48.72	0.00	36,225	55.76	34.79	4.84	1994	0.79	1,139	210,400	15.10	36.15
480079503002	8.13	6.53	3.22	14.72	2.51	48,068	52.43	0.00	30,611	57.87	36.65	0.00	1974	10.22	645	155,400	5.88	44.77
480079503003	29.65	36.06	17.25	28.57	0.00	32,008	42.00	4.93	21,005	57.98	17.20	40.51	1992	13.00	1,024	134,200	11.05	44.52
480079503004	13.64	24.30	4.62	28.98	0.00	40,521	38.26	3.30	17,540	72.30	29.12	44.35	1976	0.00	817	76,300	29.43	54.10
480079504001	35.41	34.39	16.62	46.74	0.00	14,268	35.18	8.60	10,949	62.88	36.46	0.00	1974	30.11	442	57,600	44.54	51.82
480079504002	25.04	50.97	22.63	11.81	0.00	52,045	29.75	0.00	19,080	75.89	17.70	28.53	1984	3.68	771	69,500	18.70	45.59
480079504003	15.45	24.32	14.26	16.33	0.00	42,054	22.82	0.00	16,913	77.14	20.40	22.82	1979	9.40	1,175	67,100	8.26	52.96
480079505001	21.62	37.39	7.34	13.49	3.17	44,611	49.30	0.00	26,425	56.61	22.51	24.82	1985	2.99	824	114,400	12.86	46.06
480079505002	25.96	5.43	5.43	18.17	0.00	62,620	8.16	0.00	24,771	92.86	12.85	52.27	1979	9.97	445	129,100	48.62	37.72
480079505003	20.46	19.10	5.56	35.52	0.00	28,281	52.99	4.79	21,017	83.33	23.19	26.65	1978	0.00	492	59,600	6.14	57.09
480079505004	11.85	8.08	2.07	6.93	0.00	50,603	46.28	0.93	19,897	58.93	36.35	48.14	1987	0.00	676	84,100	12.84	42.50
480259501001	27.97	26.30	5.33	19.07	0.00	29,659	34.36	0.00	17,258	50.00	30.43	26.54	1968	3.35	876	50,000	15.96	42.54
480259501002	23.97	25.80	3.91	13.35	4.37	39,875	50.79	0.00	23,556	69.69	29.98	11.90	1973	0.00	650	65,900	5.25	36.23
480259502011	44.63	54.07	15.08	0.00	0.00	n/a	0.00	0.00	5,196	100.00	66.07	0.00	n/a	0.00	n/a	n/a	65.27	0.00
480259502013	17.54	15.99	4.18	8.25	0.00	53,068	15.63	0.00	25,965	79.11	19.82	39.84	1983	3.13	384	88,400	16.61	39.29
480259502021	26.02	42.28	19.50	39.52	3.48	16,979	40.19	0.00	17,401	67.28	33.83	1.58	1983	0.00	n/a	81,500	11.79	58.70
480259502022	34.27	30.17	10.01	16.91	0.00	33,214	55.17	0.00	23,900	35.94	60.33	12.76	1970	0.00	452	69,300	4.55	18.15
480259502023	14.45	20.08	1.40	1.59	7.24	66,644	26.73	0.00	36,368	55.68	25.27	3.23	1983	2.90	n/a	115,100	0.09	30.63
480259502024	20.12	36.24	3.71	13.41	0.00	43,355	31.00	0.00	13,237	53.57	27.28	27.84	1978	1.85	1,076	74,700	13.37	62.37
480259503001	22.41	50.32	15.63	18.66	0.00	36,688	23.11	2.27	14,483	67.98	30.00	0.00	1966	12.12	639	45,000	4.70	58.15

Block Group	hsls_rt (%)	nonen_rt (%)	lep_rt (%)	pov_rt (%)	hinc_rt (%)	mdn_inc ($)	ssr_rt (%)	pbast_rt (%)	prcp_inc ($)	flfp_rt (%)	nowrk_rt (%)	mblhm_rt (%)	mdn_yrblt (YYYY)	novh_rt (%)	mdn_rnt ($)	mdn_huvl ($)	mov_rt (%)	svcem_rt (%)
480259503002	7.23	29.77	5.13	7.62	0.00	63,571	23.76	0.00	27,672	60.07	14.98	0.00	1973	3.59	559	115,700	19.34	65.97
480259503003	23.85	32.96	5.88	7.68	4.75	50,655	40.06	1.48	23,324	64.89	28.05	0.00	1968	9.50	288	78,500	4.88	38.34
480259503004	23.05	27.69	6.18	23.32	0.00	46,923	17.09	0.00	22,648	72.22	11.48	0.00	1959	0.00	1,020	81,900	3.92	17.67
480259503005	41.47	52.13	23.76	28.66	0.00	24,153	31.95	0.00	11,881	85.10	23.01	0.00	1960	15.34	822	40,900	15.04	47.62
480259504001	13.07	47.18	4.44	23.70	6.76	32,589	39.86	0.00	20,488	57.14	22.70	0.00	1962	4.05	498	83,800	42.96	30.56
480259504002	17.08	46.24	6.52	18.25	0.00	52,865	32.23	0.00	15,426	79.15	25.30	0.00	1958	5.65	724	48,900	16.90	50.23
480259505001	30.10	32.79	6.29	42.34	0.00	33,560	14.40	0.00	4,187	71.11	83.14	0.00	1955	0.00	799	n/a	17.63	18.25
480259505002	54.09	70.70	12.58	11.92	5.95	24,625	40.48	8.93	11,418	66.67	46.06	0.00	1959	21.43	n/a	60,200	23.39	48.80
480259505003	49.53	47.01	16.98	48.51	0.00	13,125	28.11	0.00	9,106	39.83	39.59	21.01	1970	42.60	382	41,500	6.13	34.51
480259505004	59.32	61.11	18.80	24.91	0.00	27,500	48.48	0.00	13,390	40.43	57.64	0.00	1955	15.91	662	36,900	3.63	51.35
480259505005	56.93	76.88	17.69	34.85	0.00	12,824	51.66	4.27	8,150	67.28	44.00	0.00	1957	12.80	n/a	37,000	19.80	68.75
480259505006	36.00	40.02	14.57	14.64	0.00	29,569	13.40	0.00	14,312	58.96	22.97	3.35	1984	5.02	717	80,600	36.12	44.31
480259505007	38.60	10.56	1.14	21.45	3.52	26,944	17.58	0.00	9,970	85.09	19.75	13.28	1967	25.39	623	61,400	14.59	13.39
480259506001	24.81	44.62	7.67	14.85	3.89	39,773	44.82	0.00	17,702	60.15	35.94	15.67	1972	2.72	431	83,600	8.77	43.31
481759602002	33.27	31.13	10.83	4.31	0.00	50,324	57.35	0.00	21,678	76.65	21.27	15.05	1968	6.45	n/a	31,100	14.06	36.84
483919502001	25.79	18.85	2.95	13.91	6.44	56,627	69.15	0.00	27,003	50.64	34.55	10.17	1971	9.49	n/a	73,600	6.06	24.29
483919502002	18.84	22.52	7.66	7.03	0.00	53,854	52.13	1.57	20,170	84.81	19.97	10.29	1959	1.34	550	62,000	10.49	42.11
483919502003	45.87	42.45	18.96	37.69	0.00	22,414	52.22	2.22	14,401	51.31	35.74	0.00	1959	20.25	582	54,800	33.81	47.14
483919502004	38.47	38.48	13.98	38.78	0.00	26,184	57.48	5.14	9,061	44.96	31.78	3.27	1955	24.30	497	47,300	45.25	69.23
483919504001	14.71	22.92	5.93	10.88	3.16	54,461	43.60	0.95	23,521	56.69	25.28	12.16	1976	4.74	706	110,300	6.75	36.44
483919504002	34.45	39.92	13.39	19.72	1.64	31,058	60.00	0.27	19,793	46.75	32.89	21.37	1960	8.49	455	58,500	4.25	29.52
483919504003	30.13	39.21	7.10	12.25	0.00	33,750	32.94	0.00	15,261	76.28	17.37	28.53	1970	8.24	625	50,600	13.10	31.48
483919504004	22.49	24.35	4.96	4.04	0.00	38,929	30.11	0.00	15,166	46.51	35.04	4.55	1963	6.82	610	75,500	24.89	37.12
484090102011	17.67	18.23	0.72	11.17	0.00	45,625	41.57	1.37	19,711	50.00	34.71	0.00	1976	13.92	580	129,500	21.03	60.94
484090102012	10.90	13.52	7.22	19.44	11.34	31,646	32.79	0.00	46,608	84.87	11.85	0.00	1995	15.79	772	91,500	24.44	28.63
484090102013	46.60	26.09	3.10	37.92	0.00	38,438	30.97	3.63	16,937	53.61	34.10	1.96	1957	24.77	594	67,300	16.40	34.95

Block Group	hsls_rt (%)	nonen_rt (%)	lep_rt (%)	pov_rt (%)	hinc_rt (%)	mdn_inc ($)	ssr_rt (%)	pbast_rt (%)	prcp_inc ($)	flfp_rt (%)	nowrk_rt (%)	mblhm_rt (%)	mdn_yrblt (YYYY)	novh_rt (%)	mdn_rnt ($)	mdn_huvl ($)	mov_rt (%)	svcem_rt (%)
484090102021	39.29	38.41	16.99	18.70	0.00	34,133	24.70	6.63	10,320	59.57	28.93	12.35	1959	19.58	818	64,300	14.84	40.19
484090102022	15.68	30.71	12.24	17.70	5.41	36,637	36.08	3.29	21,011	49.84	23.55	41.95	1991	3.17	760	29,500	14.83	65.58
484090102023	27.05	28.71	11.96	20.93	0.00	40,459	49.08	0.00	26,517	69.52	28.06	0.00	1973	10.99	455	99,000	25.34	47.53
484090103011	22.79	28.46	16.79	15.08	6.24	47,614	19.69	8.38	19,760	74.75	21.34	4.29	1980	4.48	713	159,400	29.02	34.46
484090103012	19.00	27.16	5.72	16.40	2.77	56,950	35.46	2.77	24,583	63.03	28.20	0.00	1963	16.62	605	87,400	20.86	48.72
484090103013	15.86	29.37	6.07	9.12	0.00	41,250	9.51	0.00	19,673	64.80	15.60	0.00	1996	9.20	755	95,000	21.40	58.41
484090107001	16.37	23.22	6.32	8.77	5.34	54,659	30.27	0.00	25,743	68.06	24.19	15.13	1973	2.08	n/a	78,500	1.97	44.25
484090109001	27.65	42.81	12.37	23.12	0.00	52,841	36.5	3.07	19,070	70.42	22.85	34.57	1982	0.00	599	64,800	9.24	34.60
484090109002	15.13	27.98	8.43	7.57	3.37	60,476	48.61	1.59	22,603	67.04	26.83	29.96	1982	2.98	415	68,800	2.54	36.43
484090110001	29.72	55.95	15.24	23.19	0.00	25,395	41.45	6.09	14,476	77.18	24.21	11.14	1983	11.53	582	71,800	8.10	49.32
484090110002	34.35	37.55	12.15	8.49	0.00	35,256	22.93	0.00	15,784	39.71	21.91	0.00	1953	10.40	572	75,500	35.78	50.91
484090110003	35.73	42.94	23.76	7.51	0.00	47,895	23.61	7.78	18,301	58.30	25.24	0.00	1958	6.11	467	78,700	28.49	27.33
484090110004	47.01	52.21	33.18	20.75	0.00	26,364	38.27	5.59	11,073	52.16	29.28	3.21	1970	22.35	526	34,600	27.07	48.15
484090111001	29.62	50.67	28.45	17.66	12.25	59,500	29.41	0.00	24,876	55.91	41.63	0.00	1968	13.24	656	85,000	3.09	57.31

Block Group	extem_rt (%)	pop_dens	hu_dens	rent_rt (%)	ssnl_rt (%)	rntpop_rt (%)	prspunt	hisp_rt (%)	nhwht_rt (%)	nhasn_rt (%)	nhblk_rt (%)	und5_rt (%)	ovr64_rt (%)	fml_rt (%)	mdn_age	sglpar_rt (%)	marwch_rt (%)	ovr64gq_rt (%)
480079501001	7.18	6.64	7.49	13.84	49.66	15.26	2.09	12.69	85.23	1.04	0.09	2.68	28.76	49.91	55.3	4.37	10.02	1.80
480079501002	0.00	463.64	348.32	17.54	33.78	18.56	2.33	16.68	80.20	1.89	0.22	3.12	29.44	48.37	54.1	2.87	11.97	0.00
480079501003	1.39	379.79	253.63	25.19	20.20	29.32	2.26	14.37	79.69	3.46	0.93	5.75	27.23	51.73	50.2	8.36	12.87	0.00
480079501004	7.33	1508.94	1135.68	34.97	30.42	38.16	2.08	10.00	81.05	5.79	0.53	3.16	26.84	51.32	50.6	5.46	13.66	0.00
480079501005	0.00	1192.53	1022.17	28.95	29.11	30.29	1.97	15.43	76.57	4.00	1.52	3.24	29.52	54.48	55.4	5.26	7.89	0.00
480079502001	0.00	1483.51	2666.98	9.83	67.25	12.36	1.90	5.39	93.03	0.45	0.22	1.80	49.66	51.69	64.9	1.28	6.84	0.00
480079502002	0.00	979.24	957.42	20.34	42.17	24.51	2.03	10.31	86.91	0.00	0.84	2.51	39.42	51.39	60.3	5.65	9.32	0.00
480079503001	4.22	989.38	567.33	27.09	8.83	27.96	2.07	10.46	82.36	5.02	0.72	3.42	38.61	55.06	58.6	5.06	11.43	15.52
480079503002	4.26	1719.30	860.27	37.64	12.57	38.45	2.25	26.54	70.14	0.87	1.30	5.06	19.88	46.85	44.3	5.32	12.93	1.09
480079503003	2.23	632.15	311.58	17.42	11.89	21.14	2.56	35.12	60.50	1.02	0.80	6.15	17.02	49.17	43.3	8.20	18.74	0.00
480079503004	0.00	2173.20	1008.49	29.59	11.57	31.48	2.80	48.68	45.13	3.37	1.82	6.82	15.01	47.95	37.6	12.24	18.62	0.00
480079504001	11.52	2023.48	1481.23	57.55	19.09	60.60	2.11	35.01	58.75	0.61	2.92	8.21	19.88	53.19	44.4	18.88	7.70	19.45
480079504002	0.00	1271.38	752.72	28.90	16.51	28.98	2.54	50.23	46.48	1.59	0.80	7.16	17.39	49.09	40.5	8.09	17.63	0.00
480079504003	0.00	1348.55	627.64	16.95	9.09	19.20	2.64	25.14	68.10	1.71	3.66	5.86	17.17	51.51	43.2	6.87	18.45	0.00
480079505001	0.00	219.47	163.39	17.54	34.45	17.62	2.36	29.43	66.74	0.83	0.42	5.30	26.48	50.78	50.0	5.88	11.98	0.00
480079505002	8.68	222.55	124.42	21.33	18.91	18.19	2.49	30.29	66.76	0.67	0.67	6.57	14.76	46.00	40.9	9.00	14.45	0.00
480079505003	0.00	397.21	236.29	32.57	19.46	29.72	2.42	34.99	57.47	1.62	3.77	5.52	16.02	46.97	43.6	9.54	10.53	0.00
480079505004	5.29	55.37	27.44	20.85	9.72	19.86	2.55	23.48	72.65	0.94	0.43	5.45	16.36	49.42	44.9	6.73	16.72	0.00
480259501001	18.23	17.29	7.94	21.14	3.54	25.41	2.68	48.31	49.69	0.00	0.38	7.63	16.77	52.32	38.9	8.39	23.15	0.00
480259501002	13.68	6.46	3.52	17.49	15.09	19.54	2.43	40.40	57.52	0.17	0.58	5.15	21.20	50.29	46.2	4.97	15.33	0.00
480259502011	0.00	9041.67	36.14	92.31	5.88	92.86	3.23	35.53	38.42	0.24	25.72	0.05	0.56	0.42	31.8	0.00	61.54	100.00
480259502013	17.17	5.57	2.34	15.93	6.61	14.02	2.76	52.96	41.25	0.48	2.90	7.84	10.62	49.34	40.1	7.80	18.64	0.00
480259502021	21.86	12.13	5.06	10.57	6.44	9.76	3.11	49.79	49.08	0.28	0.71	8.35	15.84	50.21	36.5	8.81	24.23	0.00
480259502022	30.37	9.38	4.84	18.98	6.19	17.26	2.47	52.47	45.55	0.84	0.61	5.17	18.40	49.20	44.8	7.14	16.35	0.00
480259502023	2.74	35.65	14.39	9.48	3.73	10.11	2.61	37.60	60.64	0.38	0.75	4.14	20.84	51.91	49.5	2.93	22.93	20.78
480259502024	6.45	16.91	7.82	19.93	4.79	19.67	2.69	67.31	30.47	0.42	0.62	5.96	15.86	49.38	41.4	10.80	15.83	0.00

Block Group	extem_rt (%)	pop_dens	hu_dens	rent_rt (%)	ssnl_rt (%)	rntpop_rt (%)	prspunt	hisp_rt (%)	nhwht_rt (%)	nhasn_rt (%)	nhblk_rt (%)	und5_rt (%)	ovr64_rt (%)	fml_rt (%)	mdn_age	sglpar_rt (%)	marwch_rt (%)	ovr64gq_rt (%)
480259503001	0.00	620.81	283.03	38.58	0.27	38.01	2.48	63.60	32.17	0.37	2.36	5.84	13.04	53.66	36.3	12.04	15.74	0.00
480259503002	2.85	713.49	297.34	61.54	0.80	59.53	2.41	55.40	38.41	0.92	3.93	9.71	10.38	58.33	27.5	20.44	16.92	0.00
480259503003	7.51	2135.76	930.83	43.51	0.96	37.08	2.51	65.58	30.58	1.17	2.08	7.00	14.75	53.25	36.1	8.79	21.55	0.00
480259503004	14.46	5400.65	2015.59	26.62	0.00	28.22	2.92	59.95	35.24	0.39	1.43	7.54	13.13	52.67	31.5	12.55	21.67	0.00
480259503005	0.00	2648.95	1256.13	41.22	0.75	40.04	2.53	76.42	18.42	0.09	2.85	7.74	11.65	52.58	33.0	15.77	13.74	0.00
480259504001	3.70	690.66	341.47	43.43	2.05	44.37	2.49	75.94	19.59	0.30	3.45	7.72	14.11	52.59	36.5	11.62	13.89	0.00
480259504002	5.99	2569.67	1102.37	36.13	0.23	37.29	2.67	67.38	29.87	0.88	1.18	7.54	16.26	53.97	36.1	9.95	19.63	0.00
480259505001	2.03	2319.90	740.69	94.66	0.24	96.31	3.22	67.24	27.26	0.60	3.69	14.16	2.79	49.77	24.6	24.76	26.46	0.00
480259505002	0.00	844.42	321.73	23.84	1.26	25.84	2.96	91.35	6.61	0.24	1.20	8.89	13.82	51.56	35.8	11.74	17.79	0.00
480259505003	33.19	3171.95	1397.35	59.11	0.43	58.61	2.74	81.16	15.60	0.10	2.00	11.04	9.04	53.09	29.7	17.45	15.36	0.00
480259505004	17.57	2451.47	981.28	46.86	0.00	46.96	2.96	85.43	13.15	0.14	0.14	9.19	10.61	53.32	29.3	20.92	16.32	0.00
480259505005	0.00	3111.37	1347.95	31.08	1.03	31.75	2.69	93.92	5.19	0.00	0.45	6.68	16.17	53.86	36.5	13.55	14.34	0.00
480259505006	4.49	2162.04	785.89	53.12	1.55	53.16	2.72	63.65	28.83	2.97	2.97	10.28	9.20	49.59	29.1	19.63	23.44	19.44
480259505007	3.57	1890.55	711.04	58.61	0.67	58.87	2.91	73.21	21.76	0.38	4.03	10.44	7.80	51.57	28.4	20.15	19.41	0.00
480259506001	15.16	15.20	6.60	17.25	3.79	18.66	2.83	56.30	41.28	0.04	0.99	6.21	15.51	49.59	40.1	7.58	19.46	0.00
481759602002	19.20	2.27	1.42	18.91	25.35	18.47	2.53	51.18	47.05	0.10	0.39	5.70	21.41	45.87	47.5	5.72	14.43	0.00
483919502001	29.10	4.53	2.15	17.26	6.65	18.00	2.68	37.71	58.88	0.00	2.92	5.47	21.17	49.03	45.1	4.56	23.78	0.00
483919502002	10.74	1371.97	633.04	25.11	1.96	24.06	2.61	49.67	41.30	0.41	7.64	6.57	17.32	50.25	40.2	10.94	19.96	0.00
483919502003	8.81	1210.64	554.82	46.96	1.84	45.79	2.44	50.48	37.38	0.21	10.35	5.17	25.98	53.33	43.3	15.65	12.17	34.15
483919502004	12.31	919.21	440.24	39.11	0.88	38.14	2.54	55.20	24.72	0.14	18.54	8.99	15.59	49.86	37.7	12.55	13.28	0.00
483919504001	20.92	7.25	4.17	12.88	13.11	13.09	2.42	29.81	64.87	1.11	2.29	4.81	21.45	47.49	49.3	4.65	15.74	0.00
483919504002	17.71	2.32	1.47	28.38	14.97	29.59	2.50	58.53	38.77	0.32	1.62	5.29	20.09	50.86	45.3	5.95	17.30	0.00
483919504003	10.05	2372.00	1179.56	25.77	1.37	26.90	2.53	55.30	38.99	0.14	4.48	5.98	18.07	51.36	43.2	8.93	15.46	0.00
483919504004	22.73	2260.25	897.35	30.60	1.50	29.10	2.89	52.09	44.33	0.00	2.84	7.46	13.28	51.94	35.4	10.34	23.28	0.00
484090102011	2.79	958.60	420.48	30.91	2.70	29.22	2.55	30.89	64.64	0.77	1.95	7.46	14.16	52.23	38.4	11.55	19.36	0.00
484090102012	0.00	650.16	564.37	36.12	34.58	35.58	2.08	23.93	72.70	1.29	0.52	3.10	26.00	45.41	53.4	4.04	7.82	0.00

Block Group	extem_rt (%)	pop_dens	hu_dens	rent_rt (%)	ssnl_rt (%)	rntpop_rt (%)	prspunt	hisp_rt (%)	nhwht_rt (%)	nhasn_rt (%)	nhblk_rt (%)	und5_rt (%)	ovr64_rt (%)	fml_rt (%)	mdn_age	sglpar_rt (%)	marwch_rt (%)	ovr64gq_rt (%)
484090102013	3.67	2838.96	1432.03	46.72	6.60	45.39	2.51	42.42	51.94	0.88	2.52	7.41	14.14	50.31	39.0	9.66	16.03	1.44
484090102021	4.36	1172.34	506.13	40.34	3.26	46.53	2.83	58.53	35.64	0.30	4.42	9.14	14.36	52.41	33.5	21.88	13.64	0.00
484090102022	1.95	537.79	304.02	42.54	5.52	39.83	2.44	33.06	63.12	0.52	1.39	5.55	18.73	50.06	41.2	7.61	18.03	0.00
484090102023	11.96	2158.43	805.35	30.58	3.36	27.58	2.81	44.68	49.10	1.05	3.56	6.32	17.10	52.26	40.8	12.29	23.09	29.62
484090103011	7.23	596.77	259.78	25.51	3.32	23.12	2.73	37.63	60.62	0.57	0.06	7.47	11.31	48.62	37.0	10.10	21.06	0.00
484090103012	14.10	2449.66	947.12	26.07	0.88	27.50	2.80	41.79	52.88	1.35	1.86	8.04	10.58	50.85	35.2	12.09	25.83	0.00
484090103013	5.34	188.46	93.39	52.36	0.69	50.10	2.77	43.97	47.31	3.68	2.86	9.48	6.41	50.51	28.0	21.93	21.55	0.00
484090107001	8.70	6.11	2.51	22.38	4.65	22.77	2.87	50.05	47.94	0.20	0.40	5.82	12.04	48.85	39.8	8.14	25.87	0.00
484090109001	7.38	15.78	6.48	17.11	3.77	16.11	2.79	52.70	45.82	0.00	0.07	4.65	14.49	48.72	42.0	6.39	20.49	0.00
484090109002	6.71	26.69	10.55	14.12	1.50	13.54	2.94	55.75	43.39	0.33	0.26	6.51	13.61	50.23	39.3	8.51	24.37	0.00
484090110001	3.91	519.30	193.52	24.57	0.25	23.36	3.02	79.61	17.86	0.33	2.02	7.61	12.27	51.22	36.5	14.77	20.03	0.00
484090110002	11.64	279.64	116.06	47.74	0.22	47.17	2.52	61.54	36.05	0.09	1.97	6.71	13.33	51.61	35.1	12.11	19.00	0.00
484090110003	29.96	1750.06	591.57	40.31	0.40	37.23	2.77	60.36	37.29	0.47	1.34	7.51	12.54	47.15	33.6	13.88	22.69	21.39
484090110004	2.58	886.44	332.36	43.00	0.51	44.19	3.02	86.60	10.07	0.58	2.36	9.35	10.07	49.78	31.7	20.12	17.64	0.00
484090111001	3.46	697.11	255.06	28.51	0.36	27.73	3.17	86.98	12.89	0.00	0.13	7.03	12.11	51.30	34.4	8.68	24.79	0.00