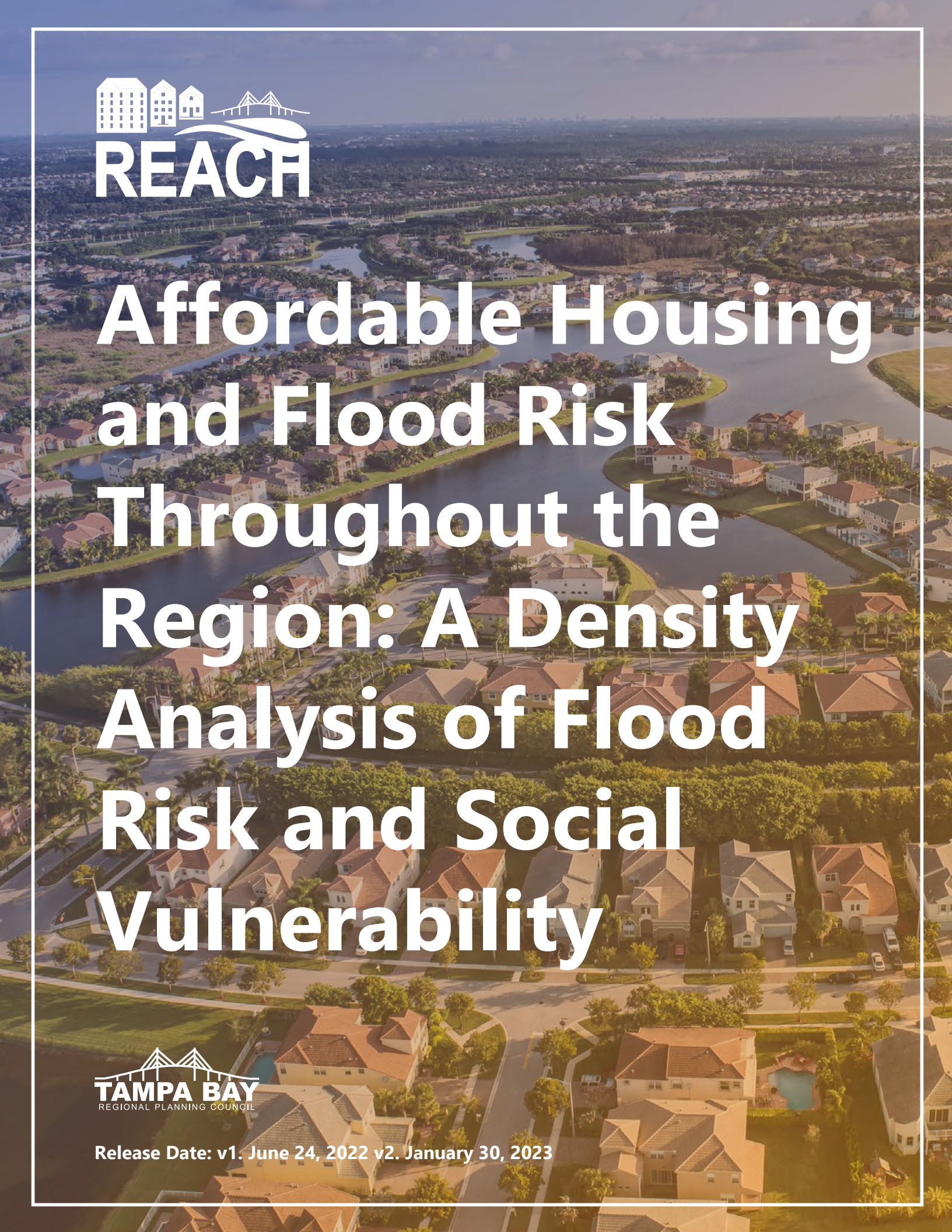

REACH

Affordable Housing and Flood Risk Throughout the Region: A Density Analysis of Flood Risk and Social Vulnerability

TAMPA BAY
REGIONAL PLANNING COUNCIL

Release Date: v1. June 24, 2022 v2. January 30, 2023

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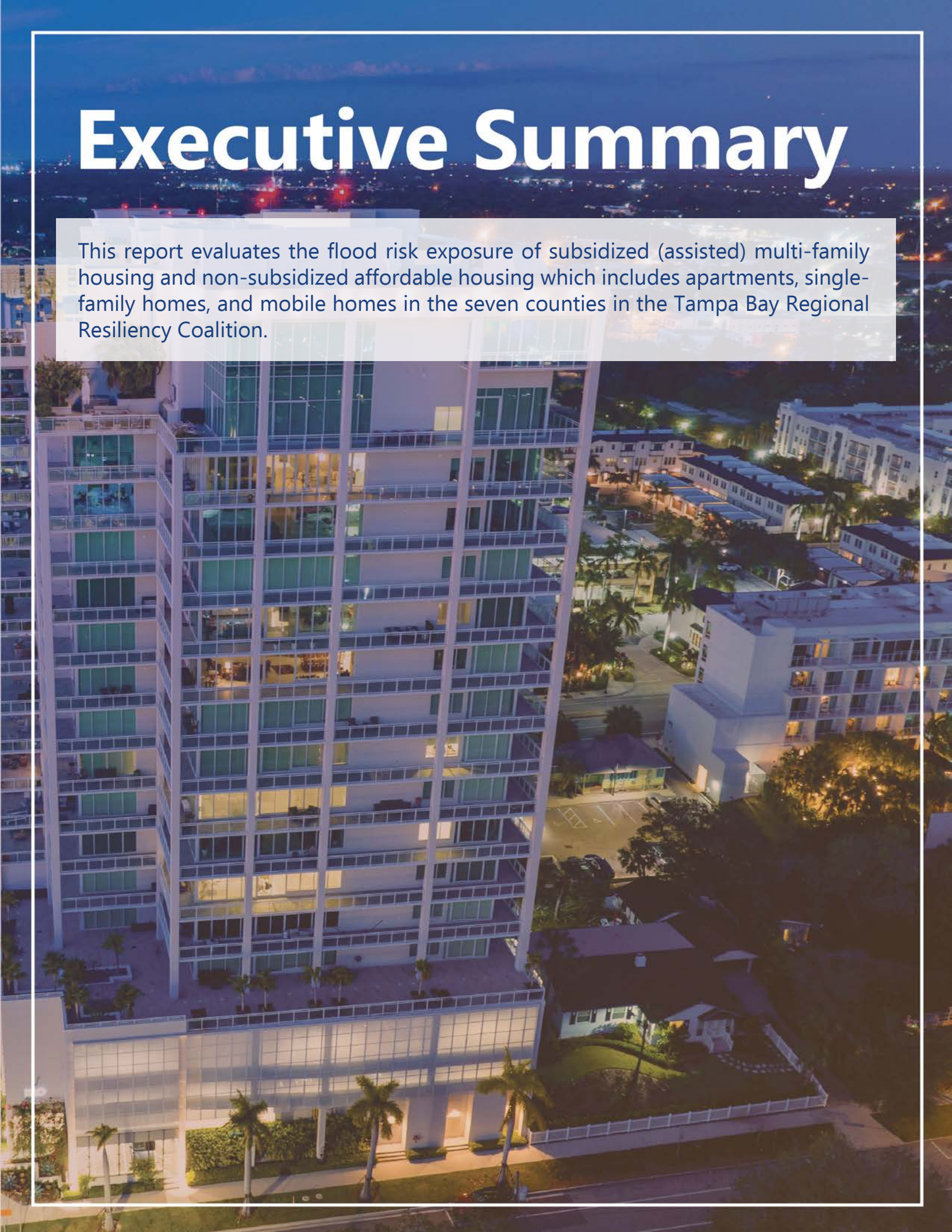
Table of Contents

Executive Summary

This report evaluates the flood risk exposure of subsidized (assisted) multi-family housing and non-subsidized affordable housing which includes apartments, single-family homes, and mobile homes in the seven counties in the Tampa Bay Regional Resiliency Coalition.



TBRPC & REACH Introduction

About the Tampa Bay Regional Planning Council

The Tampa Bay Regional Planning Council (TBRPC) brings together governments to coordinate planning for the community's future and provide an opportunity for sharing solutions among the local government jurisdictions in the six-county Tampa Bay region. The TBRPC mission is to serve our citizens and member governments by providing a forum to foster communication, coordination, and collaboration in identifying and addressing issues and needs regionally.

About REACH - Regional Analysis

In December 2019, the TBRPC received a grant from JP Morgan Chase Foundation for the Resilience and Energy Assessment of Communities and Housing (REACH) initiative. Led by the TBRPC, the REACH project team included the Florida Housing Coalition, the United Way Suncoast, the University of Florida (UF) Shimberg Center for Housing Studies, and the University of South Florida (USF) - Florida Center for Community Design and Research (FCCD&R). The REACH project brought together the region's housing resilience and recovery planning experts to assess potential risks that local communities face from extreme weather and sea level rise. This team defined challenges, practitioner needs and developed new tools to support vulnerability assessments and planning for resilient housing development and redevelopment.

REACH

Resilience and Energy Assessment of Communities and Housing

Project Overview

In 2021, Florida Statute 380.093 was created to advance resilience planning and coordinate implementation. It established the Resilient Florida Grant Program, within the Department of Environmental Protection (DEP) and defined new technical requirements for local vulnerability assessments. It also defined four primary asset categories and listed affordable public housing as one of the critical community assets to be included within a vulnerability assessment.

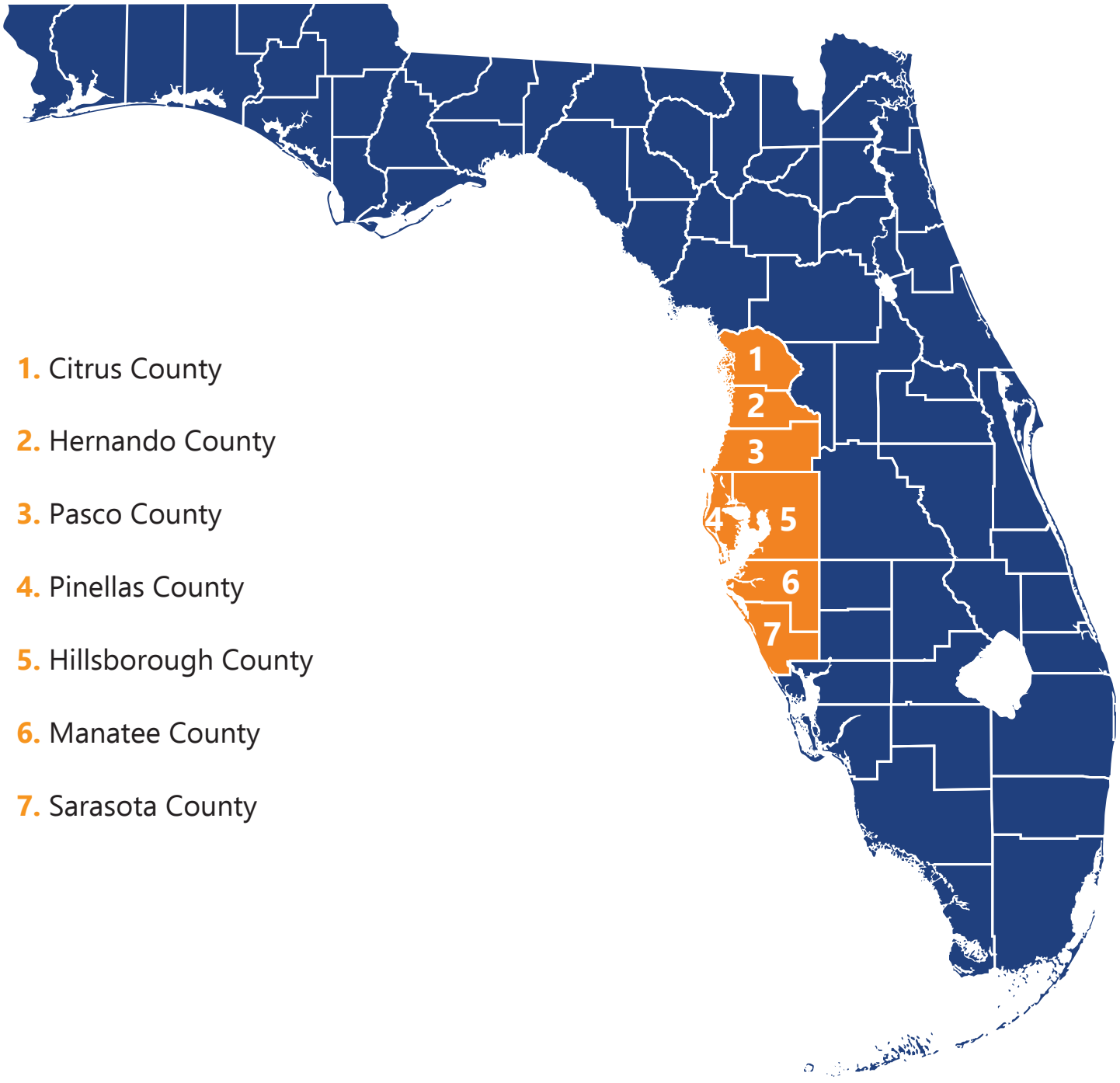
A crucial part of developing community resilience relies on identifying where flood exposed concentrations of affordable housing are located and understanding how these different flood hazards could impact the properties and their vulnerable populations. This Technical Report provides local decision makers, practitioners and housing advocates in the Tampa Bay Region with new data and analysis to quantify the aggregate level of flood-exposed affordable housing. This is done by identifying high concentrations of flood exposed affordable housing within each county while briefly examining the population demographics associated with community vulnerability throughout these exposed areas.

This report evaluates subsidized (assisted) multi-family housing and non-subsidized affordable housing which includes apartments, single-family homes, and mobile homes to present a robust picture of the extent of exposure throughout the seven counties in the Tampa Bay Regional Resiliency Coalition.

This analysis focuses on six specific hazards and identifies the number and percent of the relative housing stock exposed to the following flood events; the quick-onset hazards include the 1% and 0.2% annual floods, high frequency storm surge (Category 3) and low-frequency storm surge (Category 5). Additionally, this report analyzes exposure to intermediate high (IH) sea level rise scenarios (National Oceanic and Atmospheric Administration (NOAA), 2017) in 2070, which is one of the FDEP required scenarios for vulnerability assessments. 10-year storm events under the 2070 IH scenario are also analyzed. The IH scenario of sea level rise in 2070 is projected to be 2.59 feet (31.1 inches) (NOAA, 2017).

This report begins by summarizing the region's current subsidized multi-family housing stock via their funding sources and subsidy expirations. The report then follows with a description of the non subsidized housing stock and a county level overview of flood exposure levels for these two affordable housing types. Next, the county section starts with an overview of the density analysis while highlighting key take aways that categorize high concentrations of assisted and non-assisted, flood exposed affordable housing units. Following the overview is a detailed analysis of each county that includes the quantification of flood risk to all affordable housing categories and the accompanying social vulnerabilities identified within the density analysis.

This technical report will help local governments identify specific neighborhoods and locations within their cities and unincorporated county areas that are acutely vulnerable to flood hazards. The information provided by this analysis can act as a road map for municipalities and counties to dive deeper in analyzing the risks, engaging the communities and implementing proactive programs to mitigate the impacts and increase resilience of our most vulnerable communities in these neighborhoods.



1. Citrus County
2. Hernando County
3. Pasco County
4. Pinellas County
5. Hillsborough County
6. Manatee County
7. Sarasota County

The Tampa Bay Regional Resiliency Coalition includes Citrus, Hernando, Pasco, Pinellas, Hillsborough, Manatee, and Sarasota counties and 24 municipalities.

Perspectives on Housing and Neighborhood Resilience

This report defines and analyzes current and future flood risks while recognizing the inherent uncertainty driving increased flood exposure as a result of climate change. While each county and municipality prepares to address its specific flood risks to affordable housing, there are several high-level take aways that can inform local and regional action:

1. Current high flood risk locations will get worse. Climate science indicates that flood events now considered "1 in 100-year storms" will occur more frequently, thereby increasing the risks faced by households in the 1% annual flood zone. Therefore, investing in infrastructure improvements and other adaptation strategies for the currently recognized high-hazard areas will pay increasing dividends over time.
2. Analyzing housing (properties) vulnerability in conjunction with surrounding infrastructure at a neighborhood level is very complex and requires inter-departmental collaboration. However, this level of analysis is necessary to understand how structural factors and services will interact, and potentially compound anticipated impacts of different flood events.
3. New housing construction, especially affordable housing, should be directed away from high hazard areas and to higher elevations or more inland locations. When this is not possible, redevelopment of existing properties must adopt more innovative and stringent site design and construction practices which mitigate the anticipated flood risks, and do not increase risks to adjacent properties.
4. Resilient housing development and employment centers also need to be aligned. Relocating affordable housing to lower risk inland areas that are far from jobs increases the cost burdens for low-income families and exacerbates inequality. Coordinating affordable housing with transit-oriented development and proximity to employment centers is crucial. Households that are better off financially, due to better economic opportunities will be more resilient to flooding.

At a Glance

Assisted Housing

The most Assisted Housing Inventory (AHI) units in the region; 45% of all AHI units in the region.

Lowest percent of AHI units (2%).

Highest percent of AHI units exposed in flood zones (56%).

Mobile Homes

Most mobile homes (29,613) in the region. No more than 1/4 exposed to flood hazard

Highest percent of affordable units throughout total regional housing stock (21%).

Highest percent of multi-family units deemed affordable (45%).

Second lowest number of affordable multi-family units.

Density

Most concentrated affordable housing stock.

Most dense flood-exposed affordable units with 65% identified in flood hotspots.

Most disperse affordable housing, with only 25% identified in hot spots.

Low density pockets of flood-exposed affordable housing.

Multi-Family

Pinellas County has the highest count of affordable multi-family units exposed to each flood hazard.

Multi-family units make up the largest count of exposed affordable units in Sarasota County. Exposed units range between 2,000 and 18,000.

Density Analysis: High Concentrations of Affordable Housing Exposed to Flood Risks

Identifying areas within each county where high concentrations of affordable housing intersect with high levels of flood exposure provides actionable insight for policy makers aiming to reduce flood vulnerability. This is done by conducting a density analysis at the county level which locates areas with high clusters of flood exposed affordable housing. The density analysis first identifies all affordable housing exposed to a given flood hazard. Then the exposed homes are grouped into equal size neighborhoods. The neighborhoods with highest counts of affordable housing are identified and labeled as hot spots.

Relevance of Hot Spots

Understanding where clusters of housing units are located enables practitioners and decision makers to locate specific areas with high levels of vulnerable residents. In addition to affordable housing programs, the density analysis can inform emergency management planning and public works departments, develop prioritized lists for structural inspections or mitigation programs, and augment grant proposals to align with capital improvement projects.

Damage from various floods events can impact more than just the first-floor units by compromising the integrity of the structure or by rendering it temporarily uninhabitable. It is important to note that the housing unit count does not represent the number of units that directly damaged by specific flood hazards. Instead it represents the number of households that could be affected by flooding.

Density Patterns in the Region

The analysis identifies Manatee, Pasco, Hernando, and Sarasota as the counties with the highest concentration and lowest dispersion of affordable housing units. The general density analysis indicates that 75% of affordable housing in Manatee and 57% of affordable housing in Pasco and Hernando are located affordable hot spots.

Hillsborough and Pinellas counties have the highest counts of affordable housing and the highest dispersion of affordable units in the Region. These two counties have a lower percentage of their affordable units clustered. Specifically in the case of Hillsborough County, there are fewer and smaller concentrations of flood- exposed affordable housing.

In general, the density analysis suggests the clustering of affordable units exposed to extreme floods is less severe (lower counts of exposed units) than the level of clustering for surge events.

What Are the Social Vulnerabilities of Highly Exposed Areas?

Building off the density analysis where high concentrations of exposed affordable housing are identified, this social vulnerability analysis is used to describe the demographic composition of the most concentrated and highest exposed affordable housing neighborhoods throughout each county. Of particular focus are the neighborhood statistics describing median income, percentage of minority individuals, as well as the percentage of the population 65 years or older. These specific demographic statistics provide insight into the possible compounding social factors of density concentrated and highly flood exposed affordable housing neighborhoods.

When analyzing the relationship between neighborhood median incomes and the locations of high density, flood-exposed affordable housing units, the findings of this report imply that these at-risk neighborhoods have lower median incomes than is observed for the county as a whole. This result is likely associated with the technique used to identify non-subsidized affordable housing units (which drive the high density measures) and affirms the general relationship between housing affordability and household incomes. The affordability of housing is typically associated with lower incomes; thus, the results of this analysis suggesting that high risk flood neighborhoods have lower median incomes align with current affordable housing theory.

While the relationship between median income and housing affordability hot spots is well established, the relationship between the minority composition and housing affordability hot spots is not as straight forward. In Hillsborough County there is a high percentage of minority households, which is represented in the study neighborhoods. However. In Sarasota where the representation of minorities is lower (14% county wide) there are neighborhoods with minority concentrations four to five times larger than the county value.

Overall, the social vulnerability analysis suggests neighborhoods with higher concentrations of a minority populations, relative to the county percentage, typically have lower concentrations of an elderly population and vice versa. This provides an opportunity to leverage different resilience funding mechanisms available to support minority or elderly populations.

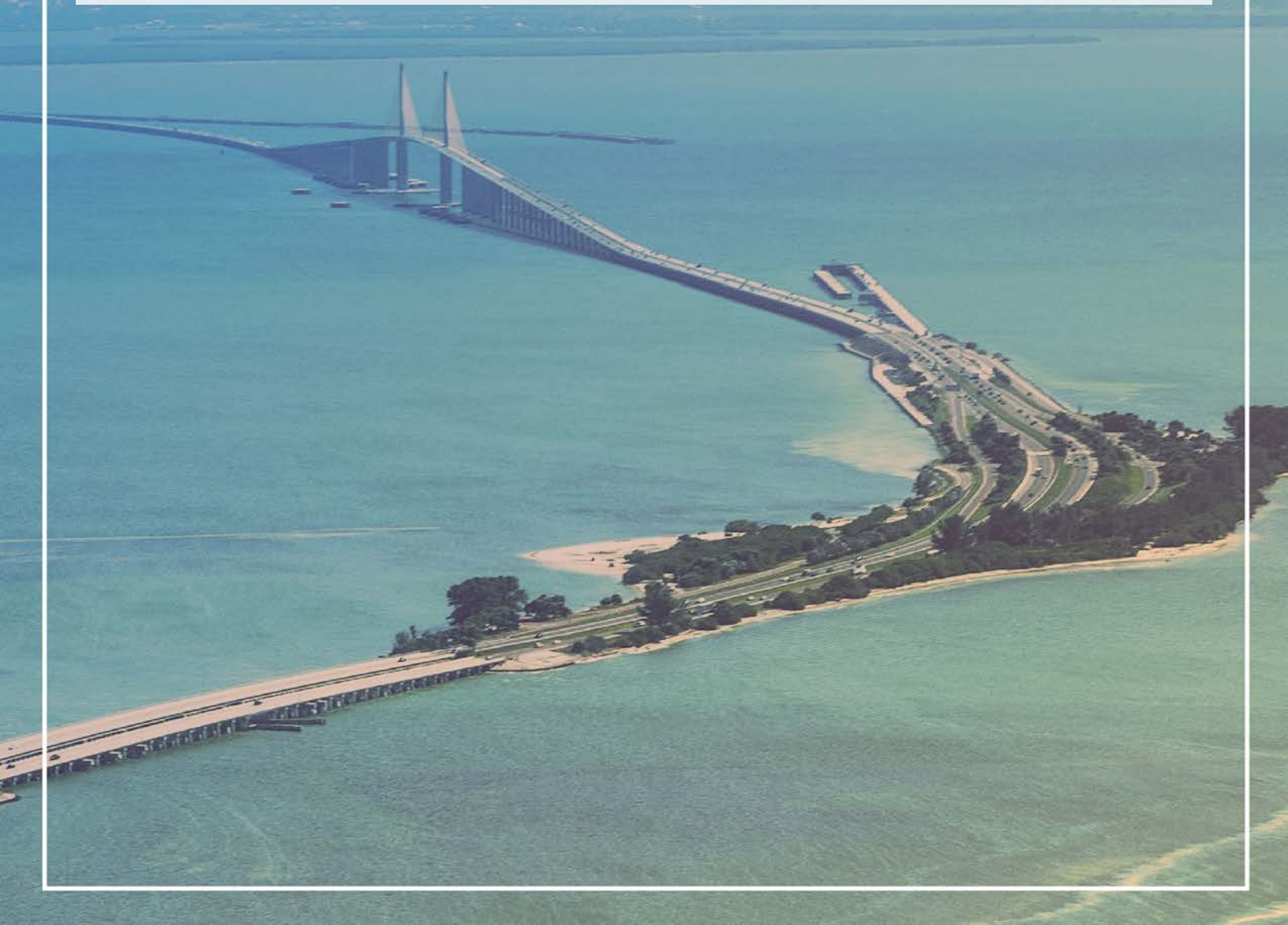
Regional Overview

The stock of affordable housing is identified through two distinct lenses, subsidized and non-subsidized units.

Subsidized housing is defined by the assistance governments provide to develop maintain, or acquire low-cost housing.

Non-subsidized, market affordable housing consists of all mobile homes in addition to portions of the multi-family and single-family housing stock that are deemed affordable.

Each typology faces different challenges to flooding hazards; yet, low elevations and near proximity to the coast are constant contributors to flood risk throughout the region.



Identifying Affordable Housing

Subsidized Housing: Assisted Housing Inventory

Assisted multi-family housing (AHI) is made affordable through various types of government subsidies. AHI data is collected by the Shimberg Center for Housing Studies using databases from various federal , state, and local housing programs. Housing programs at the federal level include those implemented by the U.S. Department of Housing and Urban Development (HUD) and the U.S. Department of Agriculture and Rural Development (USDA-RD). State programs include those run by the Florida Housing Finance Corporation (FHFC). At the local level municipal or county-specific Local Housing Finance Authorities (LHFA) also provide funding to affordable housing properties as a form of subsidy.

It is typical for AHI properties to use multiple funding instruments provided at varying levels of government. This report characterizes funding instruments using three different categories. These categories include Federal Public Housing Programs, Federal Programs administered through HUD and USDA-RD (HUD/RD), and funding administered through state or local programs.

Units classified as HUD/RD and Public Housing both receive ongoing rental support from HUD; however, Public Housing units are financed and operated by Public Housing Authorities while HUD/RD units were created by developers with favorable federal loans in exchange for affordable housing. These properties are particularly important for the lowest income households. These funding sources typically represent households with incomes between 0-50% of the Area Median Income (AMI). Most tenants have incomes below 30% AMI, and nearly all of the rest are at 30-50% AMI.

In Florida state subsidies are provided by the Florida Housing Finance Corporation (FHFC) while local subsidies are provided by Local Housing Finance Agencies (LHFA). These subsidies can come in the form of Low-Income Housing Tax Credits, bonds, and other state programs such as SAIL or HOME. These assisted housing properties provide a certain percentage of units at a capped rental prices based on a percentage of the AMI. Throughout the region, properties receiving support through state and local programs make up the largest count of total AHI developments and assisted units.

Within the seven counties there are 480 properties with 50,063 affordable housing units subsidized through government funding. These counts reflect data drawn from the Shimberg website on February 1, 2022 (Shimberg Center Spatial Data). The total number of units frequently change due the construction of new affordable housing developments. **Figure 1** provides the count of properties and assisted units that receive one or more of the funding types discussed. Since many of these properties receive funding through multiple sources, the aggregated count of properties and units by funding instrument will not

match the total count of properties in the region.

Hillsborough County has the largest number of units receiving subsidies within each of the funding categories. Overall Hillsborough County has 166 assisted housing properties and 21,381 assisted units which accounts for 35% and 47% of all assisted properties and units in the region. Pinellas County ranks second in the total count of assisted properties and units with 133 and 11,139 respectively. Throughout the rest of the Region the number of subsidized units steadily decreases. Beginning with Manatee County (4,004) the count of subsidized housing units decreases with Pasco (3,875), Sarasota (2,457), Hernando (2,018) and ends with Citrus County (1,056). However, a commonality between all these funded units is the size of the subsidized complexes, which are typically large and average 100 affordable units per complex.

The ranked counts of properties and assisted units receiving subsidies from each of the funding sources is similar to the county rankings of total assisted properties and units in the Region. Hillsborough and Pinellas County lead the Region in counts of properties and assisted units receiving subsidies for each of the different funding sources. However, in the case of HUD and RD programs Hillsborough and Pinellas have the same count of properties receiving funding through HUD and RD Programs (67 properties), but the total count of assisted units in Hillsborough is greater than the total count of assisted units in Pinellas by more than 2,000 units. This speaks to the differing levels of density provided by HUD and RD properties in each county.

	Public Housing Program		HUD & RD Programs		State and Local Programs		Total Counts	
	Properties	Assisted Units	Properties	Assisted Units	Properties	Assisted Units	Properties	Assisted Units
Citrus	0	0	20	698	13	595	29	1056
Hernando	1	124	8	216	23	1773	29	2018
Hillsborough	13	2724	67	6391	137	21610	166	21381
Manatee	6	477	17	1224	29	4073	39	4004
Pasco	3	206	35	1536	31	3246	55	3875
Pinellas	11	1231	67	3968	84	9409	133	11139
Sarasota	5	513	13	974	24	2215	29	2467
Total	**39**	**5275**	**227**	**15007**	**341**	**42921**	**480**	**45940**

Figure 1:

Counts of government subsidized housing by funding type and county

Hammock Ridge II, a Low Income Development in Spring Hill, FL. Source: htgf.com

Non-subsidized Affordable Housing

Naturally Occurring Affordable Housing (NOAH) is rental housing that is deemed affordable based on rental thresholds and other spatial housing characteristics. This analysis reviews three categories of non-subsidized housing units: single family homes, multi-family apartments, and mobile homes.

This analysis uses an areal interpolation technique implemented by University of Florida's Shimberg Center to assign estimated rental values to housing parcels throughout the entire study region. Using census block median income values, a smooth surface is created via a technique that generates estimated rental values. These values are then assigned to the polygon parcels that are identified as renter single-family households, multi-family households, or condominiums. Once parcels are assigned an estimated monthly rental value they are determined affordable or not based on 30% of the median renter income for the Tampa-St. Petersburg-Clearwater MSA. This value of $977 represents the 30% threshold used to identify NOAH rental housing throughout our study period.

Mobile homes can be grouped into non-subsidized affordable units, but their unique structural and legal characteristics suggest they should be analyzed separately from other NOAH properties. Additionally, this report treats all mobile homes as affordable units and removes any uncertainty of identifying affordable properties introduced by the areal interpolation method. The data on mobile homes is obtained via state DOR records.

Figure 2 provides the counts of NOAH and mobile home properties throughout the Region. The counties with the largest populations tend to have the highest counts of NOAH and mobile home units. However this relationship is not strict. For example, Pasco County has the third largest population in the Region, but has the highest count of NOAH single-family units and the third highest count of affordable multi-family units. Pinellas County, the second most populated county in the Region, has the second most NOAH single-family units and mobile homes; however, they have the most multi-family NOAH units. Pinellas has more than double the number of NOAH multi-family units than the next closest county, which is Hillsborough. Additionally, Pasco has nearly double the count of mobile home units compared to the county with the second highest count, Pinellas County.

	Single Family Residential		Multi-Family		Mobile Homes	% Affordable
	# NOAH	% NOAH	# NOAH	% NOAH	# MH	Housing
Citrus	7350	13	1249	28	15815	18
Hernando	4616	7	2290	45	11926	18
Hillsborough	12607	3	18090	10	14514	8
Manatee	4366	4	6210	10	4658	8
Pasco	15067	9	9626	28	29613	21
Pinellas	13852	5	38637	19	17569	15
Sarasota	7686	5	20021	26	11948	14
Total	65544	6	96123	17	106043	13

Figure 2:

Count of non subsidized units by housing typology and county

Affordable Housing and Flood Risk: A Descriptive Analysis

This descriptive analysis on affordable housing and flood risk focuses on quantifying flood exposure for the different types of affordable housing. Flood hazards can be split into two groups based on the time of exposure to each hazard; quick onset and slow onset disasters. The quick onset flood hazards occur over a period of days and include the following hazards; surge from hurricanes, 1% annual, and 0.2% annual flood events. Slow onset disasters occur over longer time periods and include hazards such sea level rise and king tide events which will grow in severity over time. While the goal of this analysis is to describe the extent of flood exposure faced by current affordable units, an additional takeaway suggests that proactive decision making on future affordable housing development is needed to mitigate future levels of flood risk.

Within the quick onset hazard category, the first level of analysis focuses on the relationship between flooding and affordable housing using the 1% and 0.2% annual flood zone scenarios. These scenarios will be referred to as severe flooding events throughout the report. The spatial extent of these hazards are defined by FEMA's Flood Insurance Rate Maps (FIRMS). These FIRM maps are used by federal mortgage agencies to determine whether a household is required to purchase flood insurance prior to obtaining a federally backed mortgage. FEMA provides public access to these shapefiles.

The other quick onset hazard includes exposure to extreme storm surge. This analysis partitions surge hazard by splitting intensity categories into high-frequency and low-frequency hurricane events. Using the Saffir Simpson hurricane rankings, hurricanes registered as a category 3 are considered high-frequency surge events while category 5 are considered low-frequency events. The National Hurricane Center (NHC) provides spatial data layers on the extent of surge inundation for each Saffir-Simpson category. These simulation layers indicate the extent of inundation for the maximum surge event at a given Saffir Simpson category. This enables estimation of the maximum number of impacted properties for a given category providing an upper bound of exposed households to the hurricane intensity.

This analysis of slow onset hazards includes sea level rise in 2070. This hazard is based on the Intermediate High NOAA scenario and is also combined with a 10-year storm surge event scenario. These slow onset disasters contain a greater level of uncertainty on the spatial extent of risk. These hazard layers are created by the TBRPC using a modified bathtub approach which accounts for local tide gauge measurements of mean higher high water levels.

The following table presented in **Figure 3** describes the count of different affordable housing typologies exposed to the chosen hazards. These counts are meant to serve as an overview of the flood risk affordable housing is exposed to within the TBRPC Region.

Regional Summary of Assisted Multi-Family Property Exposure to Flood Risks

An important first step in preparing a vulnerability analysis requires defining the number of assisted multi-family properties at risk to flood hazards. This section provides a summary of the region's assisted multi-family properties exposed to the different types of flood risk. Counties with the largest populations lead the region in total numbers of affordable, flood-exposed properties and units. However, within the region, smaller and less populated counties face substantial risks when considering the percentage of their total assisted housing stock that is exposed to different flood scenarios.

Risks to Assisted, Multi-Family Properties

As of (Include Date that AHI data was downloaded by Russ for flood analysis) there are 480 assisted multi-family properties with a combined 50,063 housing units in the Tampa Bay region. Hillsborough and Pinellas County have approximately 63% of these assisted properties, with 166 located in Hillsborough County and 133 located in Pinellas County. These two counties also have the highest number of assisted properties and units exposed to the flood hazards analyzed in this report.

	Annual Flood				Storm Surge				Intermediate High 2070				
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge		
County	N	%	N	%	N	%	N	%	N	%	N	%	Total
Citrus	11	38	11	38	7	24	7	24	1	3	2	7	**29**
Hernando	9	31	9	31	1	3	6	21	0	0	0	0	**29**
Hillsborough	34	20	35	21	33	20	83	50	1	1	4	2	**166**
Manatee	8	21	8	21	15	38	37	95	1	3	1	3	**39**
Pasco	9	16	15	27	19	35	24	44	2	4	3	5	**55**
Pinellas	24	18	38	29	59	44	76	57	10	8	22	17	**133**
Sarasota	8	28	15	52	16	55	24	83	1	3	3	10	**29**

Figure 3:

Flood exposure to assisted multi-family properties by county in the Tampa Bay Regional Resiliency Coalition.

Flooding from Extreme Inundation

Of the 480 assisted properties , 103 (21%) and 131 (27%) are exposed to flooding from severe inundation events (1% and 0.2% storm respectively). Within the 1% flooding event Hillsborough has the largest number of exposed properties, with 34, representing 20% of their assisted housing stock. Pinellas has 24 properties exposed to 1% annual flood risk which represents 18% of their stock. Across the region, Citrus County has the highest percent of their assisted housing stock at risk to the 1% annual flood risk with 11 properties (38%). Hernando has the second highest percent of their stock at exposed to 1% annual flood risk with 9 properties (31%) while Sarasota has the third highest with 8 properties (28%).

The 0.2% annual flood events represent a longer return period, but a higher number of exposed properties. In Pinellas County the number of exposed properties increases from 24 to 38, while in Hillsborough County the number of exposed properties increases from 34 to 35 properties. In Pasco County the change from a 1% annual flood to a 0.2% annual flood leads to an increase from 9 to 15 exposed properties. The 15 properties exposed to 0.2% annual flood zones represents 27% of their total assisted housing stock. Counties with lower counts of exposed properties have a higher percentage of their total stock at risk. Sarasota County has the highest percent of assisted properties within the 0.2% annual flood zone with 52% (15 properties) while Citrus County has the second highest percent of exposed properties with 38% (11 properties).

Risks from Hurricanes Surge

Throughout the entire region 150 assisted housing properties are exposed to Category 3 hurricane storm surge. Pinellas County has the most exposed properties (59 properties) which represent 44% of its total assisted multi-family building stock. Within Sarasota County there are 16 properties, representing 55% of its total stock, exposed to Category 3 storm surge. This represents the largest percentage of assisted properties at risk.

For Category 5 storm surge the number of exposed properties, in total, increases to from 150 to 257. For this particular flood hazard Manatee County has the largest percent of exposed properties with 37 properties representing 95% of their stock. Hillsborough has the highest number of exposed properties with 83. This represents 50% of their assisted housing stock. Pinellas has the second highest number with 76 properties representing 57% of their stock. Citrus and Hernando have the lowest numbers of exposed properties as well as the lowest percent of their stock at risk. Hernando has 6 exposed properties (21 % of its stock) and Citrus has 7 exposed properties (24 % of their stock).

Sea Level Rise

Future flood risks were also assessed in this report. Inundation due to predicted sea level rise from the intermediate high 2070 NOAA curve (NOAA, 2017) exposes 16 multi-family assisted properties throughout the region. Pinellas County contains 10 of the total 16 properties. When combining the effects of a 10-year storm with the higher sea levels the number of exposed assisted multi-family properties increases to 35. Specifically, 22 of the 35 properties at risk are located Pinellas County, which represents 17% of their total stock.

Risk by Housing Type

Figure 4 provides the count and percentage of non-subsidized units exposed to flooding broken down by affordable housing typologies. The analysis suggests that mobile homes represent the largest typology of affordable housing exposed to flooding hazards for all of the counties in this study. This poses a unique challenge for policy makers due to differing legal requirements regarding flood insurance and mobile homes.

Focusing in on each county and the exposure of non-subsidized units, Pinellas County has the highest count of NOAH units exposed to severe inundation events (1% and 0.2% annual flood zones) and hurricane surge. While Pinellas may have the highest absolute count of flood exposed non subsidized affordable housing units, Sarasota County has the highest percentage of their non-subsidized stock exposed the severe flooding events (1% and 0.2% annual flood zones). Additionally, Sarasota County has the highest percent of non subsidized units exposed to high frequency storm surge; however, Manatee County has the highest percentage of their non subsidized housing stock exposed to low frequency storm surge.

While the absolute count of flood exposed non-subsidized units ranks similar to overall counts of non subsidized units for these counties, there is more parity when looking at the relative percents of flood exposed units in flood zones. For example, Manatee County does not have the most mobile homes exposed to rare flood events, but they do have the largest percent of their mobile home stock exposed to 1% annual flood zones. Additionally, the count of mobile homes exposed to the 0.2% annual flood zones in Sarasota is not the largest in the Region, but with 73% of their mobile home stock exposed to 0.2% annual flood zones they do have the highest portion of their mobile home stock exposed. Manatee County also has a high percentage of their mobile home stock exposed to 0.2% annual floods with close to 50% of their mobile homes in the designated flood zones. Due to differing flood insurance regulations for single-family units and mobile homes it is likely these properties have lower rates of flood insurance. In the case of Sarasota and Manatee County, the high percentage of flood-exposed affordable units poses a significant issue to the long term sustainability of these units.

Freedom Gardens, a Multi-family Affordable Community in Brooksville, FL. Source: htgf.com

The different rankings of exposed counties based on absolute and relative counts experienced for 1% and 0.2% annual flood zones is also true for hurricane storm surge. Pinellas County, once again, has the highest count of non subsidized units exposed to high frequency and low frequency storm surge (33,371 and 48,464). Pasco has the second highest count of non subsidized units exposed to high frequency storm surge (21,261) while Sarasota has the second highest exposed to low frequency storm surge (35,216). However, Sarasota has the highest percentage of non subsidized units exposed to high frequency storm surge (61%), while Manatee has the highest percentage of units exposed to low frequency storm surge (91%).

Flooding from extreme inundation events and storm surge often occur within a matter of days and rarely last longer than a week. These quick duration events do not represent all flood risks to coastal communities. Rising sea levels due to warming oceans, melting land ice, and land subsidence pose a longer-term and chronic threat to communities. As sea levels rise communities are projected to face more frequent flooding events throughout the year. The sea level rise spatial layers are created using intermediate high SLR predictions from NOAA and elevation LiDAR data from the USGS. Using a modified bath rub inundation model this information used to identify seal level rise flood risk to different affordable housing typologies throughout the Region.

In **Figure 4,** the count of NOAH properties at risk of sea level rise (SLR) and the combined SLR with a 1 in 10 year storm are presented under the 2070 intermediate high SLR scenario. The count of exposed NOAH properties to SLR hazards is much smaller than the previously discussed, present day hazards. However, the construction of the quick onset and slow onset hazard layers is significantly different, suggesting there are issues when comparing these counts.

While this analysis acknowledges that it may not be appropriate to compare these types of flood exposure over time, the values observed can be thought of as a lower bound on the total units exposed to sea level rise. Specifically, it should be mentioned that the physical forces contributing to SLR will also change the intensity and distribution of other flooding events. Therefore, the extent of severe flood zones and storm surge will change (likely increase) causing an increase the in the count of affected affordable units throughout the Region. The analysis suggests that there are lower counts of affordable units exposed to sea level rise, which could be an artifact of the sea level modeling. However, it is also likely due to the fact that affordable housing is typically not located near the coast due to the high cost of land in these areas.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Citrus												
AHI	586	55	586	55	301	29	301	29	25	2	110	10
Mobile Homes	3518	22	5563	35	5534	35	6471	41	715	5	789	5
Multi-Family	518	41	671	54	465	37	465	37	10	1	48	4
Single Family	1320	18	1696	23	771	10	838	11	63	1	100	1
Total NOAH	5356	22	7930	32	6770	28	7774	32	788	3	937	4
Hernando												
AHI	690	34	690	34	128	6	690	34	0	0	0	0
Mobile Homes	2370	20	2713	23	836	7	1763	15	387	3	397	3
Multi-Family	799	35	824	36	137	6	1164	51	0	0	0	0
Single Family	899	19	1005	22	542	12	2340	51	0	0	0	0
Total NOAH	4068	22	4542	24	1515	8	5267	28	387	2	397	2
Hillsborough												
AHI	5546	26	5706	27	4742	22	11948	56	197	1	439	2
Mobile Homes	2774	19	2824	19	1872	13	4370	30	407	3	634	4
Multi-Family	3935	22	3960	22	1730	10	7601	42	65	0	299	2
Single Family	1622	13	1658	13	2313	18	5975	47	181	1	468	4
Total NOAH	8331	18	8442	19	5915	13	17946	40	653	1	1401	3
Manatee												
AHI	1237	31	1237	31	2066	52	3658	91	129	3	129	3
Mobile Homes	2147	46	2150	46	2605	56	4192	90	472	10	731	16
Multi-Family	1425	23	1641	26	1825	29	5756	93	157	3	238	4
Single Family	748	17	869	20	1293	30	3915	90	197	5	298	7
Total NOAH	4320	28	4660	31	5723	38	13863	91	826	5	1267	8
Pasco												
AHI	1146	30	1348	35	1545	40	1985	51	387	10	587	15
Mobile Homes	7351	25	8727	29	6369	22	9046	31	1266	4	2039	7
Multi-Family	2708	28	4282	44	5775	60	7183	75	1002	10	2183	23
Single Family	3468	23	5592	37	9117	61	11929	79	1146	8	1876	12
Total NOAH	13527	25	18601	34	21261	39	28158	52	3414	6	6098	11
Pinellas												
AHI	2235	20	3374	30	5231	47	6256	56	1149	10	2182	20
Mobile Homes	3982	23	5893	34	10982	63	14966	85	2850	16	3863	22
Multi-Family	10539	27	13624	35	17085	44	25282	65	3516	9	8421	22
Single Family	2132	15	3473	25	5304	38	8216	59	745	5	1545	11
Total NOAH	16653	24	22990	33	33371	48	48464	69	7111	10	13829	20
Sarasota												
AHI	712	29	1254	51	1219	49	1997	81	61	2	323	13
Mobile Homes	4864	41	8740	73	10326	86	11672	98	1540	13	3842	32
Multi-Family	5561	28	8804	44	9727	49	17130	86	2090	10	3177	16
Single Family	1572	20	3322	43	4296	56	6414	83	225	3	481	6
Total NOAH	11997	30	20866	53	24349	61	35216	89	3855	10	7500	19

Figure 4:

Counts and Percentages of Affordable Units Exposed to Varying Flood Hazards

High Density Risks and Surrounding Social Vulnerabilities

In addition to the physical location of affordable units, housing and neighborhood characteristics are important factors of vulnerability that need to be accounted for when analyzing flood risk. Levels of clustering for affordable housing units exposed to different flooding hazards provides policy makers insight into the vulnerability of a county's affordable housing stock. Additionally, information on the time period of development for these affordable units and the surrounding neighborhood characteristics provide important information that can highlight compounding vulnerabilities of flood-exposed affordable housing. This section focuses on answering two specific questions at the regional level:

1. What is the extent of clustering for hazard exposed affordable housing?
2. What are the average housing and neighborhood statistics for high density pockets of flood-exposed, affordable housing units?

Affordable Housing Clusters

It is common to find houses of similar structure and value situated within the same neighborhood. This is due to a number of reasons including the timing of neighborhood development and the proximity to amenities. Additionally, hazard exposure is reliant on physical features such as land elevation and proximity to the coastline. These features are typically homogeneous throughout similarly located pieces of land as described by Tobler's First Law. Therefore it is not surprising to find that a majority of the counties in the TBRPC Region have highly clustered neighborhoods of affordable housing exposed to flood hazards. This subsection focuses on describing the level of clustering exhibited by the identified affordable units exposed to varying flood hazards.

Figure 5 provides the level of clustering for affordable housing units throughout the TBRPC Region. The table presents the counts of affordable units, including both subsidized and non-subsidized units, identified within each county's hot spots. The definition of these hot spots is further explained in the County Analyses and Appendix A. Additionally, in **Figure 5** the percent of affordable units in these hot spots relative to the entire affordable stock exposed to the given flood hazard is provided as way to determine the dispersion of flood-exposed affordable housing.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 5:

Counts and percents of exposed affordable units located in hot spots

The columns of **Figure 5** are split into 5 distinct categories reflecting the type of flood hazard that is analyzed. The first column titled, all affordable, looks at the dispersion of affordable housing throughout each county and does not subset based on a specific flood hazard. This column describes how concentrated affordable units are in each county. Specifically, in Hillsborough County affordable housing is highly disperse with only one-quarter of all affordable units captured in clustering hot spots. This suggests that affordable housing is highly spread out in Hillsborough County. On the other extreme, Manatee County has a low level of dispersion for affordable units. Three quarters of all affordable units in Manatee County are captured within the hot spot analysis suggesting that affordable housing is highly concentrated in this county.

The 1% and 0.2% annual flood zone columns describe the concentration of affordable housing that are exposed to these severe flooding events. For these specific hazards Citrus County has the highest levels of dispersion for affordable housing units exposed to these severe floods such that the hot spot analysis captures 26% and 38% of all affordable units exposed to 1% and 0.2% annual flood zones. Manatee, Pasco, and Sarasota County have high concentrations of affordable units exposed to these types of flood hazards with more than half of their exposed affordable units captured in both of the hot spot analysis.

The high-frequency and low-frequency storm surge columns describe the level of clustering exhibited by affordable housing locations exposed to the varying hurricane flooding events. As described previously the high-frequency storm surge designation includes exposure to Category 3 storm surge and the low-frequency designation describes exposure to Category 5 storm surge. In general, this analysis suggests that affordable units exposed to storm surge are more tightly concentrated than those exposed to other flood events. This intuitively makes sense, since a key requisite of exposure to storm surge is proximity to the coast. However, the general trend describing the extent of clustering for each county is maintained throughout each flood hazard.

The results of this analysis provide both a number of take-aways. Counties with highly clustered affordable units present unique opportunities to invest in larger mitigation projects that increase flood resilience since more units will be protected. Whereas, counties with higher dispersion of at-risk affordable homes would benefit from smaller, targeted approaches. However, without action, counties that have large clusters of hazard exposed affordable homes are at greater risk of experiencing catastrophes that impact a high percentage of the affordable housing stock.

Regional Housing Characteristics

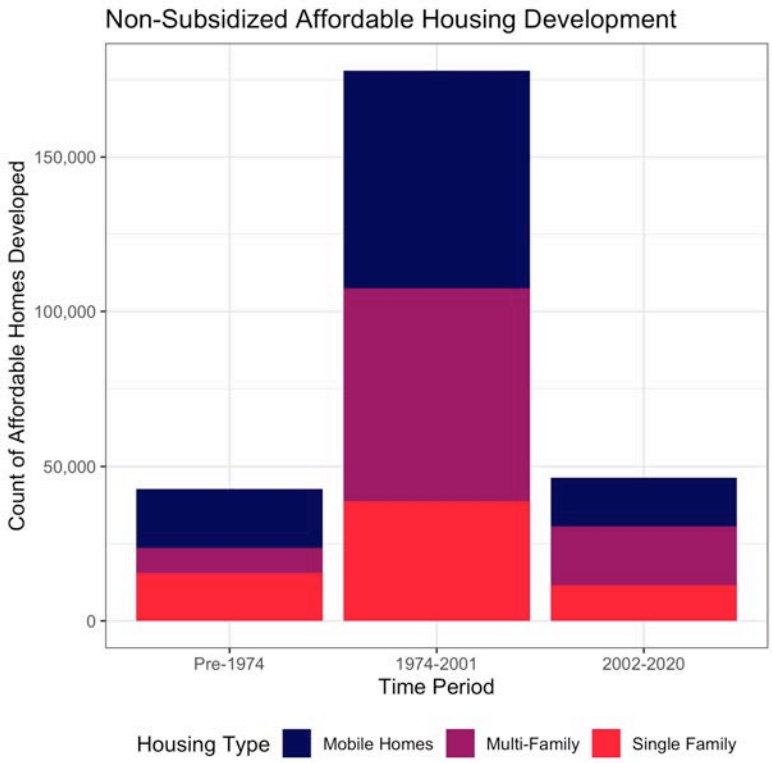


Figure 6:
Count of Subsidized Housing Developments by Building Period

The age of a household is often used as a proxy for the structural integrity of the home. Older homes, built under less stringent building codes are often considered to be more vulnerable to climate events such as flooding. Unfortunately, these older homes often comprise a significant portion of the affordable housing stock.

Figure 6 provides an age breakdown of currently identified NOAH units by the building code era they were constructed during. The majority of NOAH units were constructed during the time period from 1974 to 2001. 1974 was the initial year flood insurance rate maps (FIRMs) were introduced in Florida. These maps initiated building requirements that were meant to increase the structural resilience of new housing to high-wind and rain events. In 1993 Hurricane Andrew caused significant levels of destruction in the southeast portion of Florida. Due to the level of destruction a building code update was implemented in 2001 introducing a new building era with much stricter building codes.

On average, homes built prior to the implementation of the FIRM building code would be most vulnerable to flood events. This is especially true when focusing on NOAH properties. By definition NOAH properties are older, and may have structural deficiencies due to age and maintenance. One of the key take aways from Hurricane Andrew was that many homes built after the implementation of FIRMs (post 1974) were found to be built below code. Since this particular stock makes up a significant amount of NOAH properties in the TBRPC Region, it may be necessary to encourage structural updates for at-risk older properties.

Another important take away from **Figure 6** is that the majority of affordable units constructed during the 1974-2001 building era were mobile homes. These affordable housing typologies typically are the most vulnerable housing units to extreme weather events, compounding the vulnerability of being constructed during a more lax building code period.

Figure 7 shows the year of development for properties currently designated as NOAH households located in the1% annual flood plain. The development of these homes overlaps with implementation of FIRMs. It is possible that these properties were constructed at the same time as the roll out of FIRM regulations and because of this they faced more lax oversight. If this were to be the case, a significant amount of currently designated NOAH properties may be under-prepared for flood hazards. This could pose a problem to the long term availability of market-rate affordable housing since these types of households are likely more vulnerable to flood hazards.

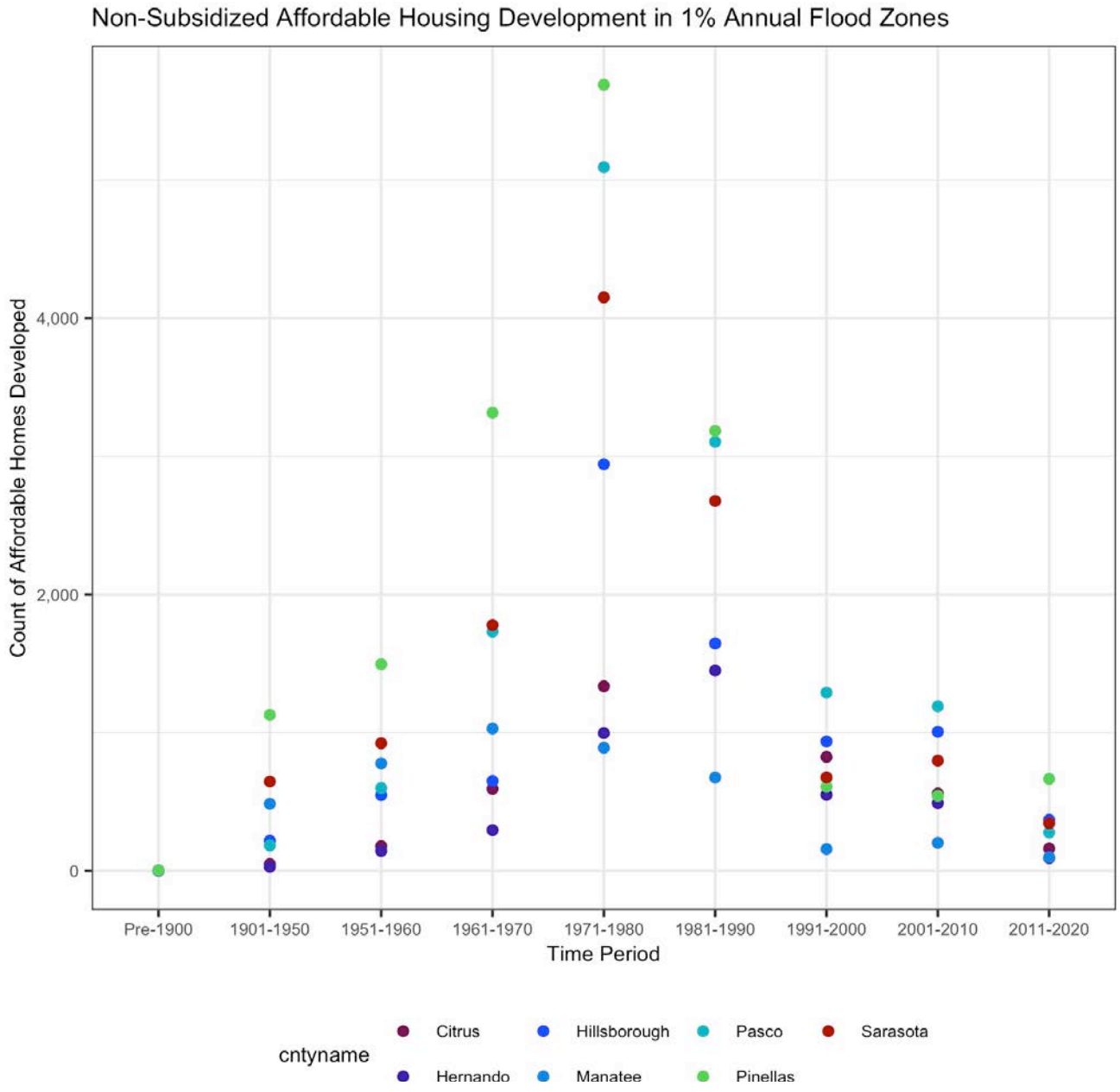


Figure 7:

Count of Affordable Units Built in the 1% Annual Flood Zone by County and Year

In addition to the physical structure of affordable housing the social variables associated with affordable housing neighborhoods plays an important part in determining the level of flood vulnerability for these communities. **Figure 8** presents the average income, minority percent, and elderly percent of neighborhoods with the highest concentrations of affordable units exposed to both the 1% annual flood zone and high-frequency storm surge. The County Analyses section goes into further detail describing how these neighborhoods were identified. For the majority of counties, the average median income of the most exposed affordable units is lower than the county average. Since the majority of these affordable housing units are located in census tracts with lower median incomes, this result does not present much of a surprise. However, an important relationship between the average minority percent and the average elderly percent of households is described in **Figure 8**. It appears that in most affordable housing neighborhoods with high flood exposure there is an inverse relationship between the minority percent relative to the county average and the elderly percent relative to the county average.

In **Figure 8**, the green and red values of the neighborhood averages are meant to demonstrate whether the averages for the affordable housing neighborhoods are greater or less than the county averages, respectively.

	Median Income		Minority Percent		Elderly Percent	
	Neighborhood	County	Neighborhood	County	Neighborhood	County
Citrus	45953	44237	6	9	36	36
Hernando	47790	48812	13	19	43	27
Hillsborough	58506	58884	43	45	12	14
Manatee	47927	59009	26	25	29	27
Pasco	37871	52828	14	21	29	23
Pinellas	51322	54090	17	20	25	24

Figure 8:

Acute, multi-hazard flood risk neighborhood social vulnerability averages

Low Income Housing in Tampa, FL. Source: lowincomehousing.us

Oaks at Lakeside, a Low Income Development in Bradenton, FL. Source: htgf.com

County Analyses

The county analysis identifies locations, specific to each county, that exhibit high concentrations of flood exposed affordable housing. This process includes combining assisted housing units, Naturally Occurring Affordable Housing (NOAH) properties, and mobile homes together while analyzing their density relative to different flood hazards. The counties analyzed in this report include Citrus, Hernando, Hillsborough, Manatee, Pasco, Pinellas, and Sarasota. Locating these high risk areas can help policy makers target particularly vulnerable locations with adaptation initiatives meant to protect and maintain the stock of affordable housing.

County Analysis Methods

The county analysis seeks to answer two specific questions: **1.** Which neighborhoods within a particular county have high concentrations of flood exposed affordable housing? **2.** What is the socio-demographic composition of the neighborhoods with the highest concentration of multi-hazard, flood exposed affordable units? These questions are answered using techniques from spatial statistics and data provided by the US Census. The first step of this analysis defines two areas within the county which are referred to as blocks and neighborhoods. Blocks are chosen to represent neighborhood blocks and range in size from 40 to 250 kilometers squared. The number of affordable units exposed to a given flood hazard is aggregated for each block. Neighborhoods are then defined as congregations of blocks. These constructed areas are visually provided by **Figure 9**. The red square represents a block, and the surrounding white squares represent the neighborhood. The concentration analysis is then carried out at the neighborhood level comparing the count of flood exposed affordable units within a neighborhood to the count of all flood exposed units within the county. Neighborhoods with significantly larger concentrations of flood exposed affordable housing are identified as hot spots. A formal explanation of this technique is presented in the appendix.

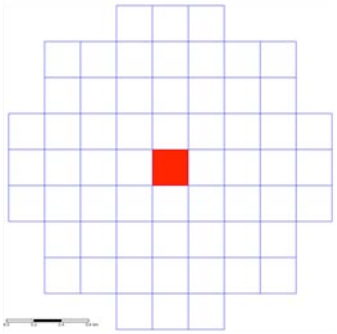


Figure 9:

Example of individual block surrounded by equi-area blocks that form a neighborhood

The fundamentals of individual flood exposure and the definitions of affordable housing guarantee the existence of hot spots within each county. Land elevation and proximity to the coast are the main variables contributing to a parcel's level of flood exposure. While the existence of affordable housing relies on a number of attributes that are often spatially correlated including the age of housing development and the proximity to different amenities.

The following analysis focuses on three specific hazards with the shortest return periods in the hazard set including an analysis of exposure to the 1% annual flood zone, the 0.2% annual flood zone, and storm surge zones for hurricanes up to category 3 on the Saffir Simpson scale. These hazards are selected over other flood events for two reasons. First, these hazards have higher frequency return periods and second, they are considered less severe than some of the other flooding events. The higher return periods suggest that these events will occur more frequently than other flood events. Additionally, the lower severity of these events provides a lower bound to the count of flood exposed affordable housing. This suggests that the risk faced due to these flooding events will increase for less frequent, but more severe floods.

This analysis then focuses in on neighborhoods with the highest concentrations of exposed housing. These locations with the highest concentrations of flood exposed affordable housing are further described by their social vulnerabilities. The characteristics of the social vulnerability analysis include Census Data (2019) describing census tract incomes, minority concentrations (the percentage of Black and Hispanic populations), and elderly concentrations (65 years and older) of the residents. The characterization of these neighborhoods can educate policy makers on compound risks resulting from high flood exposure and the interactions with social vulnerabilities. The resulting product will demonstrate specific neighborhoods to be targeted with efficient climate mitigation strategies that can accommodate the unique neighborhood demographics.

Citrus County Analyses

Citrus Density Analysis

Citrus County is one of the only counties within the Tampa Bay Region that has more assisted housing units funded through the federal government than through state and local channels. In fact, 20 of the 29 total properties and 698 of the 1056 units are funded through federal coffers. Additionally, Citrus County has the highest percentage of their Assisted Housing Inventory (AHI) units exposed to severe flood risks in the form of 1% and 0.2% annual flood zones. Specifically in Citrus County more than 50% of the AHI units are located in flood zones.

Citrus County, like Pinellas, Pasco, and Sarasota, has a high count of mobile homes exposed to the flood hazards analyzed in this report. However, while the count of exposed mobile homes is high relative to the other four counties, the overall percentage of flood-exposed mobile homes does not make up more than a third of the total mobile home stock.

Figure 10 provides the count and percent of Naturally Occurring Affordable Housing (NOAH) properties exposed to the different flood hazards. The total count of exposed NOAH properties to the different flood events implies that Citrus County does not have as many exposed NOAH units as other, more highly populated, counties in the Region. However, as a percentage of the county's NOAH housing stock, the NOAH properties exposed to the different flood hazards resides close to the average for the Region.

Key Points:

- Citrus County has a high percentage of their AHI inventory exposed to the 1% and 0.2% flood hazards (55%)
- In Citrus County the number of flood exposed affordable units doubles between the 1% and 0.2% annual flood zones.
- There is an increase of over 2,000 more mobile homes exposed to the 0.2% annual flood zone from the 1% annual flood zone in Citrus County

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Citrus												
AHI	586	55	586	55	301	29	301	29	25	2	110	10
Mobile Homes	3518	22	5563	35	5534	35	6471	41	715	5	789	5
Multi-Family	518	41	671	54	465	37	465	37	10	1	48	4
Single Family	1320	18	1696	23	771	10	838	11	63	1	100	1
Total NOAH	5356	22	7930	32	6770	28	7774	32	788	3	937	4

Figure 10:

Citrus County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

Within the NOAH specification their is a divergence in the percent of exposed units between multi-family and single family properties. Specifically, Citrus has between 450 and 700 multi-family units exposed to flood hazards. As a percentage of all multi-family affordable units, those exposed to the severe annual flood hazards (1% and 0.2% annual flood zones) represent 41% of the total affordable multi-family stock. However, the percent of flood exposed single family stock never rises above 25%.

Figure 11 displays the relative dispersion of affordable housing for the different subsets of flood exposed units. In general, affordable housing is fairly disperse in Citrus County with only 42% of the entire affordable housing stock located within hotspots. The dispersion of affordable units exposed to the different annual flood zones is also high. For example, of the affordable units exposed to 1% annual floods, only 26% are identified within the hot spot analysis. This suggests that affordable units exposed to 1% annual flood zones are well spread out in Citrus County. This is not the case for affordable units exposed to storm surge where nearly three-quarters of the affordable units exposed to high frequency storm surge are identified in hot spots. This intuitively makes sense since proximity to the coast plays a very important role in determining whether a household is exposed to storm surge.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	**10596**	**42**	**1567**	**26**	**3221**	**38**	**5241**	**74**	**5583**	**69**
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 11:

Citrus County - Counts and percents of exposed affordable units located in different flood zone hot spots

Citrus Flood Zone Hazards

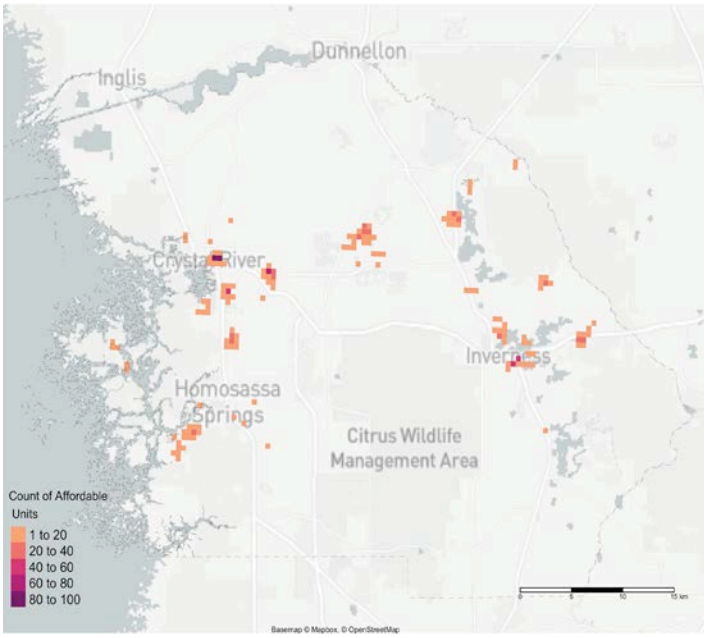


Figure 12:
Hot Spots of 1% Annual Flood Zones in Citrus County

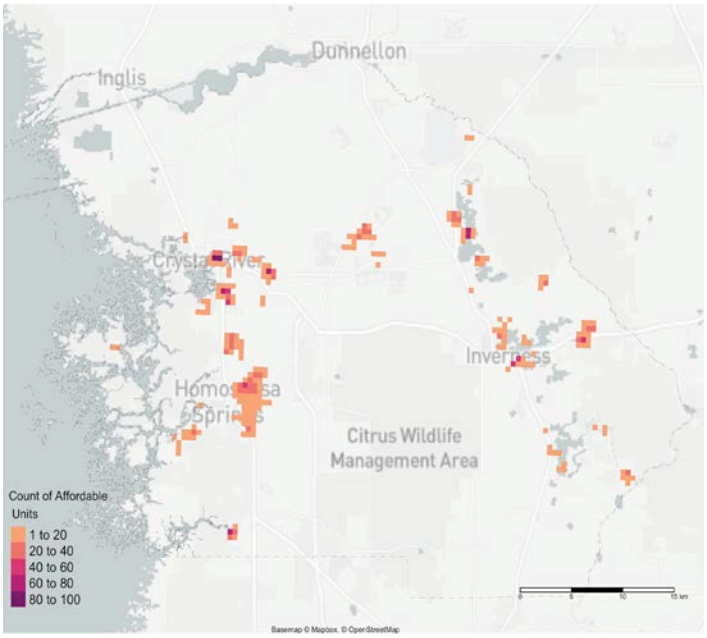


Figure 13:
Hot Spots of 0.2% Annual Flood Zones in Citrus County

Figures 12 and 13 present locations of highly concentrated affordable housing neighborhoods exposed to both 1% and 0.2% annual flood hazards. In **Figure 12**, the high density locations of affordable housing exposed to 1% annual flood zones contain 1,446 NOAH and mobile home properties with an additional 121 AHI units spread throughout 3 properties. The count of affordable units in these ''hot spots" represents 26% of all NOAH properties in Citrus that are exposed to the 1% annual flood zone and 20% of all exposed AHI units in Citrus County. Additionally, the density analysis on affordable units in the 0.2% annual flood zone contains 3,100 NOAH units and 121 AHI units. The count of exposed affordable units in these high density areas doubles between the 1% and 0.2% annual flood distinctions. Visually, this increase can be observed when comparing the number of hot spot areas between **Figures 12 and 13**.

The density analysis enables a deeper break down of housing types and their associated characteristics within the identified high density areas. Throughout the high density areas exposed to 1% annual flood zones, the NOAH properties and mobile homes have similar counts of exposed units. Multi-family units in the 1% annual flood risk hot spots make up the lowest count of exposed housing units (311 units). Whereas, mobile homes make up the greatest percent of NOAH properties identified in these hot spots with 642 units (out of the total 1,446). The density analysis for the 0.2% annual flood zone does not contain a significant increase in the count of multi-family or single-family properties relative to the 1% annual flood zone. However, the count of mobile homes identified in these hot spots increases dramatically between the 1% and 0.2% annual flood hazards. The count of mobile homes increases from 642 to 2,011 between these flood zones, equaling an increase of 213%.

The average age of NOAH units is consistent between the high density areas of homes exposed to 1% and 0.2% annual flood zones. Within both flood zones, single-family residential NOAH properties are on average older than the other housing types. The majority of single-family homes identified as NOAH properties within the high density areas were constructed in 1968 and 1987 for the 1% and 0.2% annual

flood zones. Mobile homes and multi-family units contain a majority of properties constructed in 1973 and 1986 respectively. These values are the same for both the 1% and 0.2% annual flood zones.

The majority of single-family and multi-family units in these high-density flood zones are characterized as masonry built structures. Whereas the majority of mobile homes are built with wooden frames. The average elevation values for exposed households, regardless of typology, decreases between the 1% and 0.2% annual flood zones. The change is small for mobile homes with elevations 6.74 and 6.15 meters. The change is larger for single-family (15.3 to 12.6) and multi-family (5.5 to 4.84) properties. Within these hot spots, single-family homes have the highest elevation in both flood zones.

The count of AHI units identified in these high density, flood-exposed zones is the same between both flood hazards. All of these properties are funded through federal programs. The average elevation of these government assisted properties is 7.54 meters and the average income of the occupying residents is around $17,000.

Figures 12 and 13 provide both visual and statistical evidence of locations that contain high concentrations of flood-exposed affordable housing. Areas near Crystal River (near the coast) and more inland near Inverness exhibit high concentrations of affordable housing exposed to severe flooding hazards. Crystal River's proximity to the coast suggests that the affordable units exposed to severe flooding in these neighborhoods will also be exposed to potential storm surge hazards.

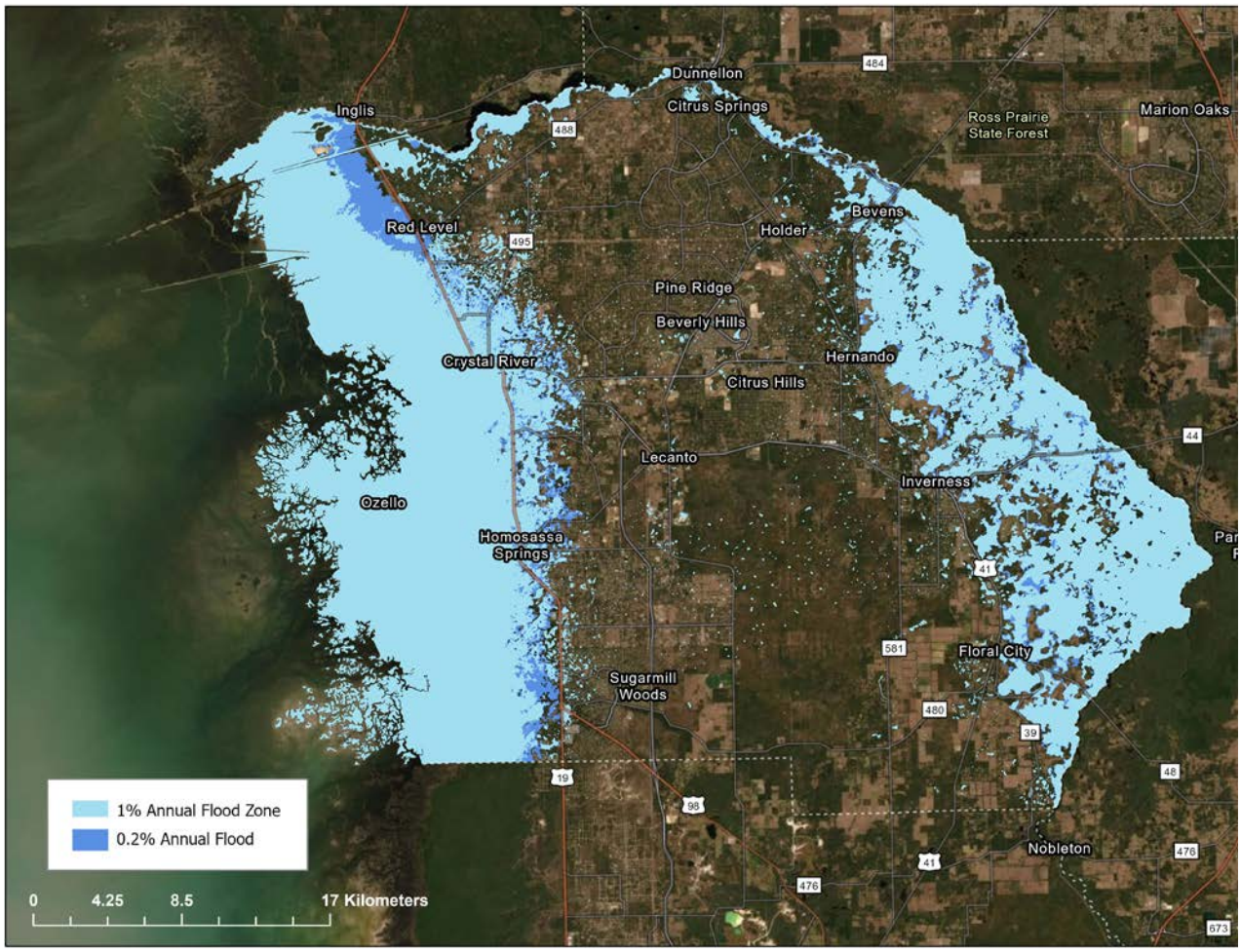


Figure 14:

Citrus County 1% and 0.2% Annual Flood Zone

Citrus Hurricane Storm Surge

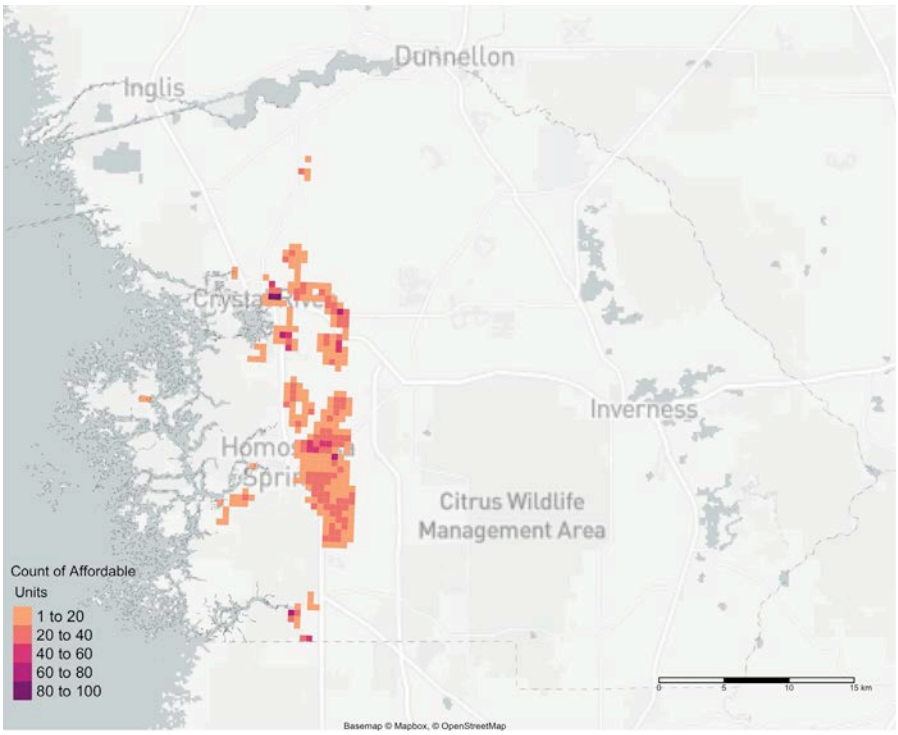


Figure 15:

Hot Spots of High-frequency Storm Surge in Citrus County

Figure 15 displays high density areas of affordable housing exposed to high-frequency storm surge. Throughout this report, high-frequency storm surge is identified as a Category 3 event on the Saffir Simpson scale. Within these surge hot spots 5,113 NOAH properties and 128 AHI units are identified. Together, the units in these hot spots account for 73% of all affordable units at risk of high-frequency storm surge. The high percentage of surge exposed units within these hot spots suggests that affordable housing exposed to surge in Citrus County is highly concentrated. Based on the visuals provided by **Figure 15**, areas near Homosassa Springs and Crystal River have high concentrations of surge exposed affordable housing.

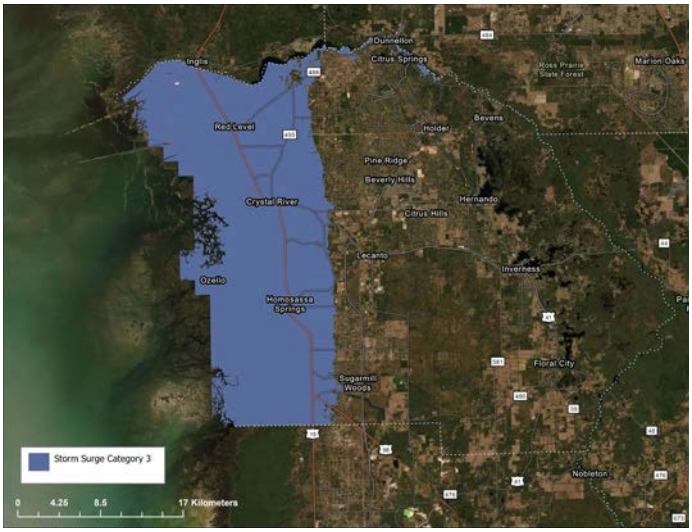


Figure 16:

Citrus County High Frequency Storm Surge

Citrus Neighborhood Analysis

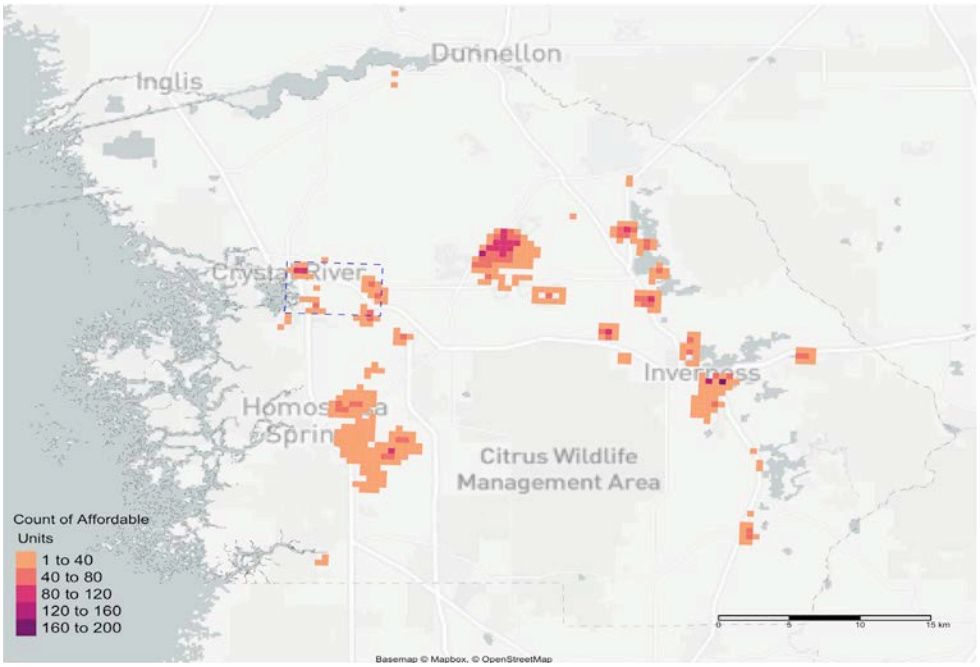


Figure 17:

Hot Spots of Affordable Housing in Citrus County

The density analysis helps identify specific neighborhoods with high concentrations of affordable housing that are acutely exposed to flood hazards. The next step of this analysis then identifies neighborhoods where the highest density clusters of affordable housing are exposed to multiple flood hazards. **Figure 17** presents a map of high density clusters of affordable housing throughout Citrus County. On this map the neighborhood study area, which is used for further analysis, is outlined by a blue dotted square near Crystal River. This study area is created by identifying the locations of highly clustered affordable housing that are exposed to both 1% annual flood zones in addition to high-frequency storm surge. While there are a number of housing clusters exposed to multiple hazards along Citrus' coast, the neighborhoods with the highest concentration of multi-hazard exposed units are situated around Crystal River.

With the neighborhood study area chosen, census tract statistics are used to further characterize these areas of highly concentrated, multi-flood hazard exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood-exposed locations.

The census demographics chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the percentage of residents over the age of 65. These three statistics help provide a deeper understanding of potential compounding social vulnerabilities associated with high flood exposure.

The neighborhood analysis keys in on locations throughout west Citrus County. These dense neighborhood clusters in Crystal River are all situated along an inlet from the Gulf likely contributing to their flood hazard exposure. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed areas. Throughout these maps, the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in. This analysis should provide insight for practitioners on the social composition of these areas and thus can inform their mitigation approaches.

Citrus Comparison Map and Median Income

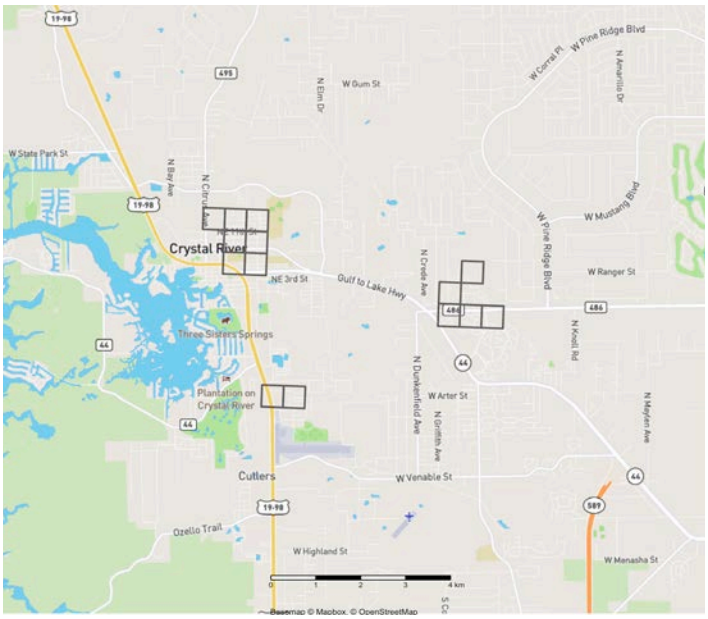


Figure 18:

High Risk Affordable Housing Hot Spots in Citrus County

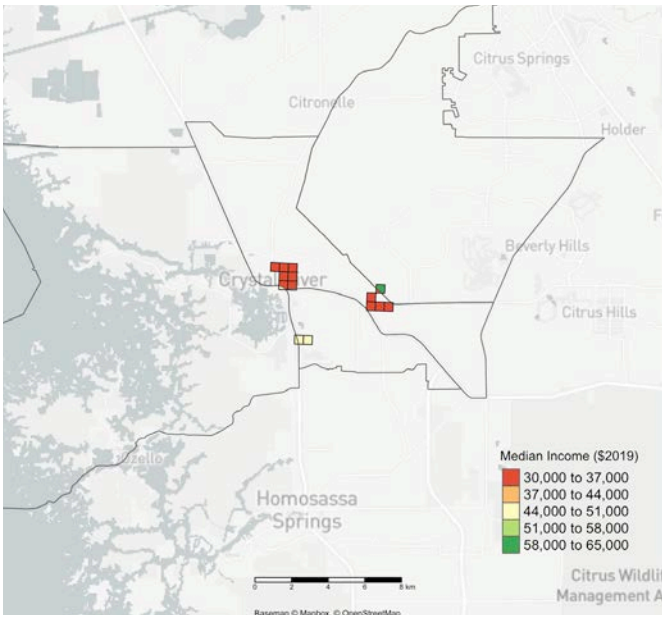


Figure 19:

Median Income of Highest Risk Hot Spots in Citrus County

Figure 19 displays the neighborhood analysis for median incomes in Citrus County. Two neighborhoods in particular, one near Three Sisters Springs and another on the southern most portion of Highway 486 contain census tract incomes below the County median. These neighborhood clusters, located in the lower income census tracts, appear to be the main contributors used to identify the high concentrations of multi-flood hazard exposed affordable units. By definition, lower income neighborhoods have more affordable housing. The median income in Citrus County is lower than the majority of the other counties in the Region, Therefore, these neighborhoods with median incomes lower than the Citrus county median likely have acute social vulnerabilities relative to other flood-exposed neighborhoods throughout the Region.

The average income in Citrus County is $44,237 which exceeds the median income in the majority of the hot spot neighborhoods. The low median income of these high density, highly exposed areas in Citrus County have compounding social vulnerabilities that should be accounted for when determining flood mitigating policies.

Citrus Minority and Elderly Percentage

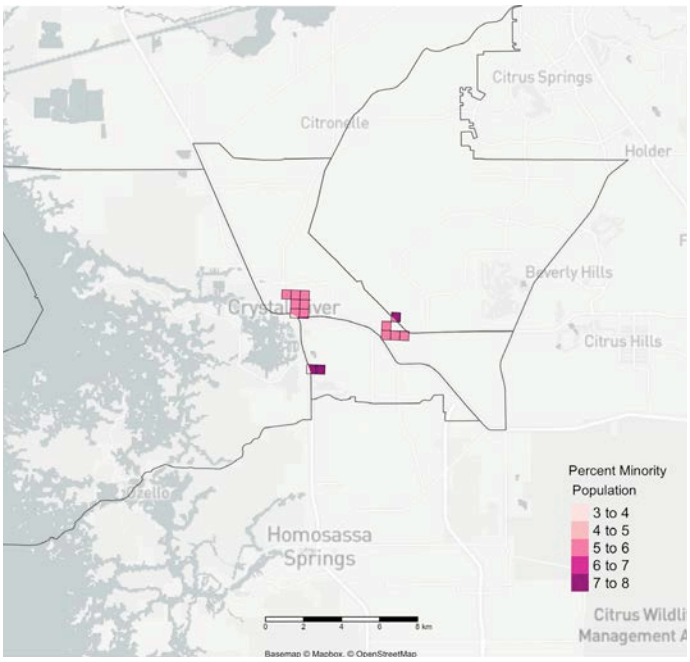


Figure 20:

Percent Minorities of Highest Risk Hot Spots in Citrus County

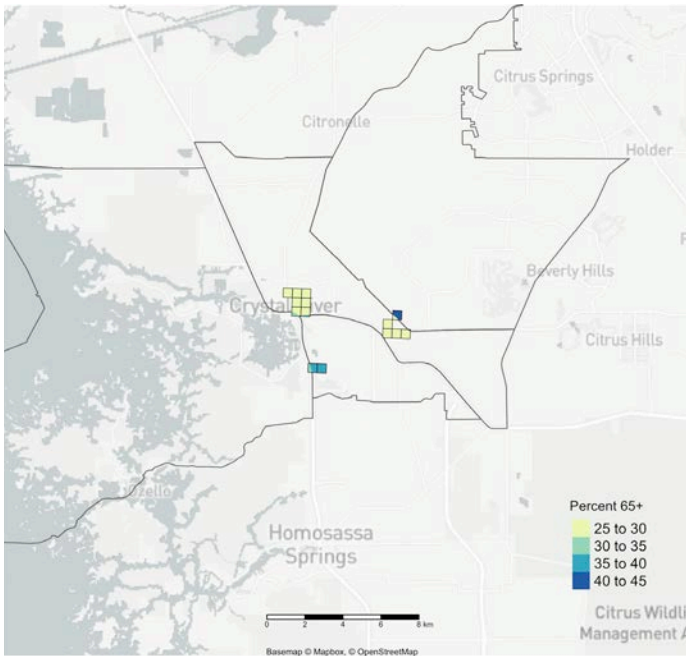
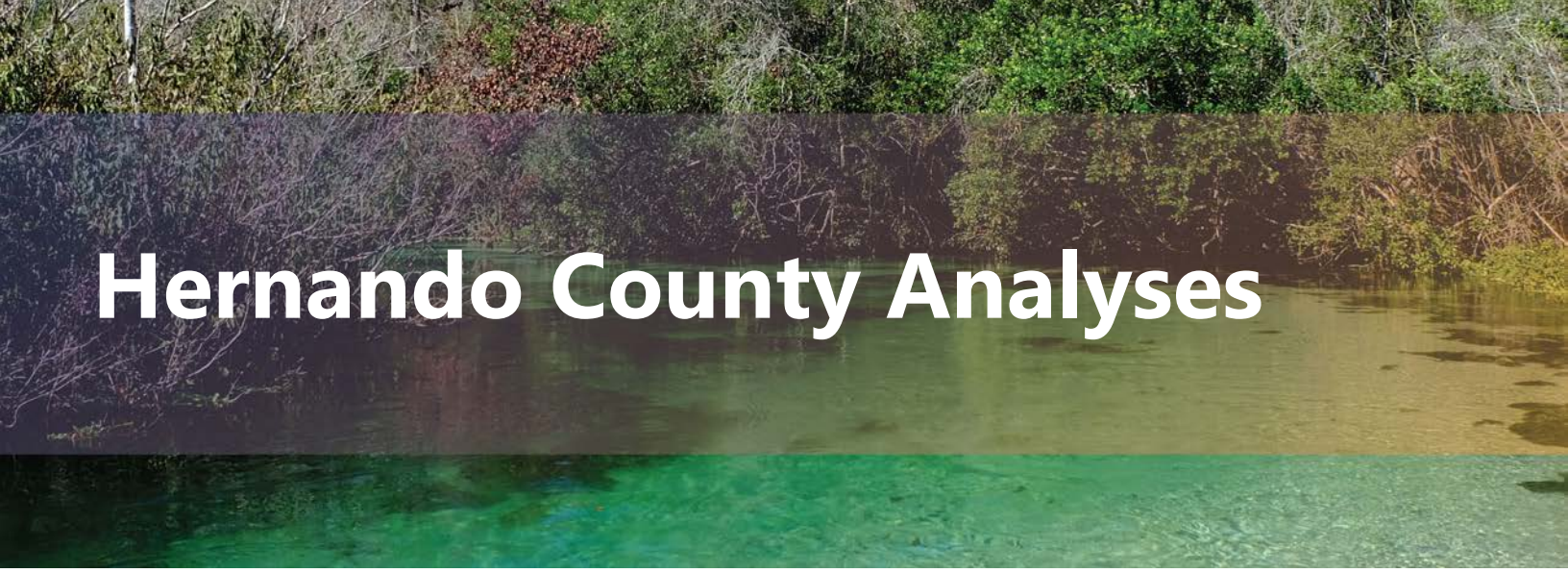


Figure 21:

Percent Elderly of Highest Risk Hot Spots in Citrus County

Figure 20 displays the distribution of minority concentrations throughout the selected study neighborhoods. Citrus has a low percentage of minorities throughout the whole county with only 8% of the population identifying as Black or Hispanic. This trend is no different when looking at neighborhoods with affordable housing acutely exposed to multiple flood hazards. Two of the neighborhoods have minority percentages that are representative of the county. The other two neighborhoods, with lower median incomes, also have lower concentrations of minority populations.

On the other hand, **Figure 21** displays flood-exposed neighborhoods with high concentrations of elderly households. Overall in Citrus County the elderly population makes up 36% of the total population. These study areas with median incomes lower than the county median and small percentages of minorities also have lower percentages of elderly households compared to the county average. This suggests that the main social vulnerabilities compounding multi-hazard flood exposure are related to low household incomes.



Hernando County Analyses

Hernando Density Analysis

Hernando County, tied with Citrus County, has the lowest count of Assisted Housing Inventory (AHI) properties in the region (29 properties). Unlike Citrus, the majority of these properties (23 out of 29) receive funding through state and local programs. More than a third of the units in these properties are exposed to some type of flood hazard. Specifically, exposure to severe floods due to locations in the 1% and 0.2% annual flood zones as well as exposure to low frequency storm surge (Category 5 storms) drive the threat of flooding for AHI properties in Hernando County. .

Mobile homes in Hernando County make up the greatest of count of exposed affordable units to the 1% and 0.2% annual flood zones. However, even with these high counts of exposed mobile homes the entire stock of mobile homes exhibits relatively minimal exposure. For 1% and 0.2% annual flood events, which constitute the highest count of exposed mobile homes, the total percentage of exposed mobile home units does not exceed 25% of the total mobile home stock. Mobile homes are the most exposed type of affordable housing in Hernando County for all flood events except for the low frequency storms, where single family homes take over the top spot.

Key Points:

- Overall, mobile homes compromise the most flood exposed affordable housing units in Hernando County.
- Hernando County has the second smallest increase in flood exposed affordable units between the 1% and 0.2% annual flood zones.
- Severe flood events related to the 1% and 0.2% annual flood zones pose the main risk to mobile homes in Hernando County.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Hernando												
AHI	690	34	690	34	128	6	690	34	0	0	0	0
Mobile Homes	2370	20	2713	23	836	7	1763	15	387	3	397	3
Multi-Family	799	35	824	36	137	6	1164	51	0	0	0	0
Single Family	899	19	1005	22	542	12	2340	51	0	0	0	0
Total NOAH	4068	22	4542	24	1515	8	5267	28	387	2	397	2

Figure 22:

Hernando County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

Figure 22 presents the counts and percents of flood exposed affordable units in Hernando County. This table provides that although multi-family affordable units make up the smallest absolute count of flood exposed affordable housing, they represent the housing type with the largest percent of flood exposed units for all flood events excluding high frequency storm surge. Specifically, 35% of all multi-family units are exposed to both the 1% and 0.2% annual flood hazard.

Additionally, **Figure 23** displays the relative density of affordable housing throughout Hernando County. It appears from this table that Hernando County's affordable housing units are closely situated near each other such that 59% of all affordable units are captured within the hot spot analysis. However, the relative concentration of flood exposed affordable units (to the 1% and 0.2% annual flood zones) is more disperse. Unsurprisingly, there is a high level of clustering exhibited by homes exposed to both types of storm surge with greater than three-quarters of all surge exposed units captured within the hot spot analysis.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	**12376**	**59**	**1999**	**42**	**2149**	**41**	**1238**	**75**	**4700**	**79**
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 23:

Hernando County - Counts and percents of exposed affordable units located in different flood zone hot spots

Hernando Flood Zone Hazards

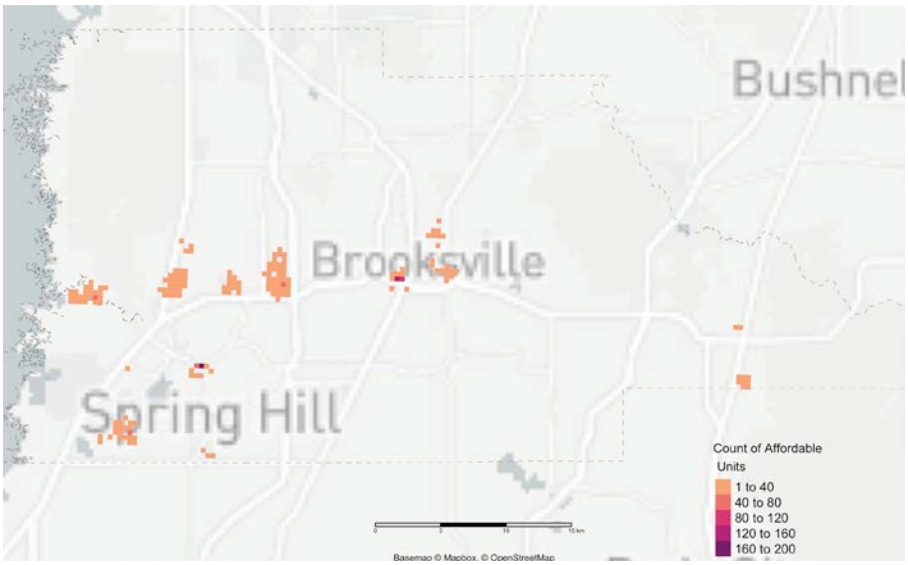


Figure 24:

Hot Spots of 1% Annual Flood Zones in Hernando County

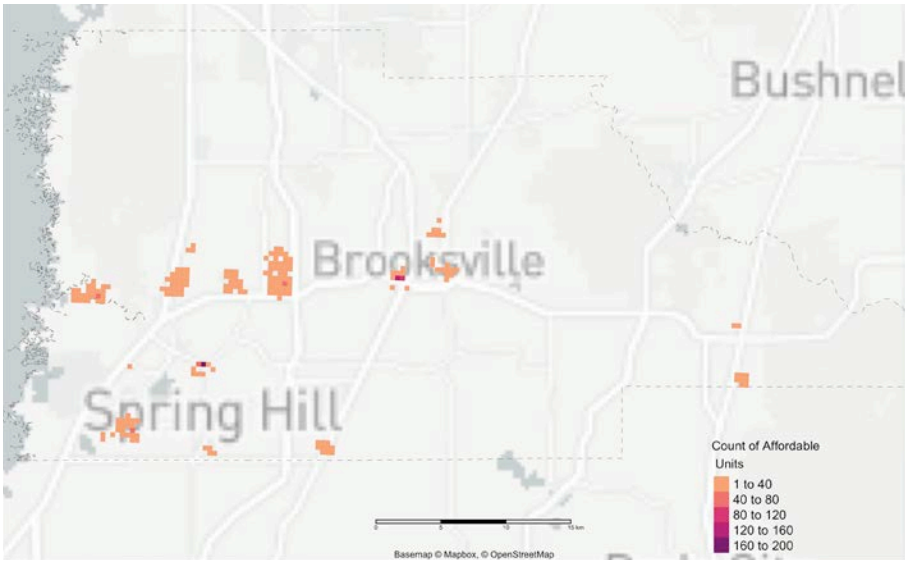


Figure 25:

Hot Spots of 0.2% Annual Flood Zones in Hernando County

Figures 24 and 25 present neighborhoods of highly concentrated affordable housing exposed to both the 1% and 0.2% annual flood zones. The high density areas of affordable housing exposed to the 1% annual flood zones contain 1,800 NOAH and mobile home properties with an additional 199 AHI units spread throughout 3 properties. The number of NOAH and AHI units exposed to 1% annual flood zones in the hot spot analysis represent 44% of the entire NOAH stock and 28% of the entire AHI stock that are exposed to 1% annual flood zones in Hernando County. **Figure 24** displays high density neighborhoods of flood-exposed affordable units in the 0.2% annual flood zone, accounting for 1,950 NOAH units and 199 AHI units. These statistically identified hot spots highlight important action areas for hazard mitigation.

This density analysis allows for a further break down of housing types and characteristics within the

identified high density areas. Throughout the 1% annual flood zone hot spots, mobile homes contribute the most to the high concentrations of flood-exposed affordable units. 1,053 units out of the 1, 800 NOAH units are designated as mobile home units. The change in total units identified by the 0.2% annual flood zone hot spots is smaller for multi-family and single-family housing than mobile homes. Specifically, the increase in mobile homes units captured by the 0.2% hot spot analysis is an order of magnitude larger (101 more units) than the increase for single-family and multi-family units (22 and 27 respectively).

Statistics on the housing characteristics of these exposed units are identical for both the 1% and 0.2% annual flood zones. Mobile homes are the oldest housing typologies within the hot spots with a majority of units built in 1974. Single-family and multi-family units have the highest number of units built during 1985 and 1987 respectively.

The majority of mobile homes and multi-family units found in either of the flood zone hot spots were built with wooden frames. However, the majority of NOAH single-family units were constructed with reinforced concrete. On average, mobile homes in these hot spots sit at the lowest elevation of the housing typologies (around 12 meters). Multi-family units are the highest on average siting approximately 19 meters above ground.

For AHI properties in these hot spots 184 units are funded through state or local means while 15 units receive federal funds through HUD or RD programs. The properties in these hot spots on average sit lower than the average NOAH units (approximately 10 meters above the ground). The average income of HUD/RD funded households in these hot spots is $10,057 while it is nearly double for the locally subsidized units $21,646.

The hot spots identified in **Figures 24 and 25** are fairly similar for both flood zones. This suggests small variability in elevation throughout Hernando County. The majority of affordable housing clusters are found between the West Coast and Brooksville.

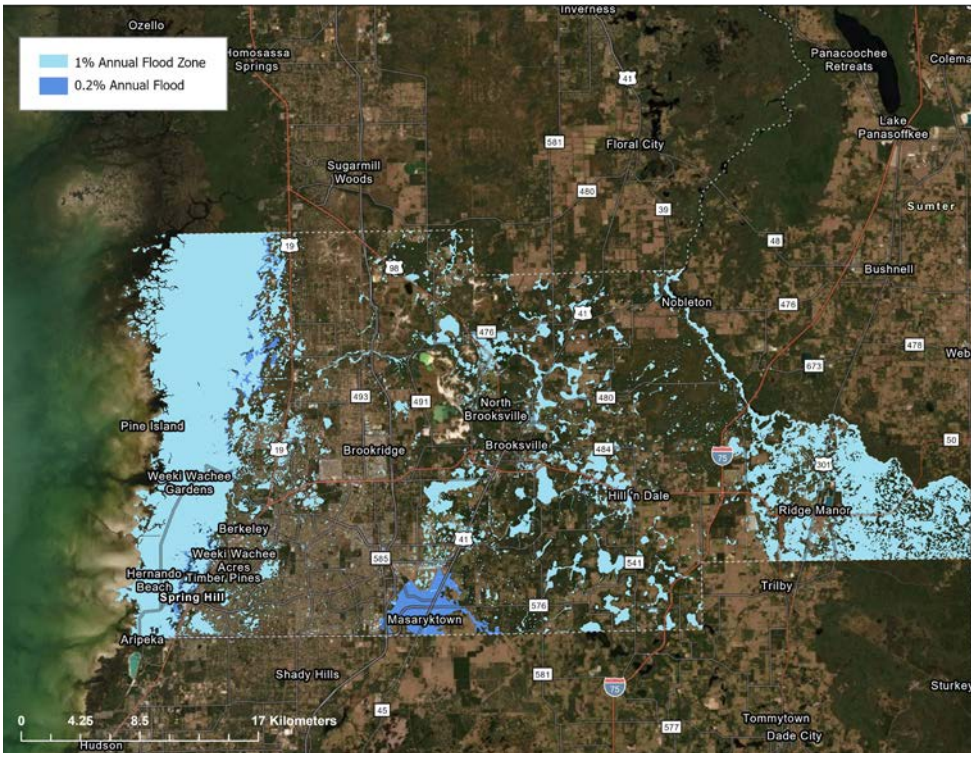


Figure 26:

Hernando County 1% and 0.2% Annual Flood Zones

Hernando Hurricane Storm Surge

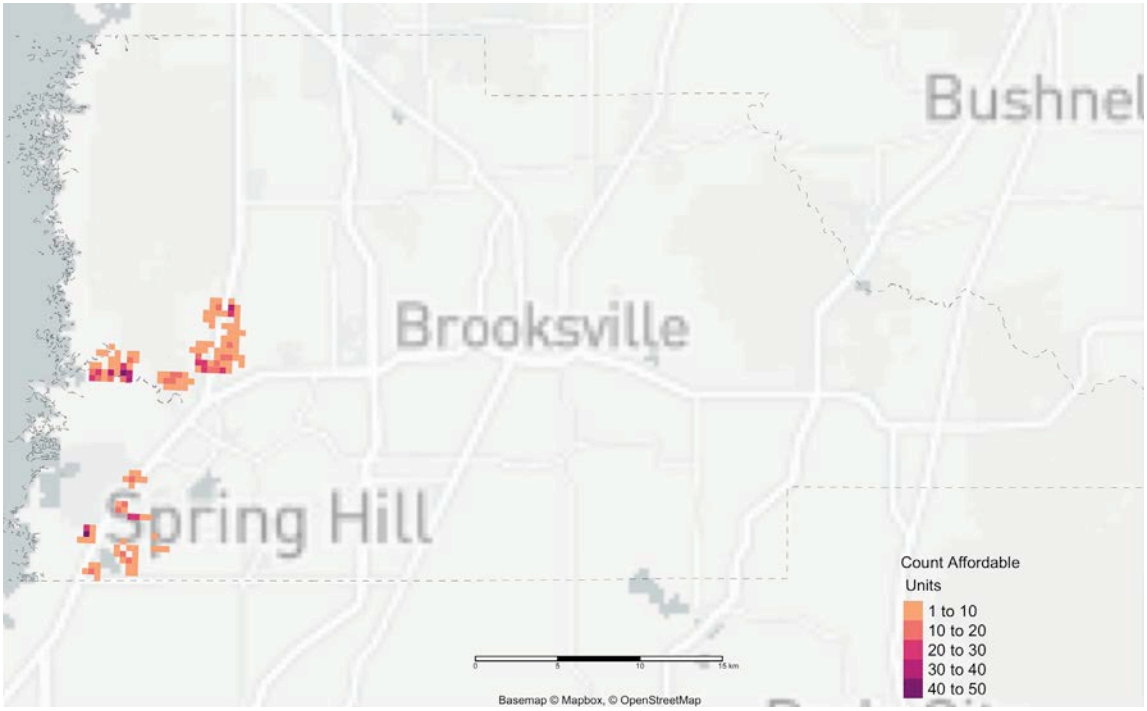


Figure 26:

Hot Spots of High-frequency Storm Surge in Hernando County

Figure 26 displays high density neighborhoods of affordable housing exposed to high-frequency storm surge. Throughout this report, high-frequency storm surge is classified as a Category 3 hurricane event on the Saffir Simpson scale. Within these surge hot spots 1,238 NOAH units are identified while no AHI units are present. The NOAH units located in these hot spots account for 80% of all affordable units at risk of high-frequency storm surge. This high percentage of surge exposed units found within these hot spots suggest high clustering levels of surge exposed affordable housing. Further evidence of this clustering is supported by Figure 23. Overall, Hernando County affordable housing does not face a significant threat from high-frequency storm surge.

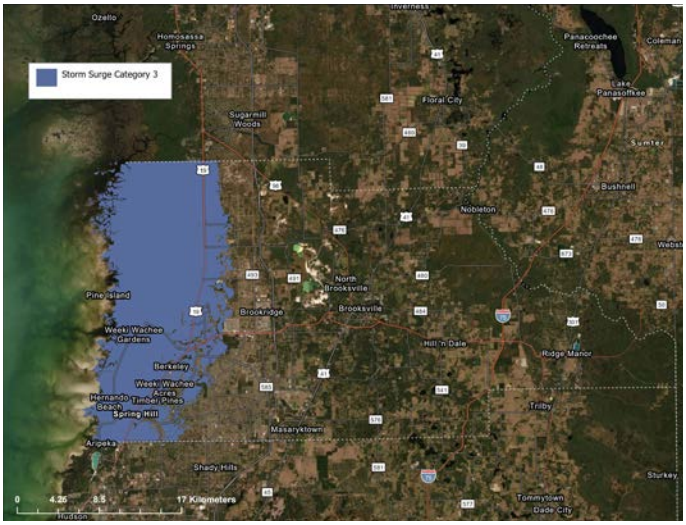


Figure 27:

Hernando County High Frequency Storm Surge

Hernando Neighborhood Analysis

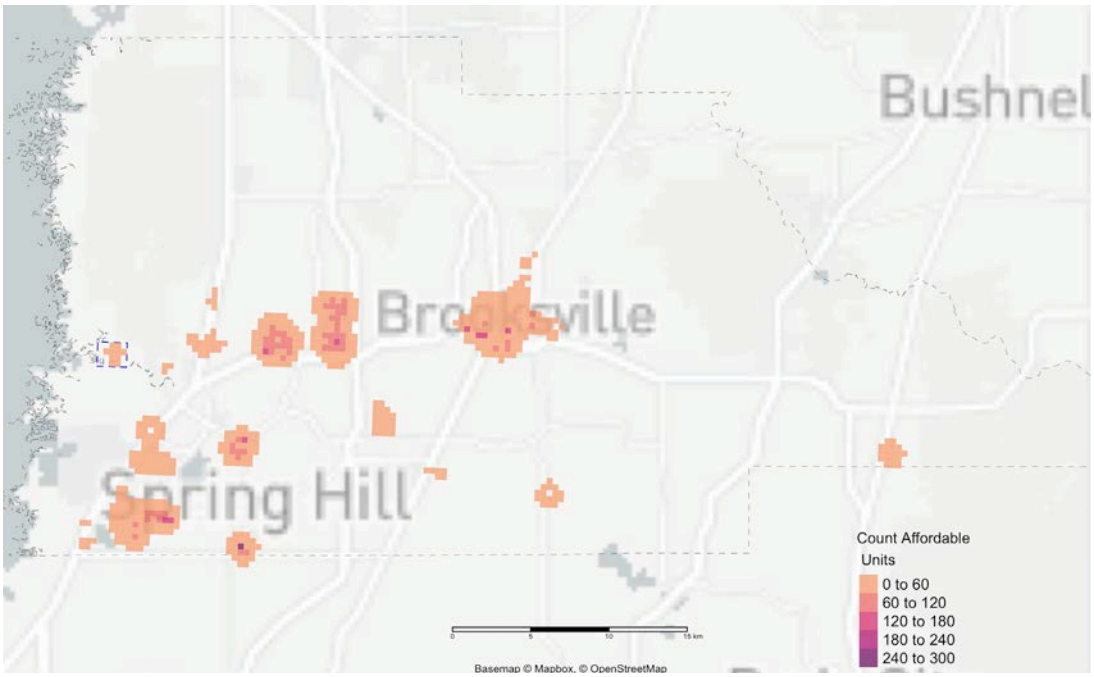


Figure 28:

Hot Spots of Affordable Housing in Hernando County

The density analysis identifies specific neighborhoods with high concentrations of affordable housing that are acutely exposed to flood hazards. The next step of this analysis then identifies neighborhoods where the highest density clusters of affordable housing are exposed to multiple flood hazards. **Figure 28** presents a map of high-density clusters of affordable housing throughout Hernando County. On this map the neighborhood study area, which is used for the continued analysis, is defined by a blue dotted square along the west coast of Hernando County, North of Spring Hill. This study area is created by identifying the locations of highly clustered affordable housing that are exposed to both 1% annual flood zones in addition to high-frequency storm surge. Since this neighborhood analysis focuses on both surge and severe flood events, the majority of high density affordable housing locations will be situated along the coast.

With the neighborhood study area chosen, census tract statistics are used to characterize the areas with high concentrations of multi-flood hazard exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood-exposed locations.

The census demographics chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the percentage of residents over the age of 65. These three statistics help provide a deeper understanding of potential compounding social vulnerabilities associated with high flood exposure.

The neighborhood analysis keys in on neighborhoods near Weeki Wachee Gardens and Palm Grove Colony. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed areas. Throughout these maps, the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in. This analysis should provide insight for practitioners on the social composition of these areas and thus can inform their mitigation approaches.

Hernando Comparison Map and Median Income

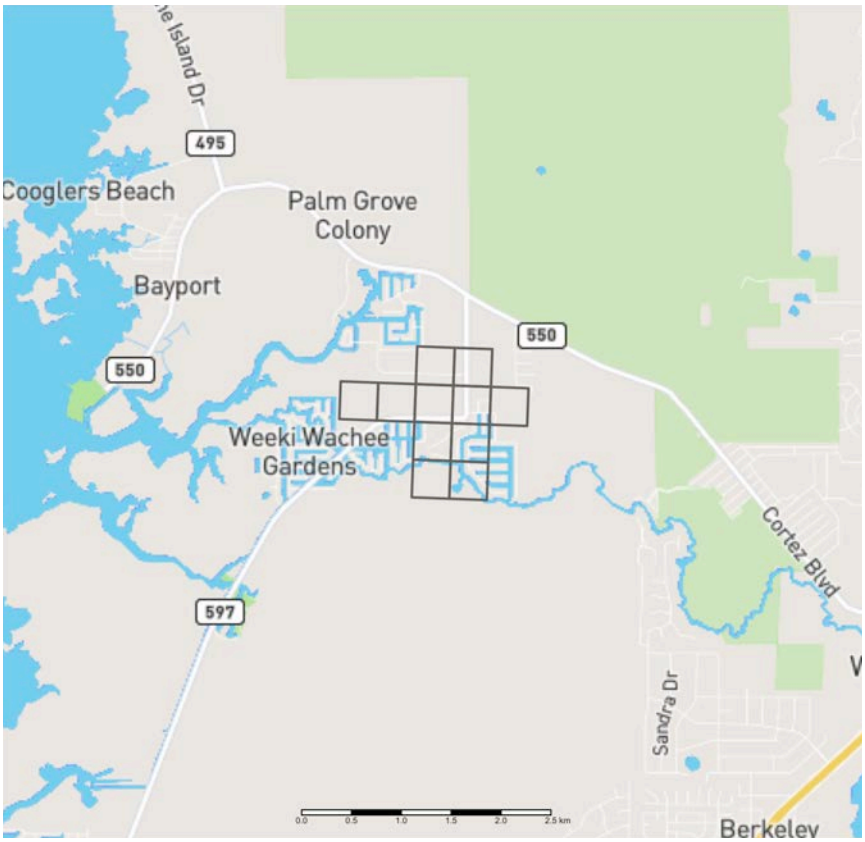


Figure 29:
High Risk Affordable Housing Hot Spots in Hernando County

Figure 30:
Median Income of Highest Risk Hots Spots in Hernando County

Figure 30 presents the neighborhood analysis of median incomes for the most flood-exposed affordable housing hot spots in Hernando County. Nearly all neighborhoods in the analysis are contained within census tracts that have median incomes lower than the county median. However, the difference is minimal. Most of these neighborhoods have median incomes between $46,000 and $47,000 while the median income in Hernando County is $48,812. Additionally, the study neighborhoods, those with the highest levels of flood exposure, are highly concentrated supporting the understanding that flood-exposed affordable housing in Hernando County is not highly dispersed.

Hernando Minority and Elderly Percentage

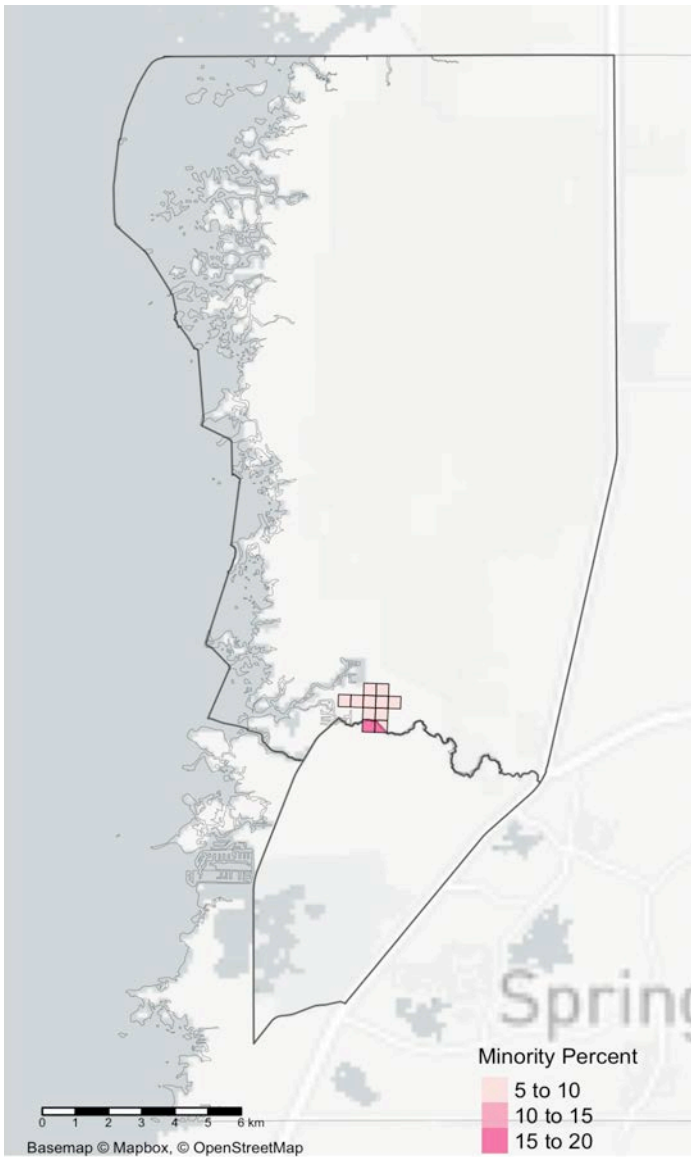


Figure 31:

Percent Minorities of Highest Risk Hot Spots in Hernando County

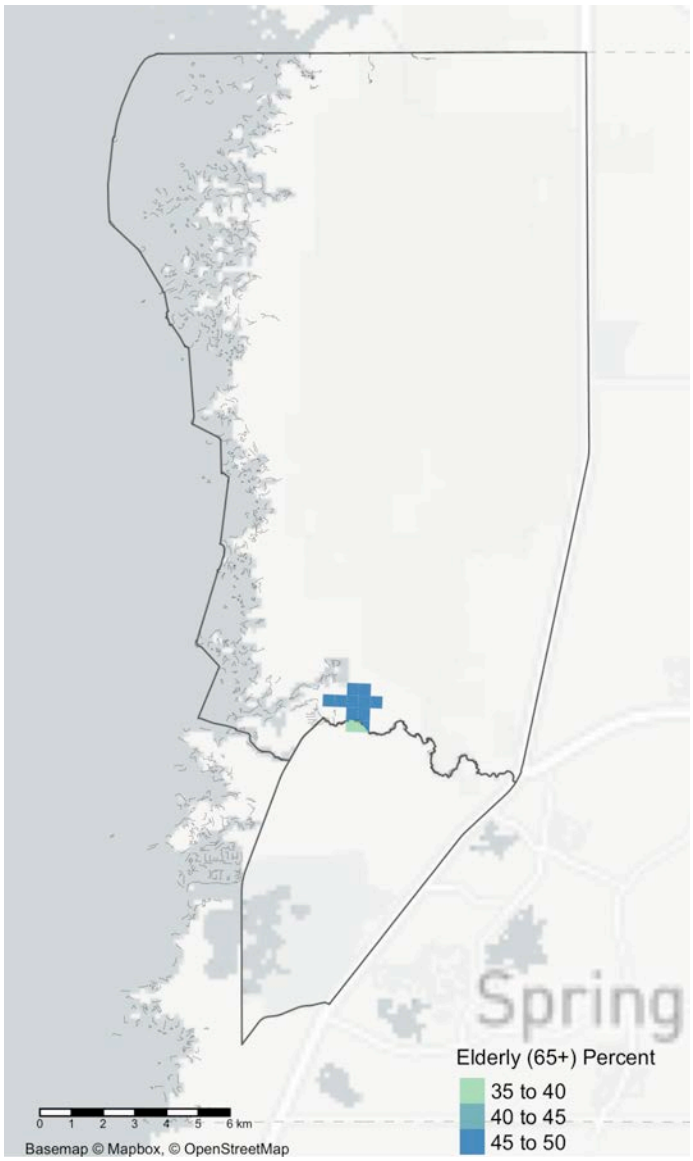


Figure 32:

Percent Elderly of Highest Risk Hot Spots in Hernando County

Figure 31 displays the distribution of minority concentrations throughout the selected study neighborhoods. Hernando has a low concentration of minorities throughout the whole county with only 18% of the population identifying as Black or Hispanic. The neighborhoods of focus for this neighborhood analysis have lower percentages of **minority populations** than the county at large.

Figure 32 provides a map of the study neighborhoods and the percentage of **elderly population** within each of the representative census tracks. Overall in Hernando County the elderly population makes up 28% of the population. The neighborhoods of interest have a much larger population of elderly individuals than is representative of the county. While these neighborhoods have lower percentages of minorities and have median incomes representative of the county; their high percentage of elderly populations lead to a unique challenge where social vulnerabilities and flood exposure overlap.

Hillsborough County Analyses

Hillsborough Density Analysis

Hillsborough County has the most assisted housing units in the seven county Tampa Bay Regional Resiliency Coalition. County wide there are 166 Assisted Housing Inventory (AHI) properties with 22,757 total units. Additionally, this analysis identifies 18,090 multi-family affordable units, 12,607 single family affordable units, and 14,514 mobile homes. Within the city of Tampa, the largest city in Hillsborough, there are 2,861 multi-family units identified as affordable, 7,715 single family units identified as affordable, and 1,515 mobile home units.

The municipalities throughout Hillsborough County receive a majority of subsidized housing funds via state and local programs (13,185 units). Within Hillsborough County, the count of state and local subsidized units is greater than the combination of state and local funded units throughout the six other compact counties. Hillsborough County also leads the Coalition with the number of flood exposed AHI units within its boundaries. Specifically when focusing on the 1% annual flood zone, the 0.2% annual flood zone, and the low frequency storm surge, Hillsborough County has the highest count of flood exposed AHI units.

Key Points:

- Hillsborough County contains the highest count of flood exposed AHI units in the compact.
- Affordable housing displays a high level of dispersion in Hillsborough County.
- Single Family affordable housing makes up the smallest count of flood exposed affordable housing in the County.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Hillsborough												
AHI	5546	26	5706	27	4742	22	11948	56	197	1	439	2
Mobile Homes	2774	19	2824	19	1872	13	4370	30	407	3	634	4
Multi-Family	3935	22	3960	22	1730	10	7601	42	65	0	299	2
Single Family	1622	13	1658	13	2313	18	5975	47	181	1	468	4
Total NOAH	8331	18	8442	19	5915	13	17946	40	653	1	1401	3

Figure 33 :

Hillsborough County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

Mobile homes within Hillsborough County never make up more than 25% of the non subsidized at-risk affordable units. Additionally, as a percent of the entire mobile home stock, those exposed to flood hazards (except for low frequency surge) represent less than 25% of the entire stock . The percentage of mobile homes exposed to the varying hazards is provided by **Figure 33**. The small changes in number of exposed mobile home units for each of the flood hazards suggests that many of these units are simultaneously exposed to multiple hazards.

Hillsborough County has the lowest percentage of non-subsidized properties exposed to varying flood hazards within the Coalition, except for the low frequency storm hazard. Although Hillsborough County is the most populated county in the Compact, it ranked third for the count of flood-exposed NOAH properties. The fact that Hillsborough does not have the highest count of exposed affordable units may be due to the high dispersion of affordable housing throughout the county. This is demonstrated by the following **Figure 34**. Throughout Hillsborough County the percent of flood exposed homes captured in the hot spot analysis is never larger than 37%. This suggests that affordable homes exposed to different flood hazards tend to be spread out within the County.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	**17647**	**26**	**4467**	**32**	**4526**	**32**	**4118**	**37**	**8563**	**28**
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 34:

Hillsborough County - Counts and percents of exposed affordable units located in different flood zone hot spots

Hillsborough Flood Zone Hazards

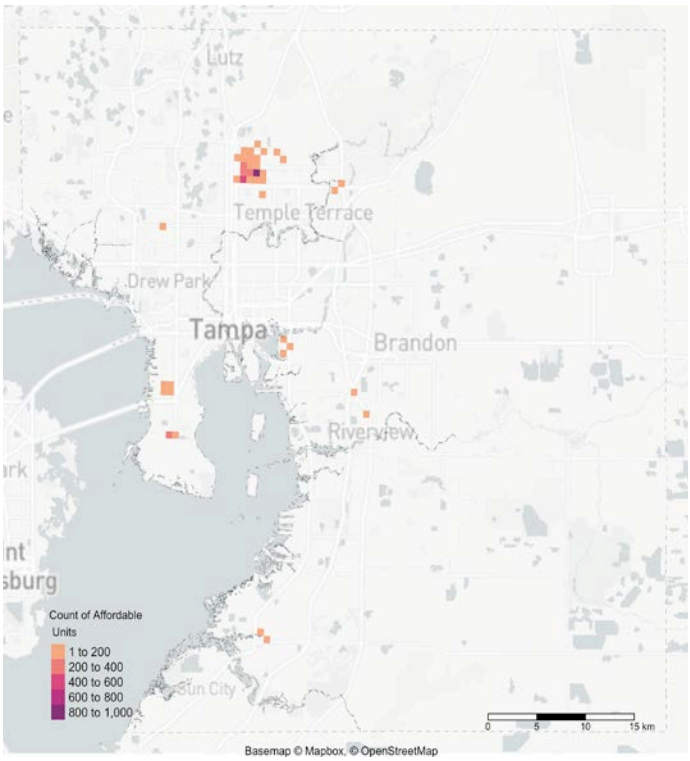


Figure 35:

Hot Spots of 1% Annual Flood Zones in Hillsborough County

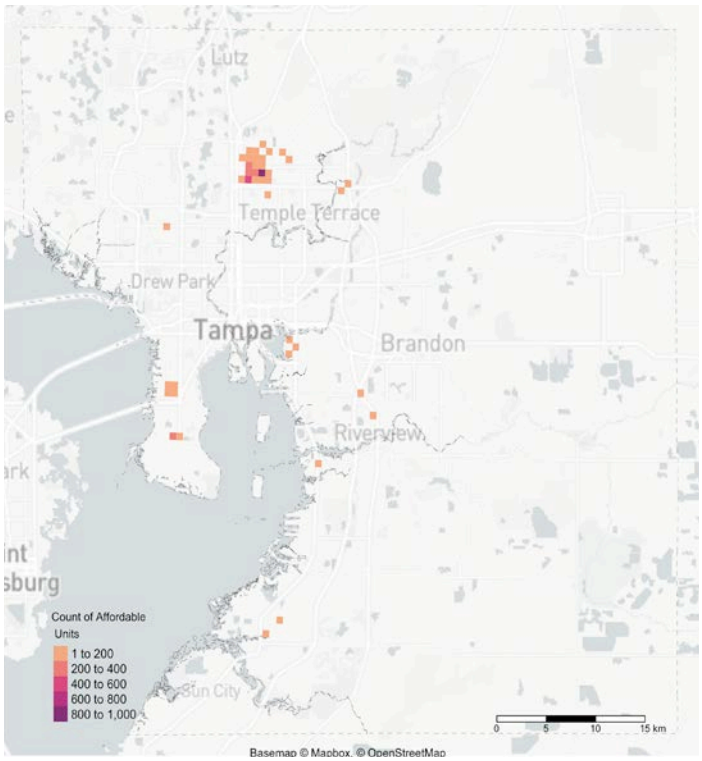


Figure 36:

Hot Spots of 0.2% Annual Flood Zones in Hillsborough County

Figures 35 and 36 present hot spots of highly concentrated affordable housing neighborhoods exposed to both 1% and .02% annual **flood zones**. Hot spots for the 1% annual flood hazard contain 2,769 NOAH and mobile home properties with 13 properties representing 1,698 AHI units. These areas of high density, which are referred to as hot spots, represent 38% of all non-subsidized properties within the 1% annual flood zone and 30% of all AHI units in this flood zone for Hillsborough County. Additionally, this analysis identifies 2,828 NOAH units and 1,698 AHI units in the 0.2% annual flood zone. The low percentage of exposed affordable units captured by the 1% and 0.2% density analysis coupled with marginal increases in number of exposed units between the 1% and 0.2% flood zones suggests that affordable housing in Hillsborough County is not significantly clustered in high flood risk locations. The affordable housing stock is highly dispersed which limits the cumulative risk to 1% and 0.2% flood zones.

This density analysis allows for a deeper break down of housing types and housing characteristics within the identified high concentration areas. Within the 1% annual flood zone hot spots, NOAH multi-family units drive the high concentrations of flood-exposed affordable units. 2,481 out of a total of 2,769 exposed NOAH units are identified as multi-family units. Multi-family units are highly represented in this specific density analysis since, by definition, multi-family housing is more dense than other housing typologies. The count of exposed multi-family units in the analysis of the 0.2% annual flood zone is similar to the 1% flood zone analysis, with only 4 additional units exposed (2,485). The small increase in exposed non-subsidized units between flood zone hot spots is driven mainly by the increase in exposed mobile home units (~100% increase). Specifically, the number of exposed mobile homes captured in the density analysis increases from 36 to 67 units.

Within both flood zones density analysis, single-family residential NOAH properties are the oldest housing typologies. The majority of single-family homes in the high density locations were constructed in 1954. In these same high density locations, mobile homes and multi-family units are typically ''newer" than their single-family, non-subsidized counterparts. In the 1% annual flood zone the majority of mobile homes were constructed in 1978 while the majority of multi-family units were constructed in 1984. The year of construction most prevalent for single-family and multi-family properties in the density analysis is consistent between the two flood zones. However, within the high density locations for the 0.2% flood zones, most mobile homes were constructed in 1999. This analysis suggests that mobile home development may have increased in the 0.2% flood zone locations during recent housing booms.

The majority of single-family and multi-family units in the flood zone hot spots are characterized as masonry built structures. The majority of mobile homes exposed to either 1% or 0.2% annual floods are characterized as wooden structures. Between the two flood zones, the average elevation for single-family and multi-family units does not change much. Single-family and multi-family units are on average 5 meters and 10.5 meters above the ground. However, mobile homes encounter a significant elevation drop off between the two flood zones. The average elevation of mobile homes in the high density 1% annual flood zones is 11.3 meters; whereas, for the hot spot analysis in the 0.2% annual flood zone, the average elevation for mobile homes is 7.3 meters. Within these designated flood zones mobile homes are the highest elevated affordable housing typologies.

Throughout the assisted housing inventory, the majority (1,016) of units located in the high density 1% annual flood zone are funded through state or local mechanisms. While less than a third (466 units) of the AHI properties located in these high density zones are funded through HUD or RD programs. Public Housing makes up the smallest portion (216) of assisted affordable housing units exposed to severe floods in these high density locations.

Figures 35 and 36 provide both visual and statistical evidence of locations that contain high concentrations of exposed affordable housing. These high density areas, also called hot spots, are fairly consistent between the severe flood hazard scenarios.

Figure 37:
Hillsborough County 1% and 0.2% Annual Flood Zones

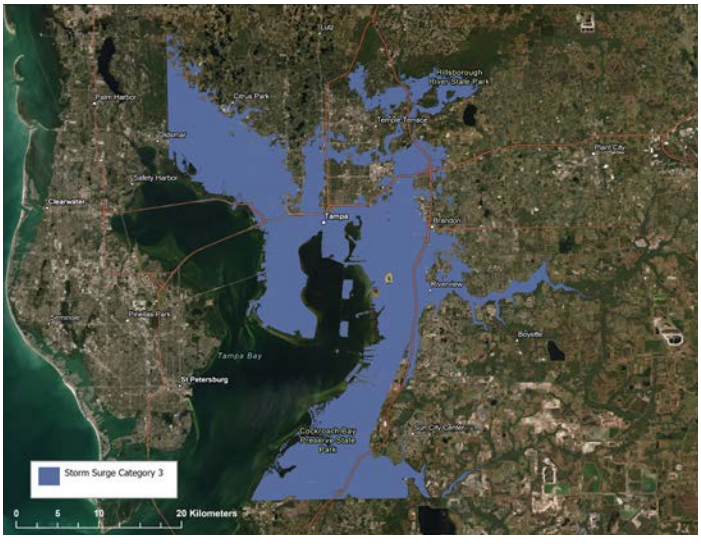


Figure 38:
Hillsborough County High Frequency Storm Surge

Hillsborough Hurricane Storm Surge

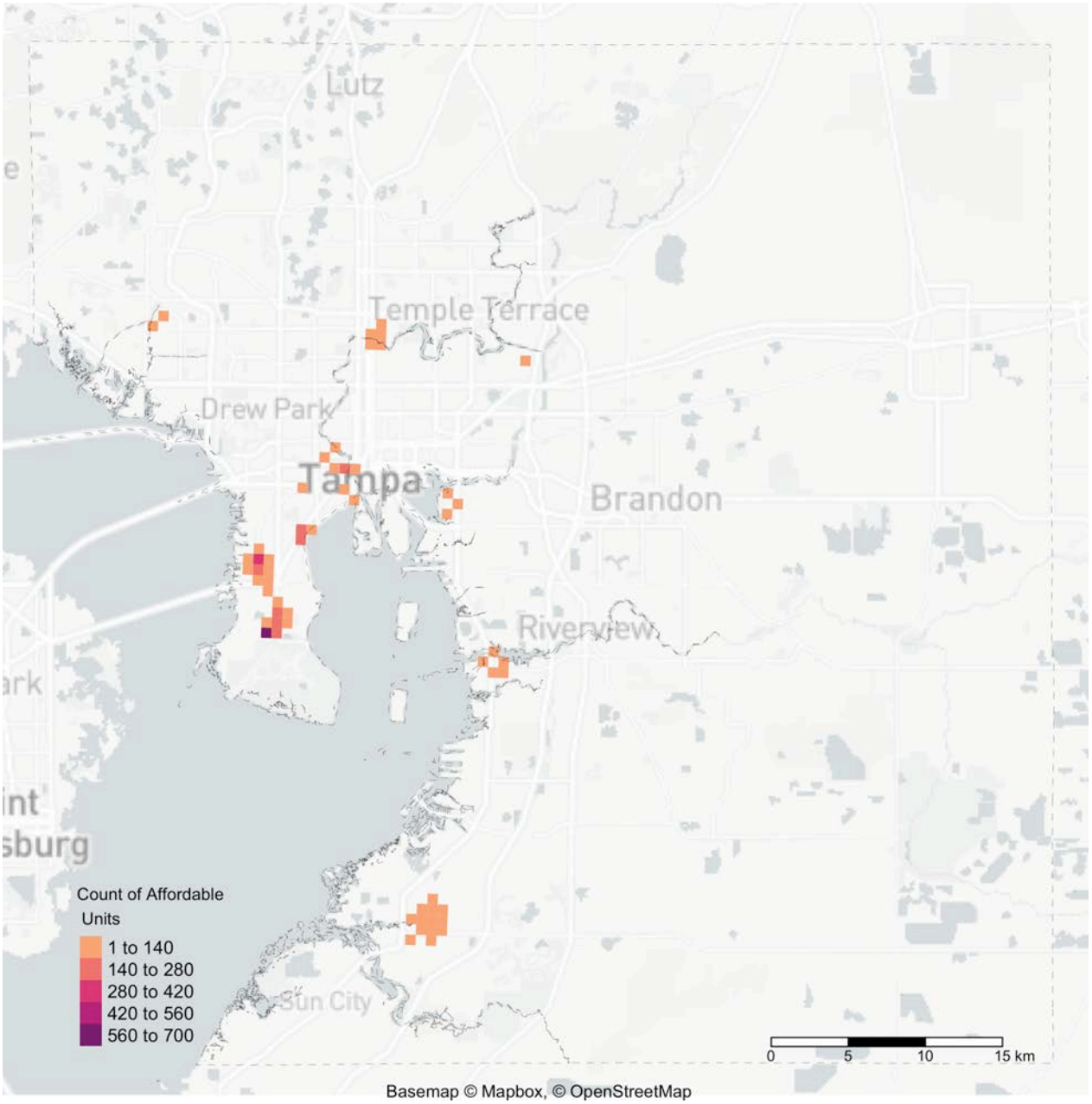


Figure 39:

Hot Spots of High-frequency Storm Surge in Hillsborough County

Storm surge from hurricanes can have important impacts on housing along Hillsborough's west coast. **Figure 39** locates hot spots of affordable housing exposed to high-frequency hurricane storm surge, which is defined as a hurricane with a Category 3 ranking on the Saffir Simpson hurricane scale. Within these storm surge hot spots there are 2,362 NOAH properties and 1,756 AHI units highly clustered and exposed to the surge hazard. Together, these hot spots account for 31% of all affordable units at risk of high-frequency storm surge. The low percentage of affordable units captured by the density analysis is again a result of the high dispersion of affordable housing in Hillsborough County. **Figure 39** indicates that the highest concentration of surge hot spots in Hillsborough County are located in South Tampa near the MacDill Air Force base.

Hillsborough Neighborhood Analysis

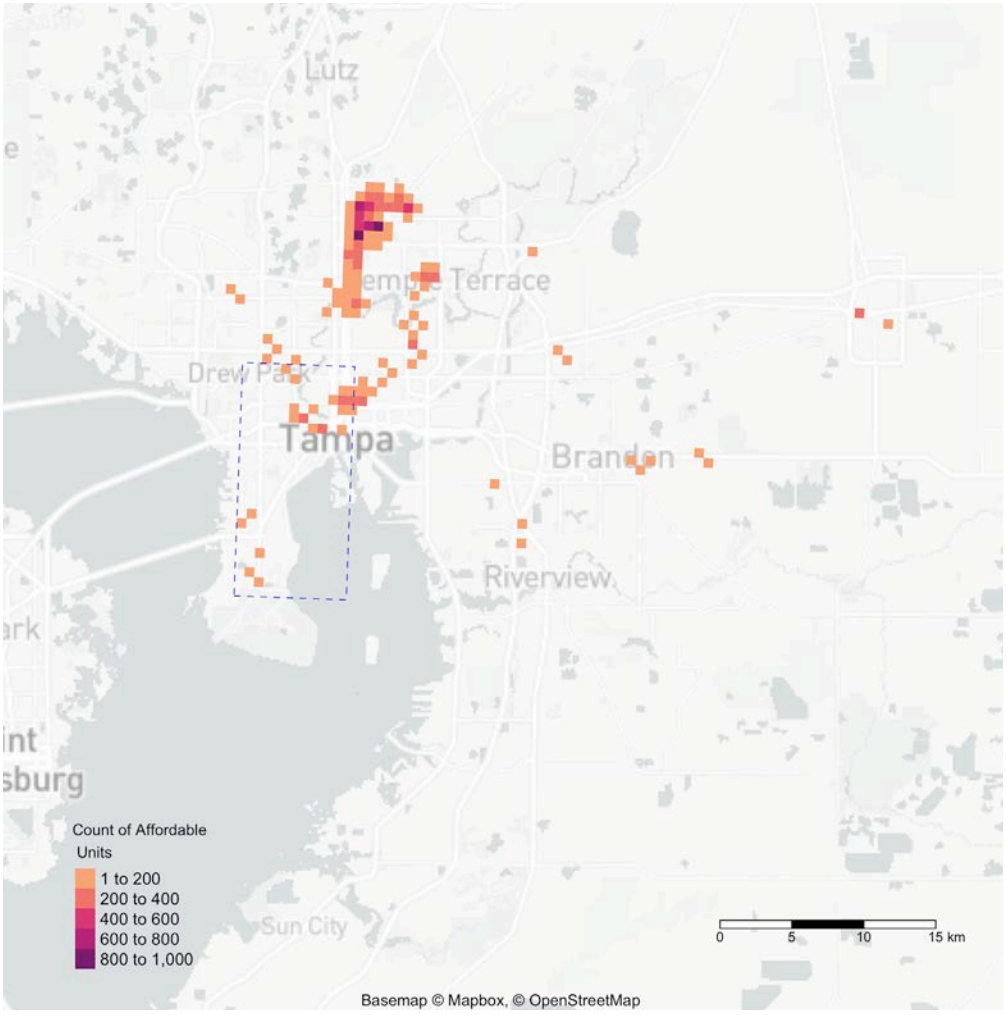


Figure 40:

Hot Spots of Affordable Housing Hillsborough County

The density analysis helps identify certain neighborhoods of affordable housing that are acutely exposed to flood hazards. In the next stage of the analysis, neighborhoods with the highest density clusters of affordable housing exposed to multiple hazards are identified. **Figure 40** presents a map of all affordable housing concentrations throughout Hillsborough County. On this map, the neighborhood study area that is used for further analysis is outlined by a blue dotted line in South Tampa. This area represents the location of the most dense neighborhoods exposed to both 1% annual flood zones and high-frequency storm surge. While there are a number of housing clusters exposed to multiple hazards throughout the county, the most dense clusters are located within this designated study area. The purpose of this map is to demonstrate where clusters of affordable housing are located throughout the county, relative to the areas with the highest multi-hazard flood exposure.

With the neighborhood study area chosen, census tract statistics are used to characterize these areas with high concentrations of multi-hazard exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood-exposed locations.

The census demographics chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the

percentage of residents over the age of 65. These three statistics help provide a deeper understanding of potential compounding social vulnerabilities associated with high flood exposure.

The neighborhood analysis keys in on locations throughout South Tampa. Affordable housing near MacDill Air Base represent specific areas with high counts of affordable housing exposed to multiple flood hazards. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed areas. Throughout these maps, the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in. This analysis should provide insight for practitioners on the social composition of these areas and thus can inform their mitigation approaches.

Hillsborough Comparison Map and Median Income

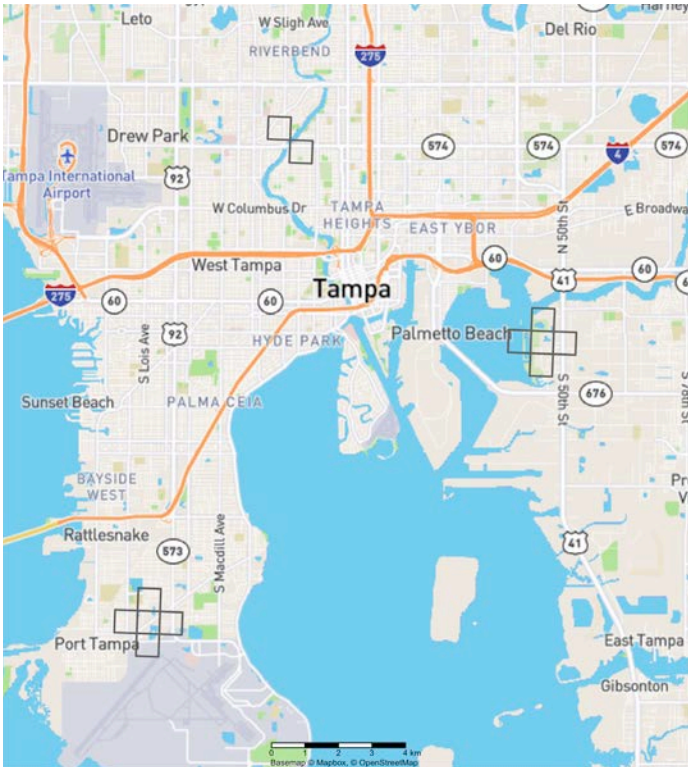


Figure 41:

High Risk Affordable Housing Hot Spots in Hillsborough County

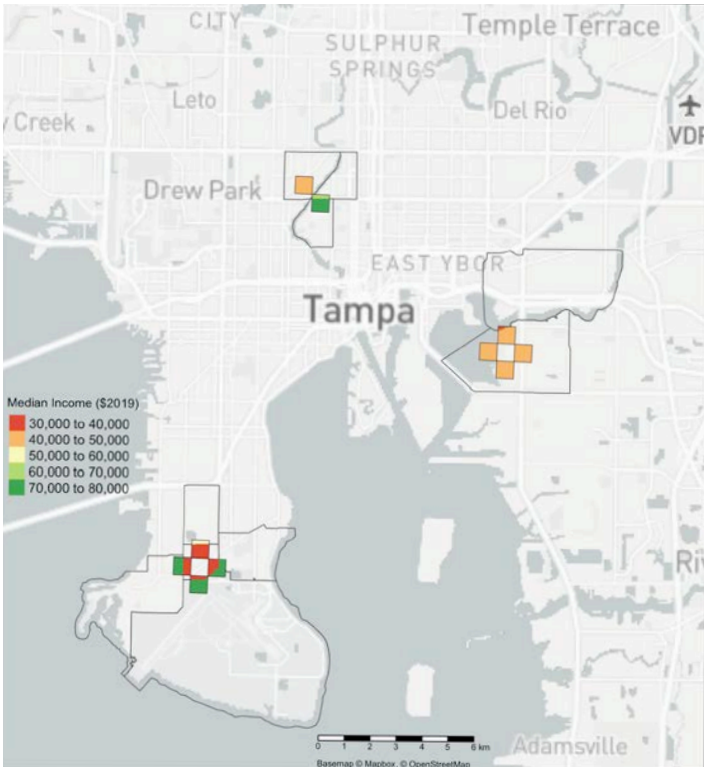


Figure 42:

Median Income of Highest Risk Hot Spots in Hillsborough County

Figure 42 presents the neighborhood analysis of median incomes in Hillsborough County. Two neighborhoods in particular, one near the MacDill Airbase and the other directly east of Palmetto Beach, display median incomes below the county median. However, the South Tampa neighborhoods near the airbase appear to have diverging neighborhood statistics, with portions of the hot spots in higher income census tracts and other portions residing in the lowest income tracts. Due to the dispersion of affordable housing throughout Hillsborough County it is not surprising to find high concentrations of at-risk affordable housing in higher income census tracts.

The average income in Hillsborough County is approximately $59,000 which exceeds the median income in the majority of the hot spot neighborhoods. Hot spots of exposed affordable housing just north of Riverview are located in census tracts with median incomes higher than the county median.

Hillsborough Minority and Elderly Percentage

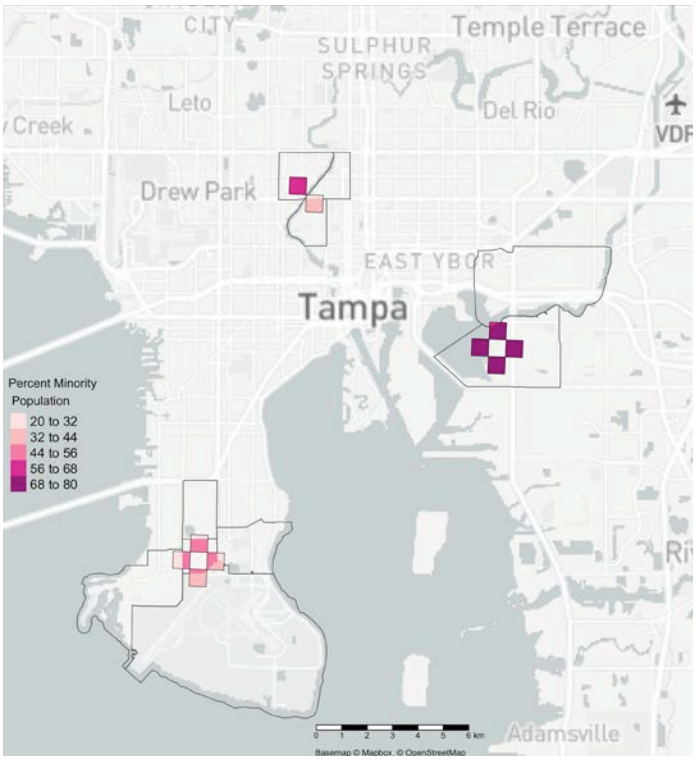


Figure 43:

Percent Minorities of Highest Risk Hot Spots in Hillsborough County

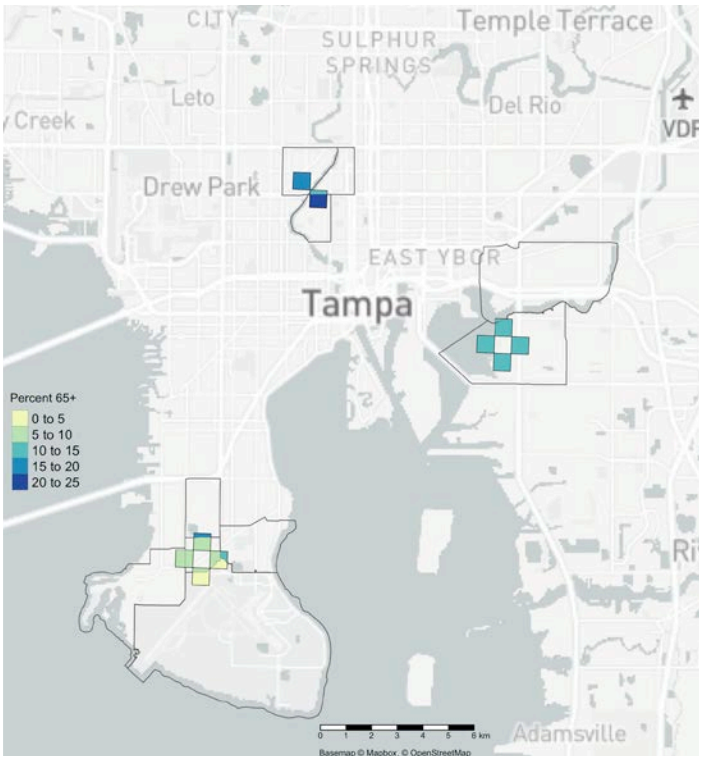


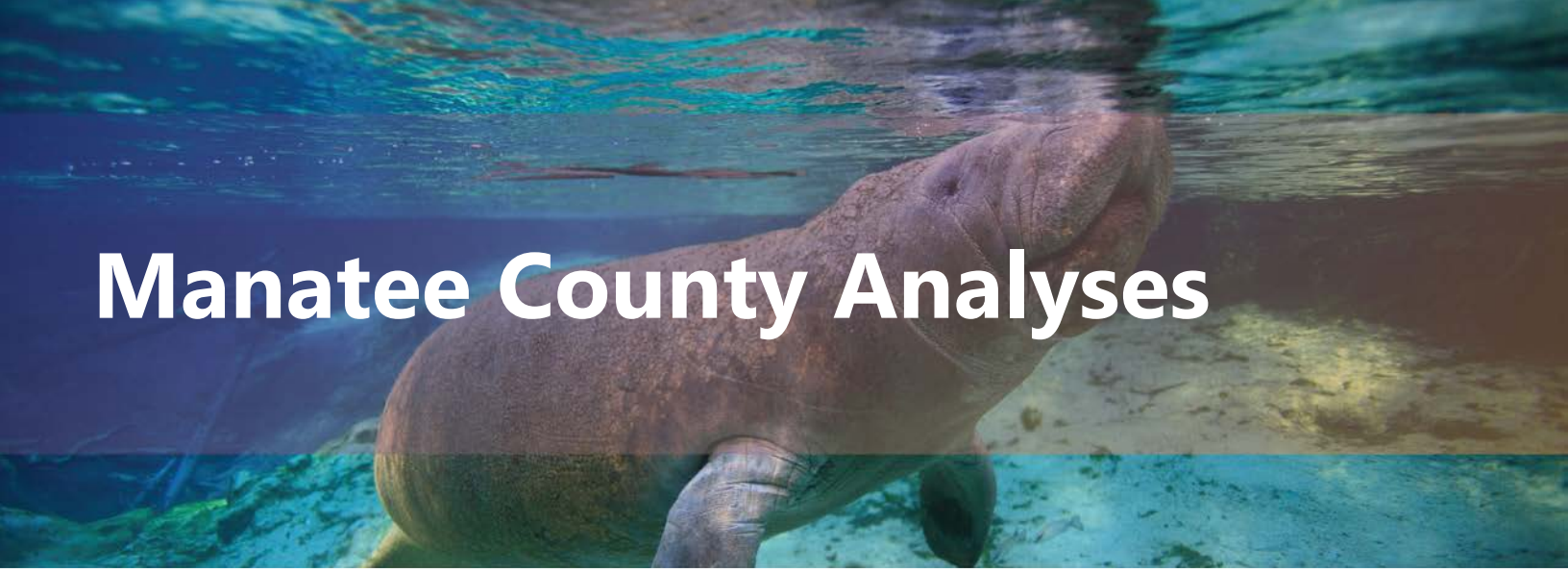
Figure 44:

Percent Elderly of Highest Risk Hot Spots in Hillsborough County

Figure 43 displays the spatial distribution of minority households throughout the study neighborhoods. Relative to other counties such as Pinellas, hot spots in Hillsborough County typically are located in more diverse census tracts. As a whole, Hillsborough is fairly diverse with nearly half of the population identifying as a minority (46%). Hot spots in census tracts with higher incomes also appear to be less diverse with a smaller percentage of their population considered minority households. The study neighborhood west of Palmetto Beach with census tract median incomes below the county median, have a higher concentration of minorities than any other hot spot neighborhood.

Figure 44 provides the Hillsborough County map of multi-hazard affordable housing neighborhoods overlaid with the percentage of elderly households (as defined by individuals of age 65 and greater). Hillsborough County has a smaller population of elderly households than neighboring Pinellas County. Only 14% of the Hillsborough's population is over the age of 65. One small portion of the neighborhood in South Tampa has a census tract population with a higher elderly percentage than the percentage represented in all of Hillsborough County. The rest of these high hazard, high density neighborhoods reside in census tracts with elderly percentages below the county percentage.

The neighborhoods to the west of Palmetto Beach have the lowest median income and highest percentage of minority populations within our study neighborhoods. These neighborhoods have a representative percentage of the elderly population relative to the county as whole. This specific situation where multiple social vulnerabilities overlap with high hazard exposure present unique adaptation challenges for these neighborhoods.



Manatee County Analyses

Manatee Density Analysis

In Manatee County, the greatest threat to their assisted housing stock comes from hurricane storm surge. Manatee County's stock of Assisted Housing Inventory (AHI) units falls very close to the Regional average. However, more than half of these AHI units are exposed to surge hazards. Approximately nine out of ten AHI units are exposed to surge threats from low-frequency storms (Category 5). While these types of storm occur infrequently, they represent a tangible threat to a significant portion of the stock of assisted housing units in Manatee County. The close proximity of these AHI units to the coast contributes to the unique challenges that government subsidized housing face.

Similar to Citrus, Hernando, Pasco, and Sarasota County, mobile homes in Manatee County constitute the largest count of at-risk affordable housing units. With counts ranging between 2,000 and 4,200 flood-exposed units, Manatee's flood-exposed mobile homes make up the largest percentage of their total mobile home stock relative to the percent of exposed stocks in other counties. Looking at storm surge hazards, mobile homes are second to multi-family units in absolute counts of flood exposed affordable units.

Key Points:

- 9 out of 10 affordable housing units in Manatee County are exposed to Category 5 Hurricanes.
- Manatee County has the most concentrated affordable housing units.
- Affordable single family units in Manatee County represent the group with the lowest flood risk of all affordable housing units.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Manatee												
AHI	1237	31	1237	31	2066	52	3658	91	129	3	129	3
Mobile Homes	2147	46	2150	46	2605	56	4192	90	472	10	731	16
Multi-Family	1425	23	1641	26	1825	29	5756	93	157	3	238	4
Single Family	748	17	869	20	1293	30	3915	90	197	5	298	7
Total NOAH	4320	28	4660	31	5723	38	13863	91	826	5	1267	8

Figure 45:

Manatee County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

Throughout Manatee County, storm surge exposure is the main risk to affordable housing. This is especially the case for flood exposure of non subsidized units. Even within the storm surge category for flood risk there is a large disparity between high frequency and low frequency storm surge. The count of non subsidized affordable housing units exposed to low frequency storm surge is more than double the count of non subsidized units exposed to high frequency storm surge. Between 29% and 90% of multi-family and single-family units are exposed to varying levels of hurricane storm surge, which represents a very large range of flood exposed units. This increase in exposed units is not as drastic when analyzing non subsidized properties in the flood zones. Neither single-family nor multi-family exposed units represent more than a quarter of the total NOAH housing stock for the different annual flood zones.

Figure 46 demonstrates the level of dispersion for affordable housing within Manatee County. Of all the counties in the Compact, Manatee County has the most concentrated level of affordable housing units. This high concentration of affordable housing is also evident in the extent of clustering for units exposed to the different annual flood zones. However, Pasco and Hernando County have a higher concentration of surge exposed affordable housing than Manatee County.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	**14698**	**75**	**3666**	**65**	**4134**	**69**	**5200**	**66**	**13593**	**76**
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 46:

Manatee County - Counts and percents of exposed affordable units located in different flood zone hot spots

Manatee Flood Zone Hazards

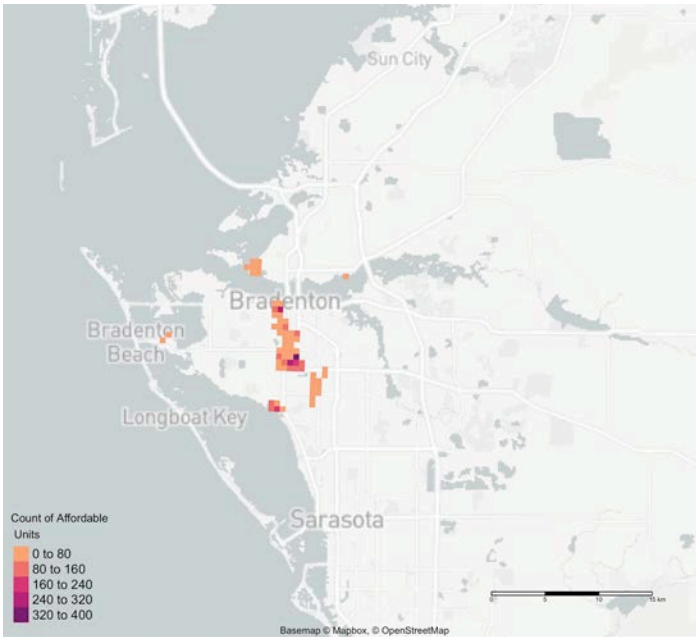


Figure 47:
Hot Spots of 1% Annual Flood Zones in Manatee County

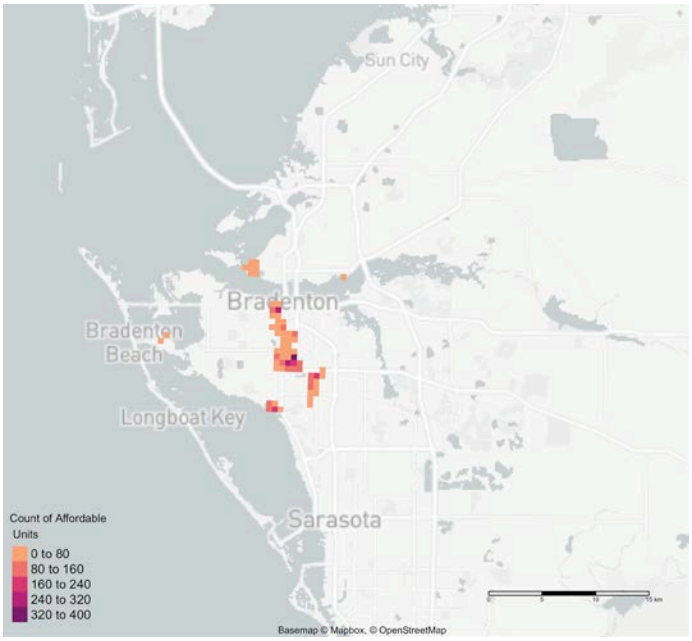


Figure 48:
Hot Spots of 0.2% Annual Flood Zones in Manatee County

Figures 47 and 48 present hot spots of highly concentrated affordable housing neighborhoods exposed to both 1% and 0.2% annual flood hazards. Hot spots within the 1% annual flood zone contain 3,444 NOAH and mobile home properties with an additional 222 AHI units throughout 2 properties. These hot spots capture 80% of all NOAH properties within the 1% annual flood zone and 17% of all AHI units within this flood zone. The hot spot analysis on the 0.2% annual flood zone contains 3,768 non subsidized units and 366 AHI units. The high percentage of exposed non subsidized units suggests that non subsidized units exposed to flood risk are highly concentrated; whereas, the subset of AHI units exposed to flood risk are more dispersed. These statistically identified hot spots highlight important action areas for hazard mitigation.

The density analysis provides a further break down of housing types and housing characteristics within the identified high density neighborhoods. Within the hot spots of 1% annual flood zone exposure, mobile homes are the predominate non subsidized housing type. Mobile homes account for 1,928 units of the 3,444 non subsidized units exposed. Multi-family units also represent a significant portion of the affordable homes contained in these hot spots with 1,110 exposed units. Switching from the 1% annual flood zones to the 0.2% annual flood zones there is a minimal increase in number of exposed units. The increase in the count of multi-family units located in these high density areas is the largest for all housing typologies, increasing from 1,110 units to 1,317 (a 207 units increase).

Housing characteristics of the flood-exposed units in the two hot spot analyses are consistent for all of the housing typologies. Affordable single-family units are generally the oldest housing types with the majority of units built in 1957 for the 1% annual flood zone and 1955 for the 0.2% annual flood zone. Mobile homes and multi-family units have a similar year built statistics between the two hazards with the majority of units being built in 1969 and 1973 respectively.

The majority of mobile homes in these flood zone hot spots are built with wooden frames. While the

majority of NOAH single-family and multi-family units are masonry structures. On average, mobile homes in these hot spots sit at the lowest elevation of the housing typologies (around 4.08 meters). Multi-family units are on average situated the highest at approximately 5 meters above ground. The difference between average elevation for these housing typologies is small, suggesting that local elevation does not play a significant role in different risk levels observed by these housing types.

The composition of AHI units (222 in total) in these hot spots are funded through federal government subsidies. The properties in these hot spots on average sit lower than other affordable housing units (approximately 4 meters above the ground). The average income of HUD or RD funded households in these hot spots is $17,634.

Figures 47 and 48 provide both visual and statistical evidence of locations that contain high concentrations of exposed affordable housing. These hot spots are fairly consistent between the severe flood hazard scenarios, suggesting that many of these affordable units are exposed to flooding at multiple return periods. The majority of exposed affordable housing clusters are found in the Bradenton area, which poses further problems due to their proximity to the Gulf.

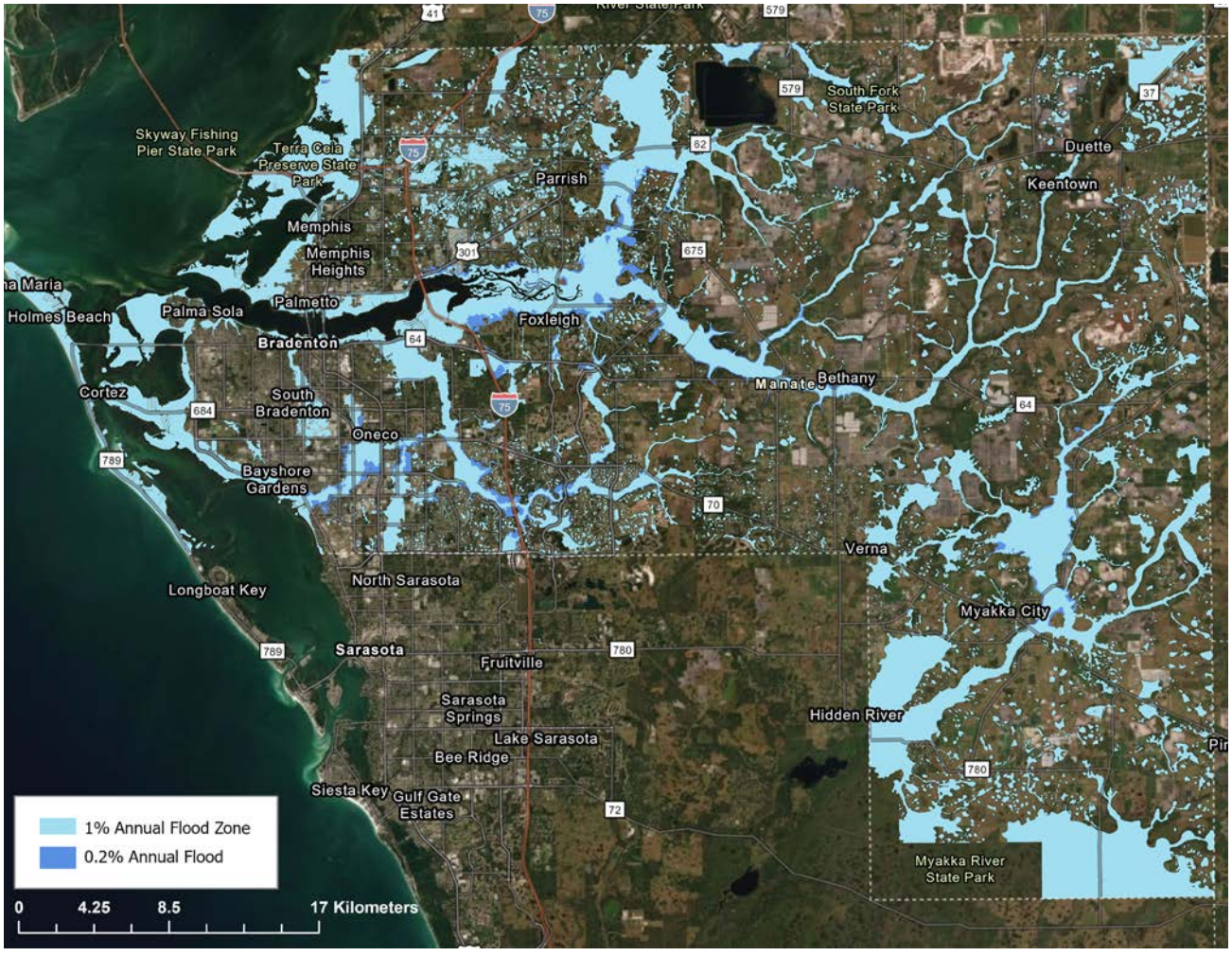


Figure 49:
Manatee County 1% and 0.2% Annual Flood Zone

Manatee Hurricane Storm Surge

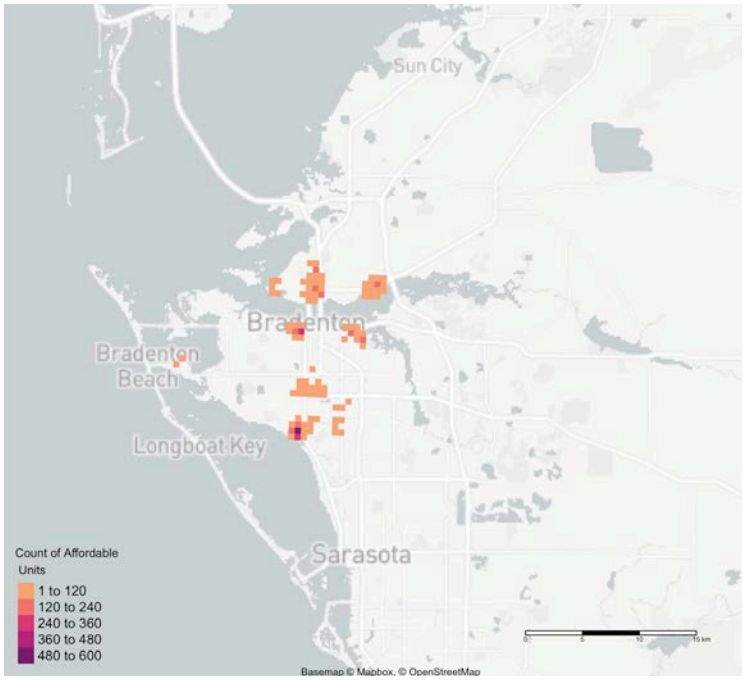


Figure 50:

Hot Spots of High-frequency Storm Surge in Manatee County

Figure 50 displays high density neighborhoods of affordable housing exposed to high-frequency storm surge. Throughout this report, high-frequency storm surge is identified as a category 3 hurricane on the Saffir Simpson scale. Within these surge hot spots 4,250 NOAH properties and 950 AHI units are identified. These hot spot units account for 81% of non subsidized units exposed to high-frequency storm surge and 44% of AHI units exposed to high-frequency storm surge. Overall, the affordable homes in these high-frequency surge hot spots account for 72% of all affordable units exposed to high-frequency surge. Throughout Manatee County, there are higher concentrations of affordable housing exposed to storm surge than other **flooding events**. This is mainly due to the high count of affordable units along the coast. These high density hot spots are found between Bradenton and Longboat Key.

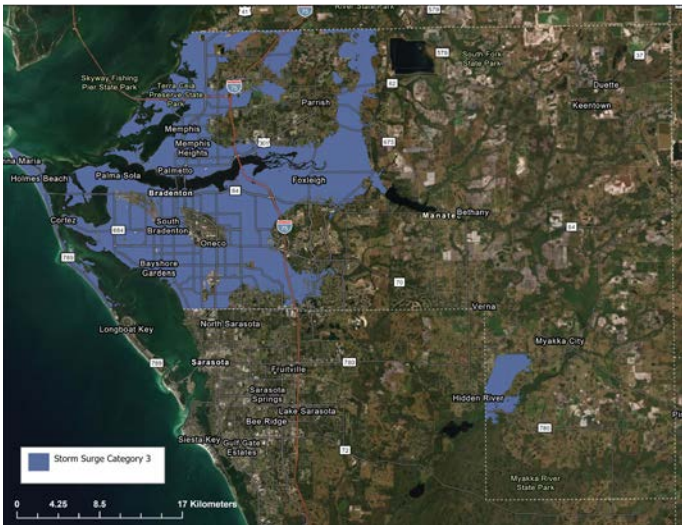


Figure 51:

Manatee County High Frequency Storm Surge

Manatee Neighborhood Analysis

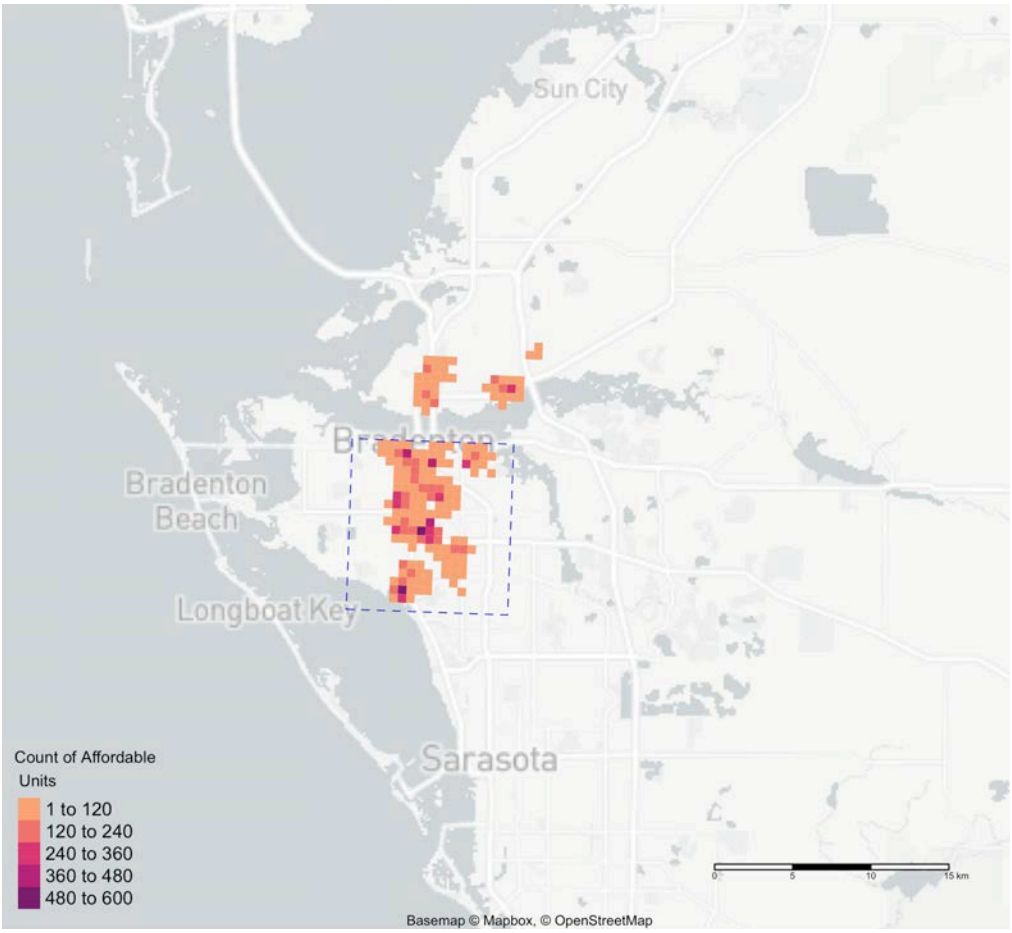


Figure 52:

Hot Spots of Affordable Housing in Manatee County

The density analysis helps identify specific neighborhoods with high concentrations of affordable housing that are acutely exposed to flood hazards. The next step of this analysis then identifies neighborhoods where the highest density clusters of affordable housing are exposed to multiple flood hazards.

Figure 52 presents a map of high density clusters of affordable housing throughout Manatee County. On this map the neighborhood study area, which is used for the continued analysis, is defined by a blue dotted square along the west coast of Manatee County, between Sarasota and Bradenton. This study area is created by identifying the locations of highly clustered affordable housing that are exposed to both 1% annual flood zones and high-frequency storm surge.

With the neighborhood study area chosen, census tract statistics are used to characterize the areas with high concentrations of multi-flood exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood-exposed locations.

The census demographics chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the percentage of residents over the age of 65. These three statistics help provide a deeper understanding of potential compounding social vulnerabilities associated with high flood exposure.

The neighborhood analysis keys in on neighborhoods along 14th street. Specifically to the northern end, there are high concentrations of exposed affordable units near Manatee Memorial Hospital. To the South more hot spots are identified in the Trailer Estates mobile home park. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed neighborhoods. Throughout these maps, the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in. This analysis should provide insight for practitioners on the social composition of these areas and thus can inform their mitigation approaches.

Manatee Comparison Map and Median Income

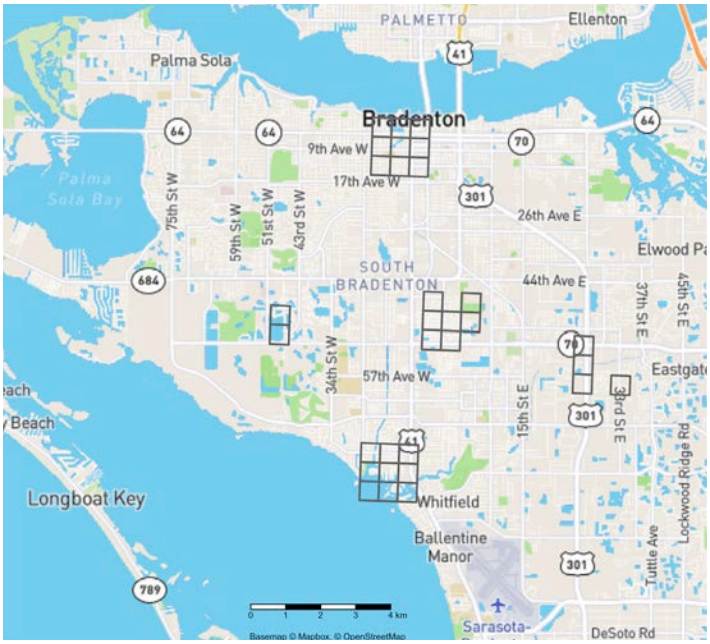


Figure 53:

High Risk Affordable Housing Hot Spots in Manatee County

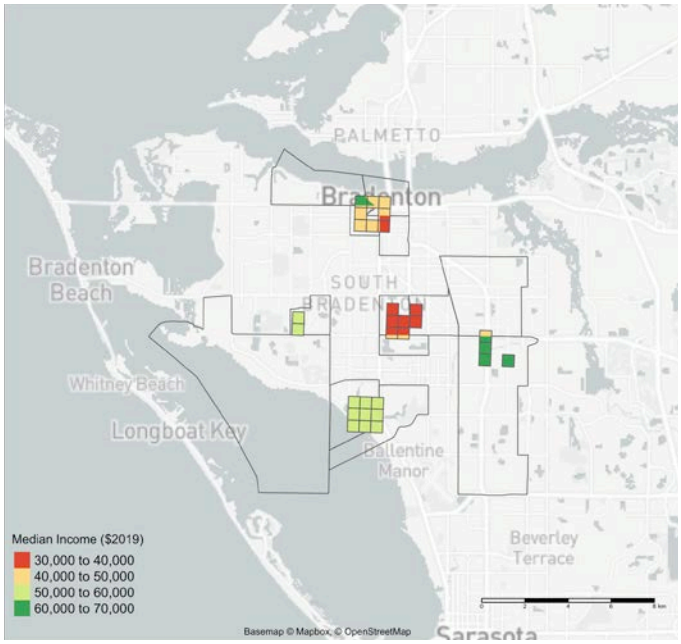


Figure 54:

Median Income of Highest Risk Hots Spots in Manatee County

Figure 54 presents the neighborhood analysis of median incomes for the most flood-exposed affordable housing hot spots in Manatee County. Almost all of the neighborhoods in the analysis are contained in census tracts with median incomes below that of the county's median. The median income in Manatee County is $59,009, which is one of the highest in the Region. From the neighborhood analysis, the map shows a majority of the neighborhoods residing in census tracts with median incomes close to half of Manatee County's median. Median income is the lowest for census tracts between the inlets, yet increases as the study neighborhoods get closer to the water.

Manatee Minority and Elderly Percentage

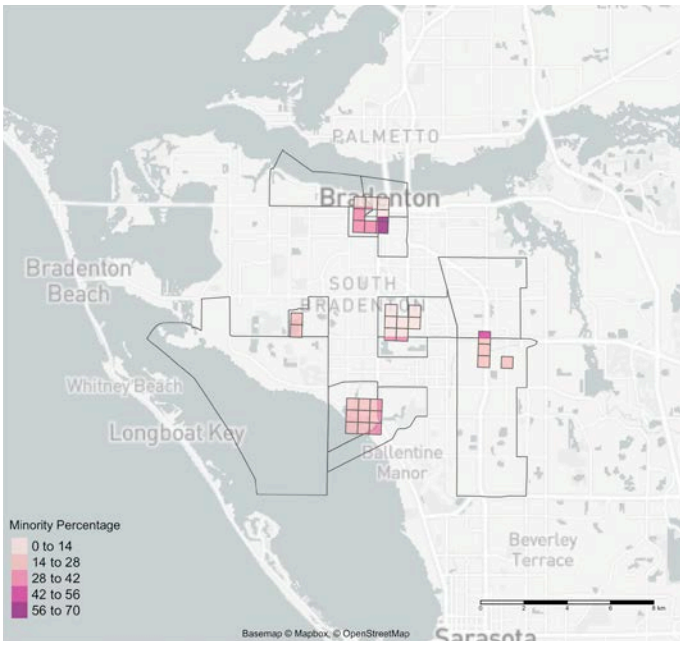


Figure 55:

Percent Minorities of Highest Risk Hot Spots in Manatee County

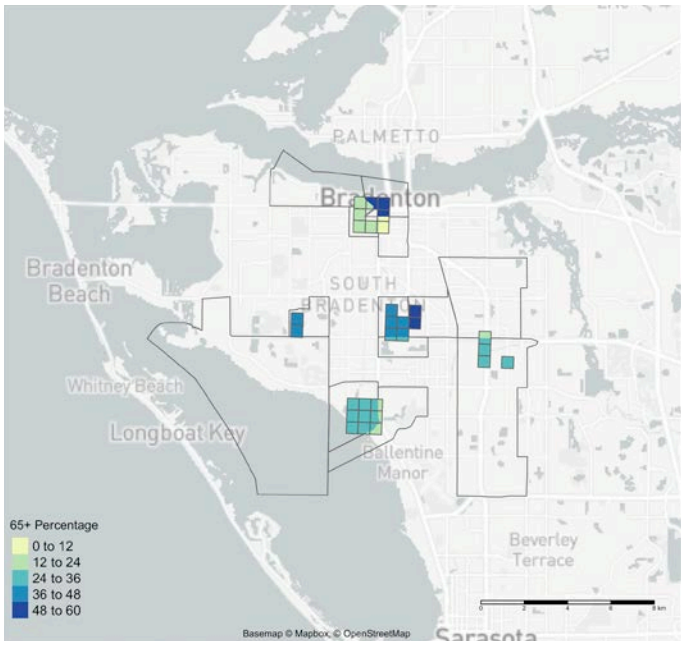


Figure 56:

Percent Elderly of Highest Risk Hot Spots in Manatee County

Figure 55 displays the distribution of minority concentrations throughout the selected study neighborhoods. The minority population in Manatee County represents close to 25% of the total population. The majority of neighborhoods identified in this analysis contain a proportion of minorities that is representative of the County as a whole. However, a few neighborhoods along 14th street are located in census tracts that have minority rates double the County rate.

Figure 56 presents a map of the study neighborhoods and the percent of the elderly population within each of the corresponding census tracks. Overall Manatee County has an elderly population that makes up 27% of the total population. The majority of the study neighborhoods, particularly near the water in Bradenton, have a smaller proportion of elderly folks. A portion of two neighborhoods along 14th street are located within a census tract that contains nearly 50% of the population that is older than 65. This is double what the County average is.

Pasco County Analyses

Pasco Density Analysis

The majority of Pasco County's subsidized housing is funded through local and state mechanisms. Pasco County has the third most Assisted Housing Inventory (AHI) units relative to all other counties in the Compact. When comparing the flood exposure of AHI units to non subsidized units throughout Pasco, the analysis suggests that these two different affordable housing typologies experience similar levels of exposure. The percent of flood-exposed AHI units varies between 30% and 50% of the total assisted housing stock depending on the flood hazard, but the highest percentage of affected units are exposed to low-frequency storm surge.

As is the case for Citrus, Hernando, and Manatee, mobile homes in Pasco County make up the largest count of flood-exposed affordable housing units. For many of the flood hazards analyzed, mobile homes in Pasco County have the highest count of exposed housing units. However, these high counts do not represent a large percentage of the overall mobile home stock. In Pasco County, mobile homes make up the largest concentration of affordable housing units. The count of mobile homes, which are all considered affordable, is greater than double any other type of affordable housing.

Key Points:

- Pasco County has the highest count of mobile homes exposed to 1% annual flood zones in the Compact.
- Pasco has the second highest concentration levels of flood exposed affordable housing in the Compact.
- Single family affordable units are the most flood exposed housing types for hurricane storm surge.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Pasco												
AHI	1146	30	1348	35	1545	40	1985	51	387	10	587	15
Mobile Homes	7351	25	8727	29	6369	22	9046	31	1266	4	2039	7
Multi-Family	2708	28	4282	44	5775	60	7183	75	1002	10	2183	23
Single Family	3468	23	5592	37	9117	61	11929	79	1146	8	1876	12
Total NOAH	13527	25	18601	34	21261	39	28158	52	3414	6	6098	11

Figure 57:

Pasco County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

While mobile homes make up the greatest count of flood-exposed units, NOAH units have the highest percentage of flood-exposed stock for most of the analyzed flood hazards. Besides the 1% annual flood zone, where AHI units have the highest percent of exposed stock, multi-family and single family affordable housing types have the highest percent of exposed units. This is particularly true for the percent of exposed units to storm surge. For the high frequency and low frequency storm surge hazards, NOAH units make up the largest counts of exposed affordable units. Additionally, these high counts of exposed units make up a larger percent of the entire affordable stock.

Figure 58 shows that Pasco County has a high level of clustering among their affordable housing units. This is particularly the case when looking at affordable units that are exposed to 0.2% annual flood zones and the different storm surge levels. More than 50% of all flood exposed homes are captured within the hot spot analysis.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	**34428**	**59**	**8469**	**58**	**12368**	**62**	**19387**	**85**	**24093**	**80**
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 58 :

Pasco County - Counts and percents of exposed affordable units located in different flood zone hot spots

Pasco Flood Zone Hazards

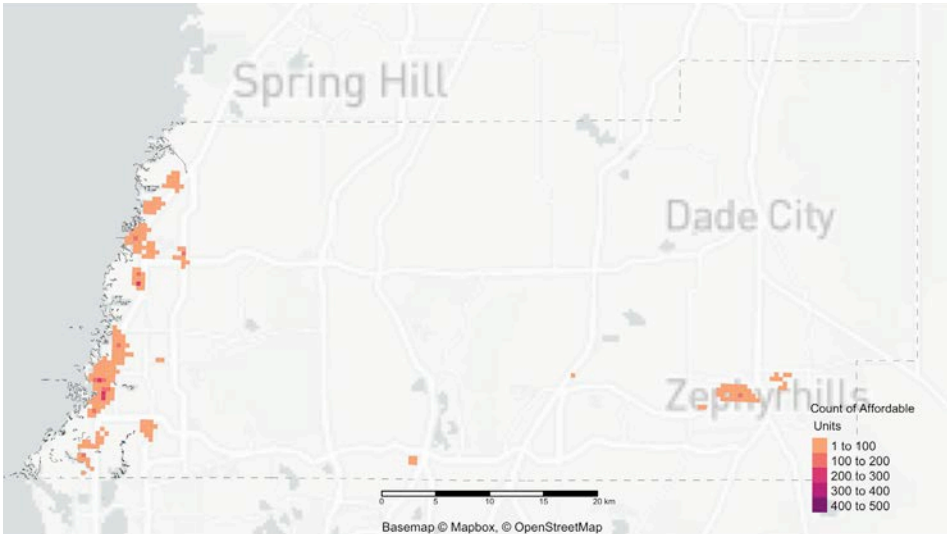


Figure 59:

Hot Spots of 1% Annual Flood Zones in Pasco County

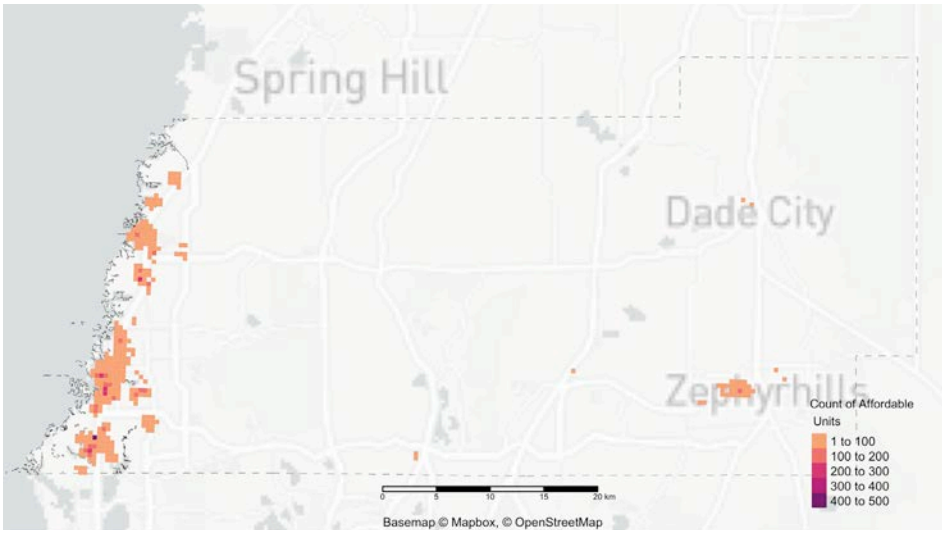


Figure 60:

Hot Spots of 1% Annual Flood Zones in Pasco County

Figures 59 and 60 present the hot spots of highly concentrated, flood-exposed affordable housing neighborhoods for both the 1% and 0.2% annual flood hazards. The maps and subsequent analysis suggest that affordable housing units are clustered in flood prone neighborhoods. High density neighborhoods, also referred to as hot spots, exposed to the 1% annual flood zone contain 7,892 NOAH and mobile home properties in addition to 577 AHI units. The units identified in these flood-exposed hot spots represent 58% of all NOAH properties within the 1% annual flood zone and 50% of all AHI units in the 1% annual flood zone. Focusing on the 0.2% annual flood zones, the hot spot analysis captures 11,655 NOAH units and 713 AHI units.

The density analysis allows for a further break down of housing types and housing characteristics within the identified high density neighborhoods. Throughout the hot spots of 1% annual flood zone exposure, mobile homes make up the majority of exposed affordable units. 3,368 units out of the

7,892 non subsidized units are designated mobile home properties. The count of exposed single and multi-family units in these hot spots also represent a significant count of exposed homes with 2,363 and 2,152 flood-exposed units. For each of the non subsidized housing categories, the number of units exposed to 0.2% annual flood zones relative to 1% annual flood zones raises by approximately 1,000 units. Single-family affordable units see the greatest increase in exposed units between the 1% and 0.2% annual flood zones (2,363 to 3,863).

Affordable units in the hot spots for the 0.2% annual flood zone are on average a few years older than similar housing types in the 1% annual flood zone hot spots. Within the 1% annual flood zone hot spots the majority of mobile homes were constructed in 1973. Whereas the majority of single-family homes were built in 1977 and the majority of multi-family homes were built in 1985. The mode age for mobile homes and multi-family units does not change between the 1% and 0.2% flood zones. However, the increased stock of single-family units identified in the 0.2% hot spot includes a number of older single-family homes, shifting the mode age of single-family units to 1968.

Within both flood zone hots spots mobile homes on average sit at highest elevation. For the hot spots in the 1% annual flood zone, mobile homes are on average 9.92 meters above the ground while single-family and multi-family units are on average 3.01 and 2.17 meters high. Focusing on the hot spots for the 0.2% annual flood zone the height rankings remain the same. Mobile homes sit at 7.62 meters, single-family units at 3.23 meters and multi-family units sit on average at 2.65 meters.

The hot spots for the 1% annual flood zone contain 91 units from HUD or RD funding and 486 units from state or local funding. Within the hot spots for the 0.2% annual flood zone there is a reduction in the number of HUD/RD units. This is likely due to the significant increase of NOAH stock exposed 0.2% annual flood risk, which shifts the distribution of hot spots and the affordable housing composition within them. On average, these AHI units serve populations with median incomes between $14,678 and $20,347.

Figures 59 and 60 provide both visual and statistical evidence of locations that contain high concentrations of flood-exposed affordable housing. The majority of exposed affordable housing clusters are found along the Western coast.

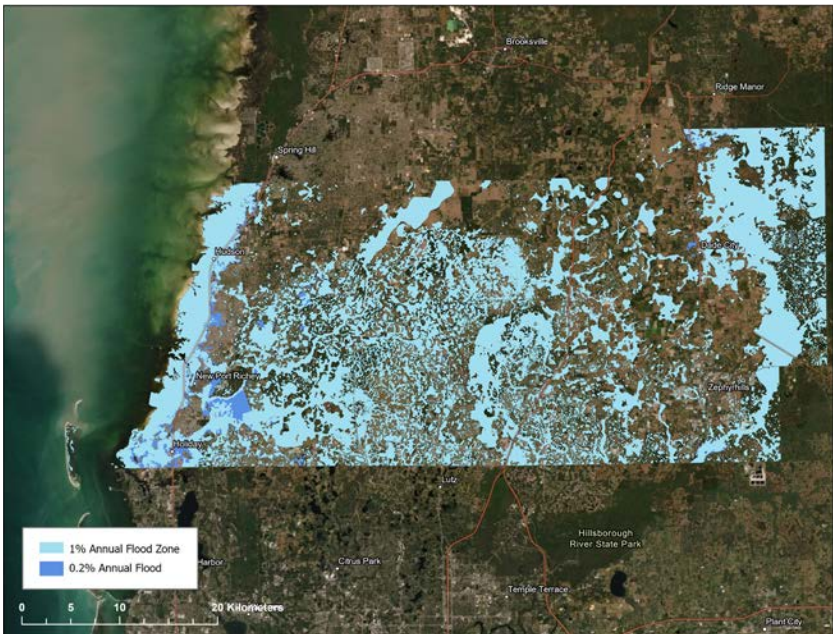


Figure 61:

Pasco County 1% and 0.2% Annual Flood Zone

Pasco Hurricane Storm Surge

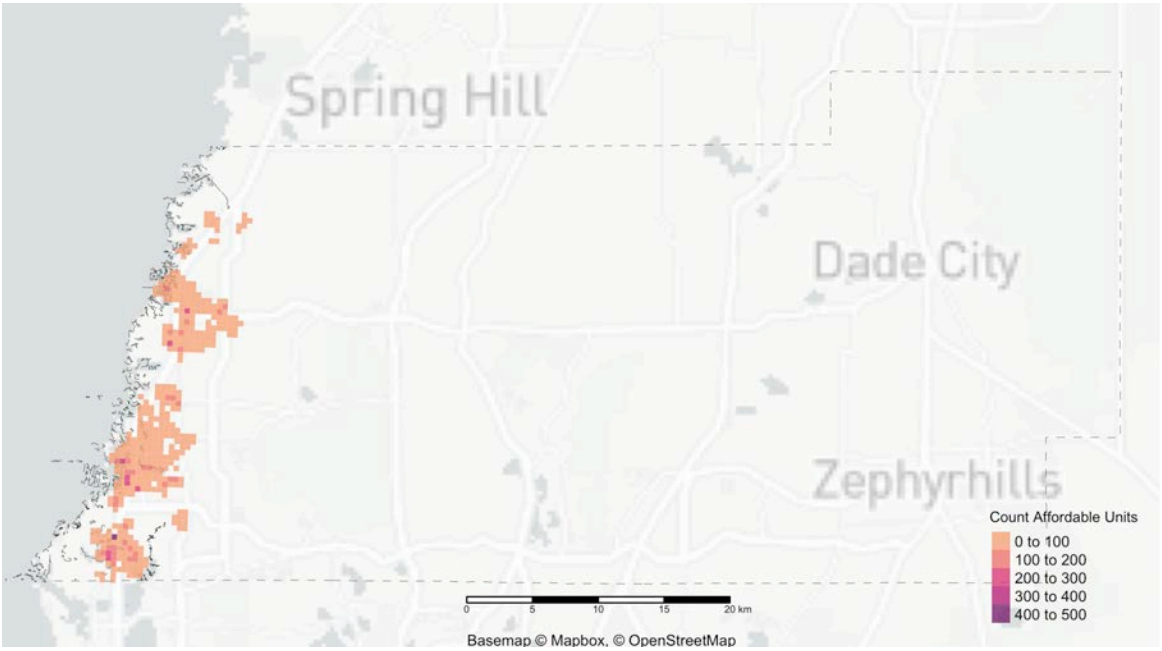


Figure 61:

Hot Spots of High-frequency Storm Surge in Pasco County

Figure 61 displays high density neighborhoods of affordable housing that are exposed to high-frequency storm surge. Throughout this report high-frequency storm surge is identified as a category 3 hurricane event on the Saffir Simpson scale. Within these hot spots of high-frequency storm exposure 18,464 non subsidized properties and 900 AHI units are identified. The affordable units within these hot spots account for 84% of non subsidized units and 58% of AHI units exposed to high-frequency storm surge. Overall the affordable units in these hot spots account for 82% of all affordable units exposed to high-frequency storm surge. This suggests that storm surge exposed affordable housing units are clustered near each other. By definition surge exposure requires a close proximity to the coast. These high density neighborhoods make up a large majority of the Pasco coast south of Spring Hill.

Figure 62:

Pasco County High Frequency Storm Surge

Pasco Neighborhood Analysis

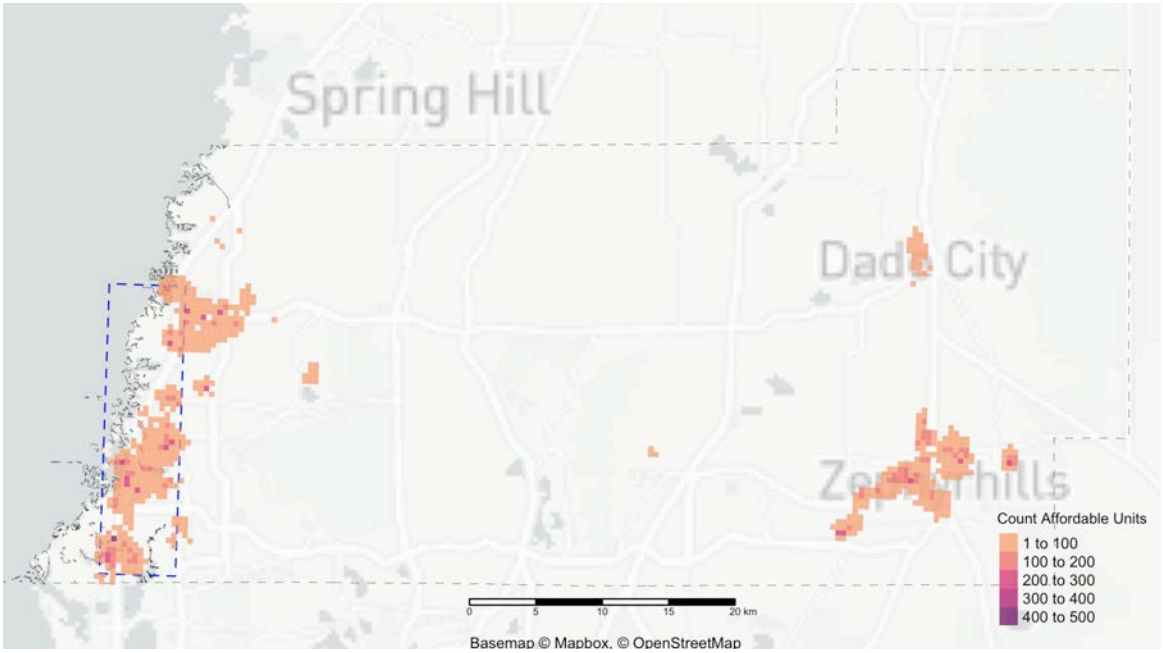


Figure 63:

Hot Spots of Affordable Housing in Pasco County

The density analysis helps identify specific neighborhoods with high concentrations of affordable housing that are acutely exposed to flood hazards. The next step of this analysis identifies neighborhoods where the highest density clusters of affordable housing are exposed to multiple flood hazards. **Figure 63** presents a map of high density clusters of affordable housing throughout Pasco County. On this map, the neighborhood study area, is defined by a blue dotted square along the west coast of Pasco County, between Hudson and Holiday. This study area is created by identifying the locations of highly clustered affordable housing that are exposed to both 1% annual flood zones and high-frequency storm surge. Since this neighborhood analysis focuses on both surge and extreme flooding, the majority of high density affordable housing locations will be situated along the coast.

With the neighborhood study area chosen, census tract statistics are used to characterize the areas with high concentrations of multi-flood hazard, exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood-exposed locations.

The census demographics chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the percentage of residents over the age of 65. These three statistics help provide a deeper understanding of potential compounding social vulnerabilities associated with high flood exposure.

The neighborhood analysis keys in on neighborhoods along highway 19. Specifically, neighborhoods in New Port Richey and Holiday contain high concentrations of multi-hazard exposed affordable housing units. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed neighborhoods. Throughout these maps the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in.

Pasco Comparison Map and Median Income

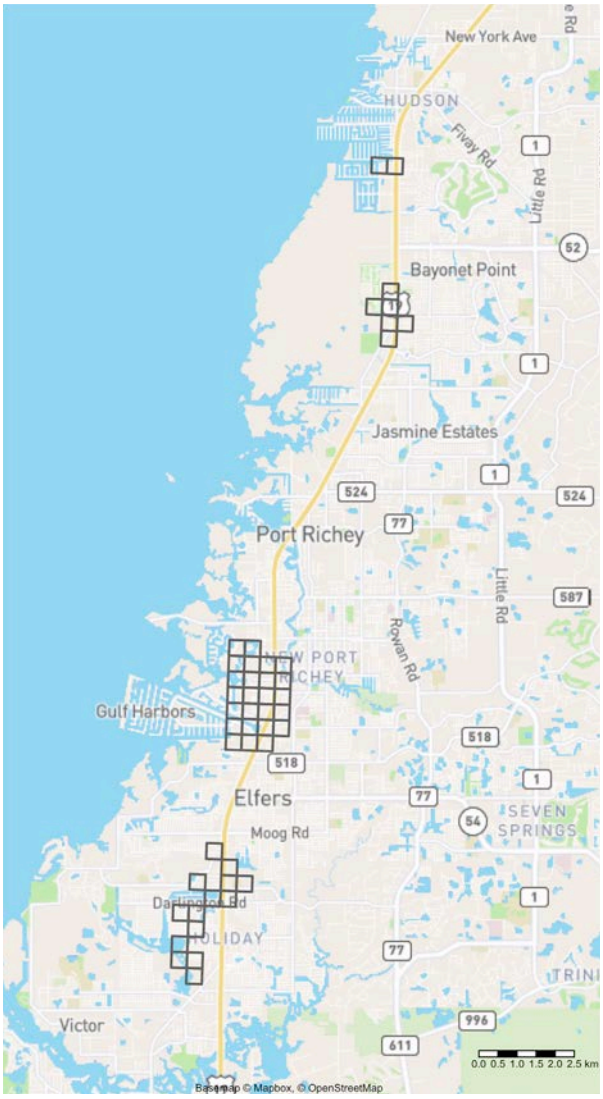


Figure 64:

High Risk Affordable Housing Hot Spots in Pasco County

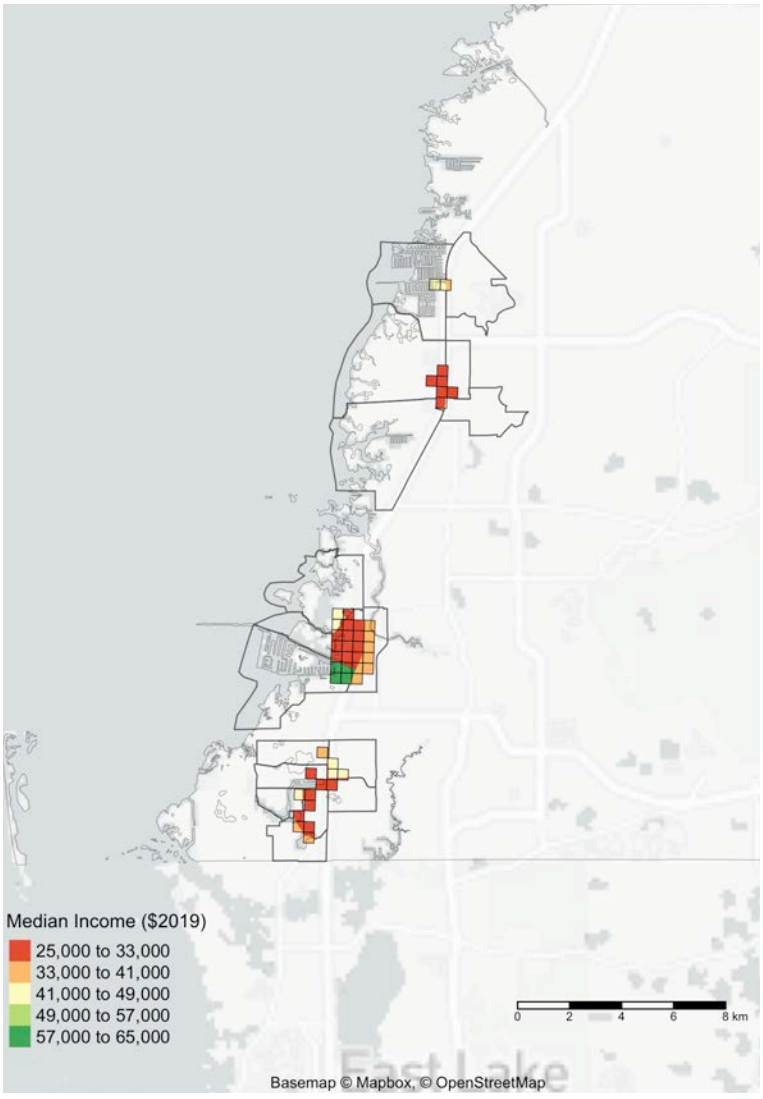


Figure 65:

Median Income of Highest Risk Hots Spots in Pasco County

Figure 65 presents the neighborhood analysis of median incomes in Pasco County. A majority of the neighborhoods identified in the study area are located within census tracts that have median incomes below the County median. The median income in Pasco County is $52,828 which is close to double the median income range for more than half of the study neighborhoods. Specifically, neighborhoods in New Port Richey and Holiday are located in census tracts with median incomes between $25,000 and $41,000. These neighborhoods present additional vulnerabilities for the households located within them.

Pasco Minority and Elderly Percentage

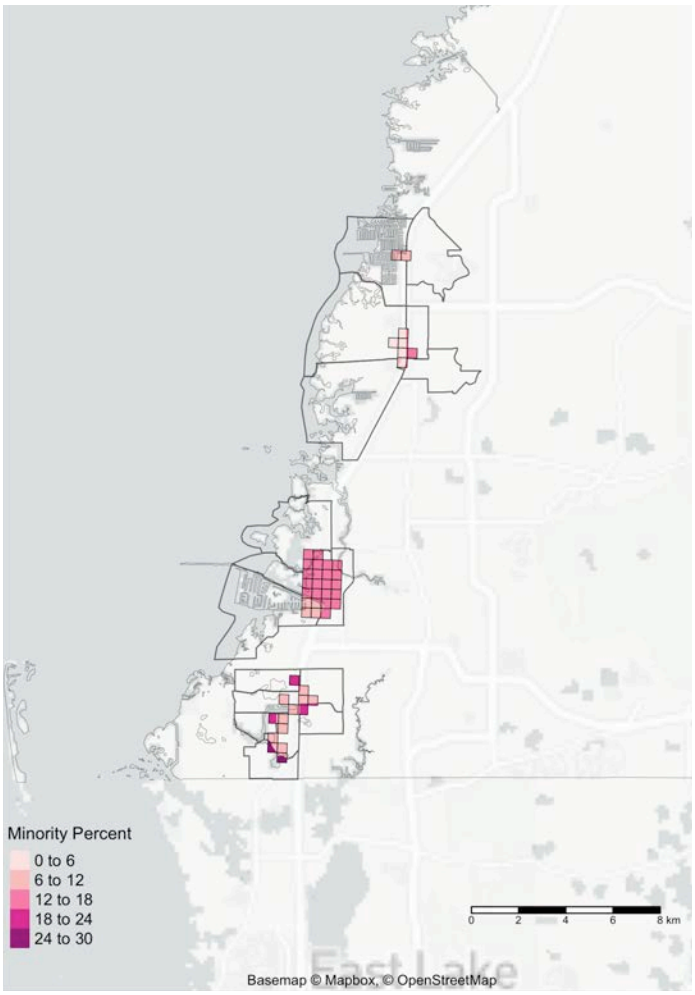


Figure 66:

Percent Minorities of Highest Risk Hot Spots in Pasco County

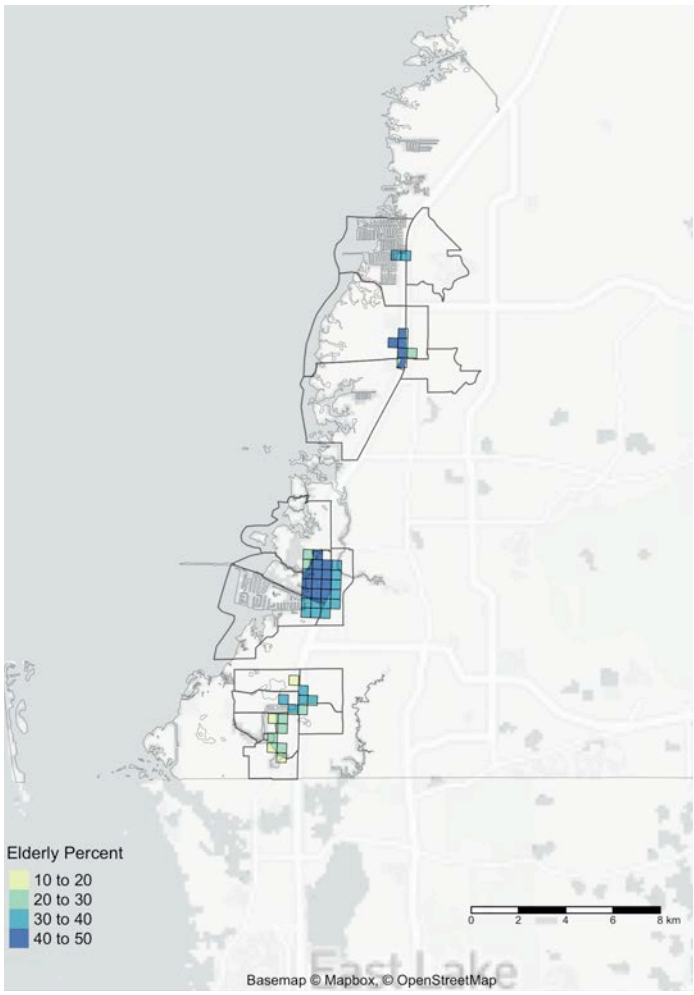


Figure 67:

Percent Elderly of Highest Risk Hot Spots in Pasco County

Figure 66 displays the distribution of minority percentages at the census tract level for the selected study neighborhoods. Overall, the population in Pasco County is composed of 21% racial minorities. However, this county statistic is not representative of the minority compositions for the study neighborhoods. The majority of the neighborhoods identified in this local analysis are found in census tracts with lower than average minority concentrations. Particularly, the neighborhoods in New Port Richey with median incomes lower than the County median, also have lower minority percentages than the County average. In fact, many of these neighborhoods have minority concentrations equal to or lower than the County level.

Figure 67 provides a map of the study neighborhoods and the elderly population within each of the study census tracks. Overall in Pasco County the elderly population makes up 23% of the total population. The majority of the neighborhoods contain higher concentrations of elderly households than is represented for all of Pasco County. The higher percentages of elderly individuals versus the lower percentages of minorities represents a similar trend experienced throughout the entire Compact.

Pinellas County Analyses

Pinellas Density Analysis

Pinellas County has the second largest stock of assisted housing units in the Region. The majority of these units are funded through local and state subsidies (4, 445 units), while federal outlets including HUD and RD sources represent the second largest funding mechanisms (7, 838 units). Exposure to low-frequency hurricane surge (Saffir-Simpson category 5) is the largest threat to these affordable units.

Mobile homes represent the second highest absolute count of flood exposed affordable units. Nearly a quarter of the mobile homes stock is located in the 1% annual flood zone (3,982 mobile home units). Within the 0.2% annual flood zones the percentage of exposed mobile home increases to a third of the total mobile home stock (5,893 units). These counts more than double when analyzing the risk of mobile homes to hurricane storm surge. In the case of low frequency surge (Category 5), 85% of the total mobile home stock is exposed to flooding.

Within the non subsidized housing category, Naturally Occurring Affordable Housing (NOAH) units make up more than 75% of the affordable units exposed to either 1% or 0.2% annual flood zones. Multi-family affordable units in particular represent the housing type with the most flood exposed units to each of the different flood hazards.

Key Points:

- Mobile homes have the highest percentage of their housing stock exposed to hurricane storm surge.
- Multi-family affordable units in Pinellas County represent the largest total number flood exposed housing units.
- Pinellas County has the second highest level of AHI units exposed to the different flood events.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Pinellas												
AHI	2235	20	3374	30	5231	47	6256	56	1149	10	2182	20
Mobile Homes	3982	23	5893	34	10982	63	14966	85	2850	16	3863	22
Multi-Family	10539	27	13624	35	17085	44	25282	65	3516	9	8421	22
Single Family	2132	15	3473	25	5304	38	8216	59	745	5	1545	11
Total NOAH	16653	24	22990	33	33371	48	48464	69	7111	10	13829	20

Figure 68 :

Pinellas County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

In addition to having the most units exposed to the different flood hazards, multi-family units also have the largest percentage of their housing stock that is exposed to 1% annual and 0.2% annual flood zones. Single family units contain either the fewest or second fewest units exposed to any of the different flood hazards. In addition to having the lowest count of exposed units, single family affordable units also have the lowest percentage of the total stock exposed to the different flood hazards.

A high percentage of the mobile home stock exposed to hurricane flooding suggests that mobile homes are highly concentrated throughout Pinellas. However, the entire affordable housing stock does not share this level of clustering. In general, Pinellas has a high level of affordable housing dispersion similar to Hillsborough County. The stock of affordable housing exposed to 1% annual flood zones displays the highest level of clustering among the different flood hazards. This is demonstrated in **Figure 69**. The other flood zone events display lower levels of clustering, with less than 50% of the exposed affordable stock located within the different flood zone hot spots.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	**29930**	**36**	**9737**	**51**	**11399**	**42**	**15955**	**40**	**20900**	**38**
Sarasota	24995	54	7602	55	15706	65	19154	70	23755	57

Figure 69:

Pinellas County - Counts and percents of exposed affordable units located in different flood zone hot spots

Pinellas Flood Zone Hazards

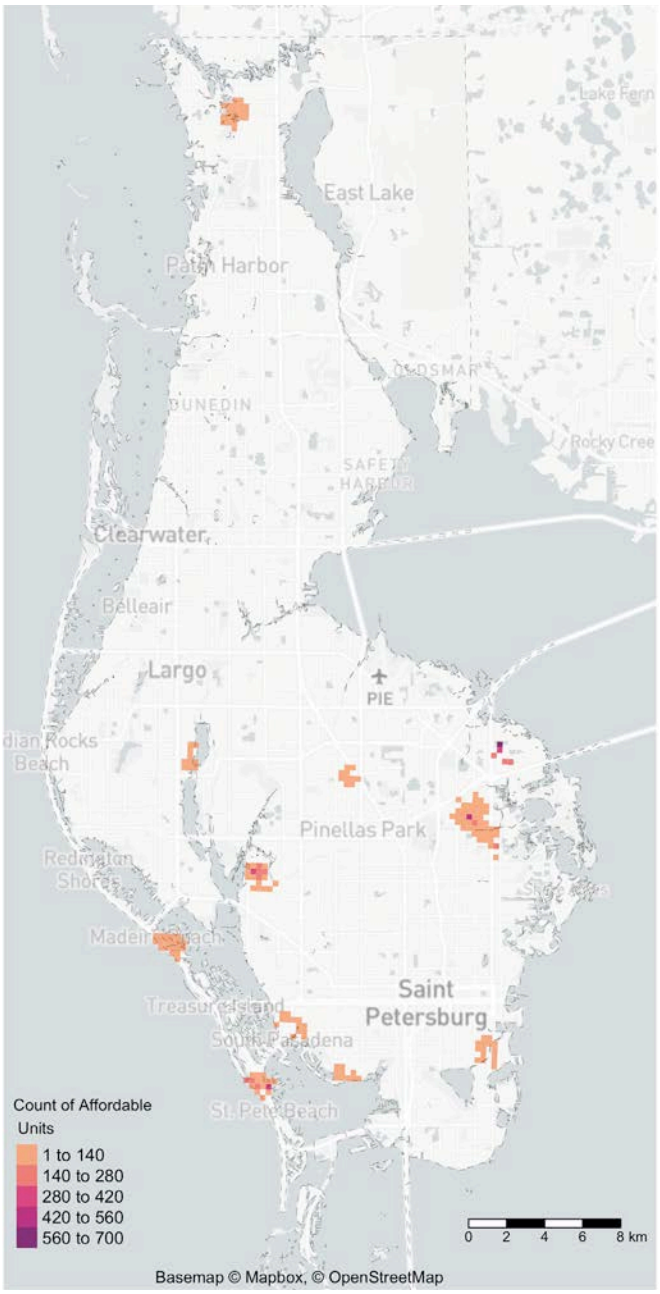


Figure 70:
Hot Spots of 1% Annual Flood Zones in Pinellas County

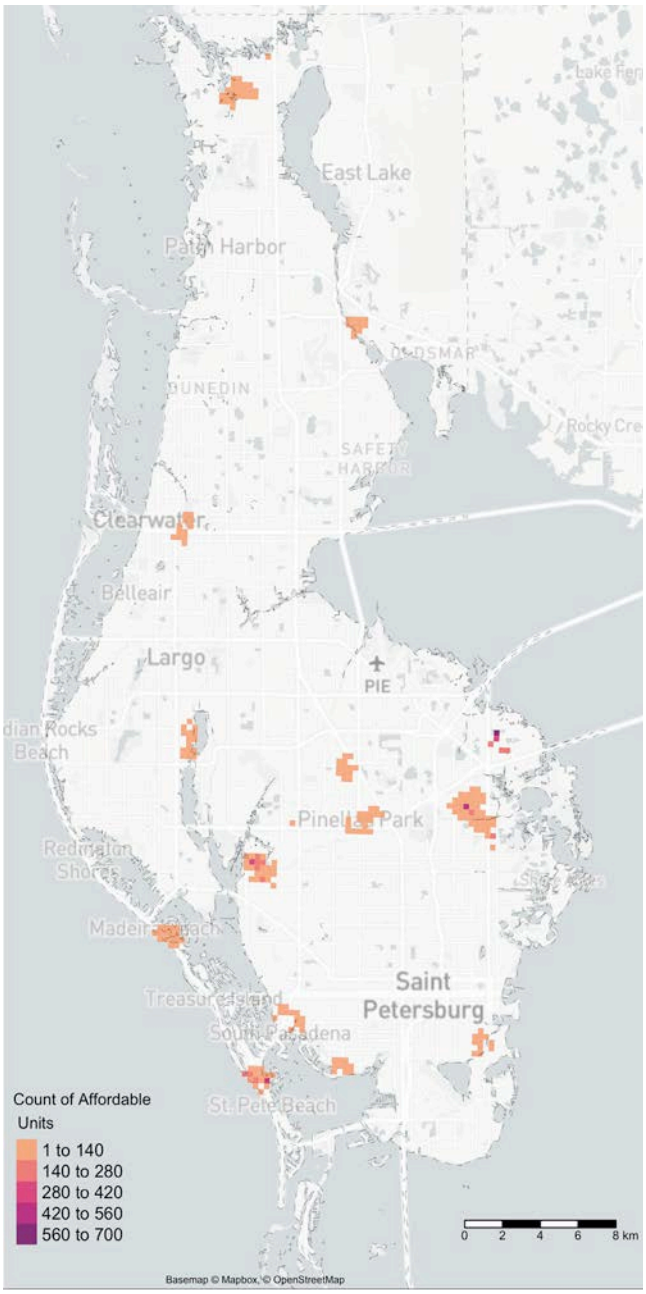


Figure 71:
Hot Spots of 0.2% Annual Flood Zones in Pinellas County

Figures 70 and 71 present hot spots of neighborhoods with high concentrations of affordable housing exposed to both the 1% and 0.2% annual flood zones. The hot spot for 1% annual flood zone exposure contains 9,025 NOAH and mobile home properties and 532 AHI units (7 properties). Within these hot spots, the identified units represent 54% of all NOAH properties in the 1% annual flood zone and 24% of all AHI units in the 1% annual flood zone. The hot spots for the 0.2% annual flood zone see an increase in total exposed units with 10,685 NOAH units and 714 AHI units. These statistically identified hot spots highlight important action areas for hazard mitigation.

Figure 72:
Pinellas County 1% and 0.2% Annual Flood Zone

The break down of NOAH housing types in the hot spots for 1% annual flood zone exposure provides that multi-family units are driving the observed high concentrations. 7,860 out of the 9,025 NOAH units in these hot spots are designated as multi-family properties. Multi-family units presumably make up such a large percentage of these hot spots because, by definition, multi-family housing is densely built. As the extent of exposure increases for the hot spots of 0.2% annual flood zones, other housing typologies see a greater increase in exposure than multi-family units. Specifically, the number of mobile homes captured in the hot spot analysis increases from 389 to 1,123 units.

The characteristics of these exposed homes is consistent between the two types of severe flood hazards (1% and 0.2% annual flood zones). In both flood zones, single-family residential NOAH properties are on average older than the other types of properties. The majority of single-family homes identified as NOAH properties in these flood zone hot spots were constructed in the late 1950s (with the most houses being built in 1958 and 1962 for the 1% and 0.2% annual flood zones). Mobile homes and multi-family units are typically ''newer" than their single-family NOAH counterparts with most properties constructed in the 1970s.

The majority of single-family units in these flood zone hot spots are masonry built structures, while the majority of multi-family units are structures built with wooden frames. The average elevation for exposed households increases between the 1% and 0.2% annual flood zones. On average non subsidized properties in the 1% annual flood zone are 2.16 meters above the ground, whereas non subsidized households in the 0.2% annual flood zone are situated 2.4 meters above the ground.

The break down of assisted housing hot spots for the 1% annual flood zone suggests most (332) units are funded through state or local sources. The rest (200 units) are funded through federal HUD or RD programs. In the hot spots for the 0.2% annual flood zones, there is an increase in the count of exposed HUD orRD units as well as an increase in the count of state and locally funded units. Additionally, there are 82 Public Housing units within these hot spots.

The two Figures displaying hot spots of affordable housing exposed to the 1% and 0.2% annual flood zones provide visual evidence of locations that contain high concentrations of flood exposed affordable housing. These hot spots are consistent between the flood hazard scenarios. Neighborhoods in Kenneth City and along the eastern coast of Pinellas County possess significant counts of exposed affordable units worth further exploration.

Pinellas Hurricane Storm Surge

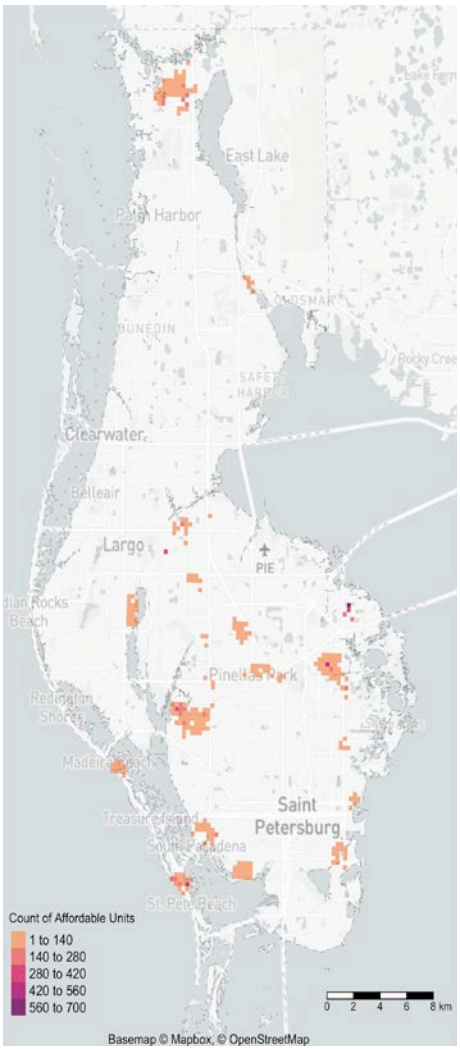


Figure 73:

Hot Spots of High-frequency Storm Surge in Pinellas County

Figure 74:

Pinellas County High Frequency Storm Surge

Severe flood events from heavy rains are not the only flood hazards threatening affordable housing in Pinellas County. The close proximity to warm Gulf waters implies that Pinellas County is also a hot target for hurricanes.

The **Figure 73** displays hot spots of affordable housing exposed to high-frequency hurricanes. These hurricanes are identified as Category 3 storms on the Saffir Simpson scale.

The total number of exposed properties within these hot spots is 14,747 non subsidized units and 1,208 AHI units. Overall, these hot spots account for 38% of all affordable units at risk of high-frequency storm surge. Threats from high-frequency hurricane storm surge threaten more affordable units within Pinellas County than either the 1% or 0.2% annual flood zone hazards.

The breakdown of housing typologies exposed to high-frequency storm surge tells a story similar to that of the previously discussed flood hazards. The majority of affordable homes identified in these high-frequency surge hot spots are multi-family units (70%). Mobile homes make up the smallest percent of affordable units found in these hot spots; however, single-family residential typologies have only 60 more units in these hot spots. Intuitively, the low representation by mobile homes makes sense since mobile homes are less likely to be located in close proximity to the coast. The average elevation of mobile homes in the high-frequency storm surge hot spots is 2 meters higher than the average elevation of mobile homes in the 1% annual flood hot spots.

Pinellas Neighborhood Analysis

The **density analysis** helps identify certain neighborhoods of affordable housing that are acutely exposed to flood hazards. The next step identifies neighborhoods with the highest density clusters of affordable housing that are exposed to multiple hazards. **Figure 75** presents a map of high density affordable housing concentrations throughout Pinellas County. The purpose of this map is to demonstrate where clusters of affordable housing are located throughout the county, relative to the areas with the highest multi-hazard flood exposure.

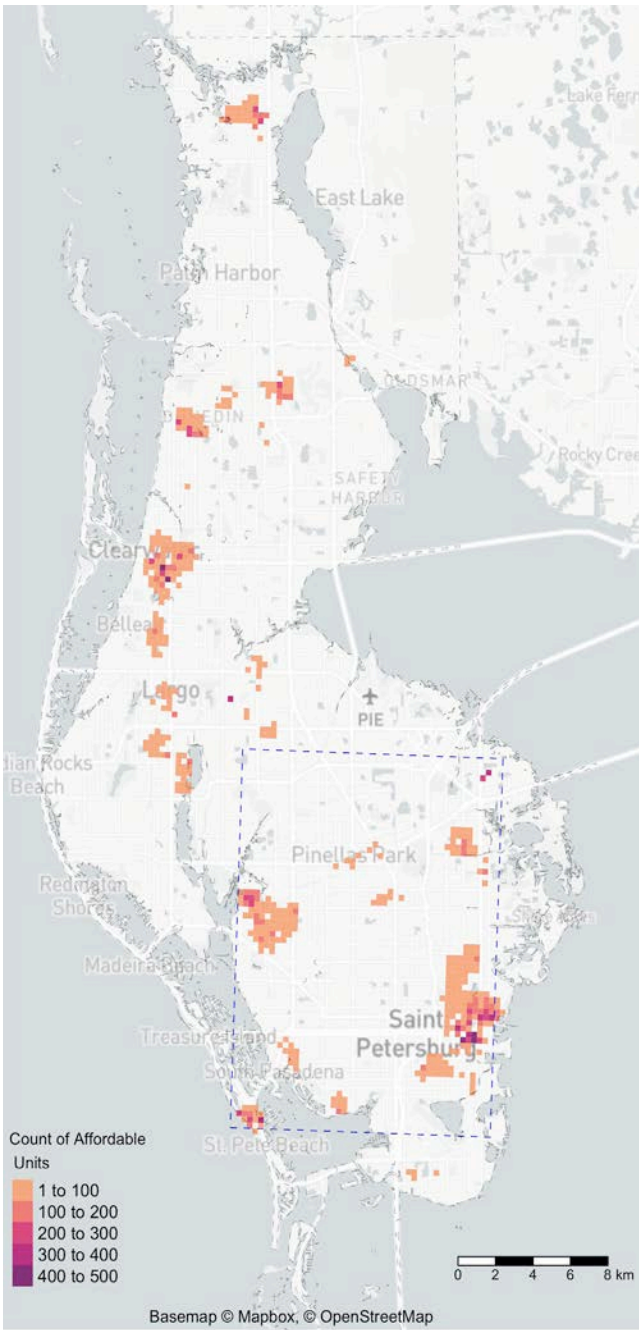


Figure 75:
Affordable Housing Hot Spots in Pinellas County

Within **Figure 75**, the neighborhood study area is outlined by a blue dotted line in the middle of Pinellas. This outline describes where the highest concentrations of affordable housing is exposed to both 1% annual flood zones and high-frequency storm surge. Since all locations throughout Pinellas are relatively close to the coast, the high concentration of affordable units in the designated study area are driving the defined boundaries of this study area.

With the neighborhood study area chosen, census tract statistics are used to characterize these areas with high concentrations of multi-hazard exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood-exposed locations.

The **census demographics** chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the percentage of residents over the age of 65. These three statistics help provide a deeper understanding of potential compounding social vulnerabilities associated with high flood exposure.

The neighborhood analysis keys in on locations throughout Pinellas Park, Kenneth City, and St. Pete Beach. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed areas.

Throughout these maps, the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in. This analysis should provide insight for practitioners on the social composition of these flood-exposed areas and thus can inform mitigation approaches.

Pinellas Comparison Map and Median Income

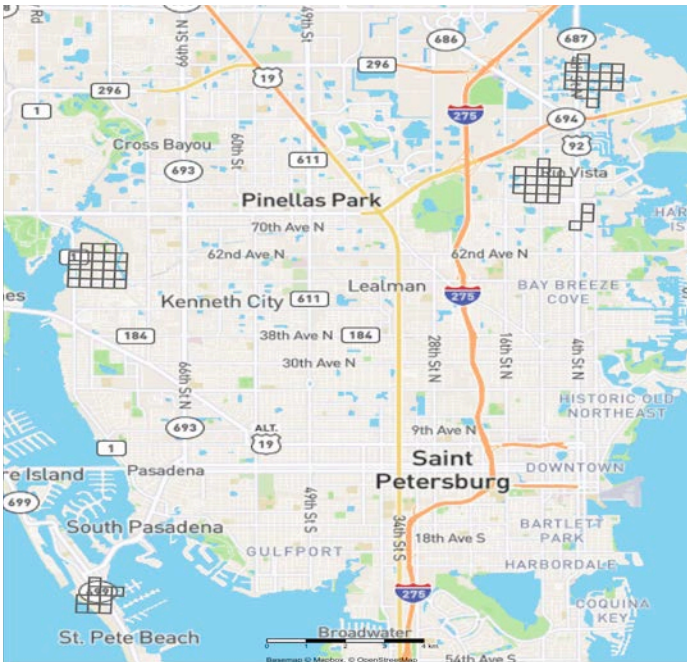


Figure 76:

Highest Risk Affordable Housing Hot Spots in Pinellas County

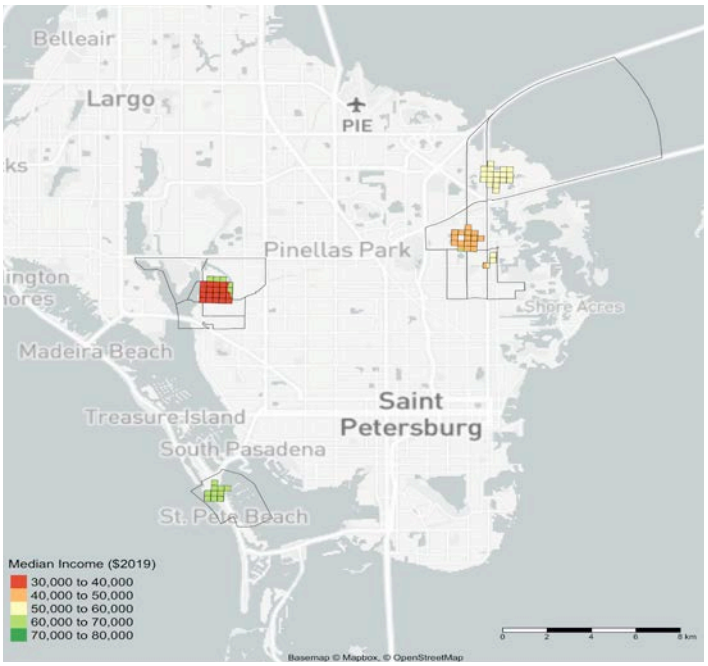


Figure 77:

Median Income of Highest Risk Hot Spots in Pinellas County

In **Figure 76**, neighborhoods with the most dense and flood exposed affordable housing units are defined by the neighborhood blocks. This map provides a reference for the other socio-demographic maps, such that the location of the highly dense and flood-exposed neighborhoods can be compared to common streets and other landmarks.

Figure 77 shows that the Kenneth City hot spot is comprised of census tracts with both high and low median incomes. However, the majority of these neighborhoods are identified in the lower income census tract, and only portions of the defined neighborhoods are located in higher income tracts. It is important to reiterate that the definition of neighborhood within this analysis does not directly correspond with census tract boundaries.

The average income in Pinellas County is approximately $54,000 which exceeds the median income in two of the three hot spot neighborhood clusters. The one neighborhood with a median income greater than the County is located on St. Pete Beach. The following analyses suggests there are other social vulnerability metrics that contribute to the high social vulnerability of this area. The Kenneth City and East Pinellas Park neighborhoods have median incomes lower than the county median by more than $10,000.

Pinellas Minority and Elderly Percentage

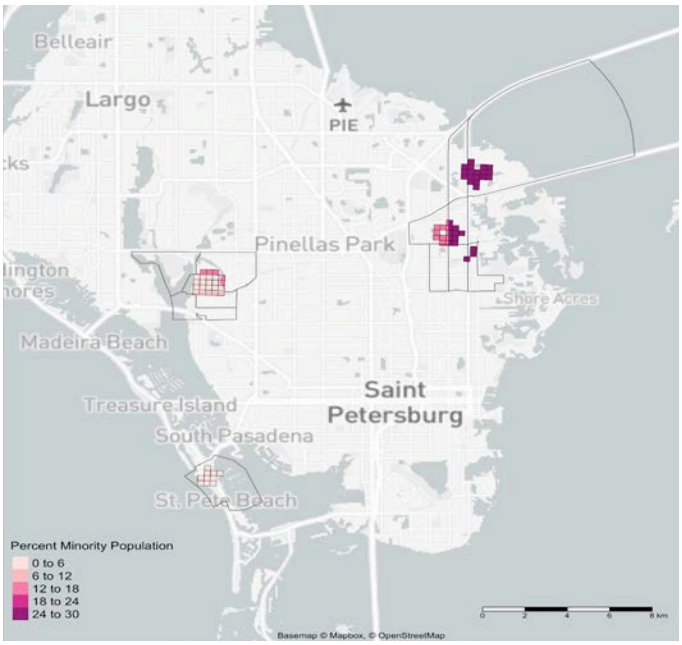


Figure 78:

Percent Minorities of Highest Risk Hot Spots in Pinellas County

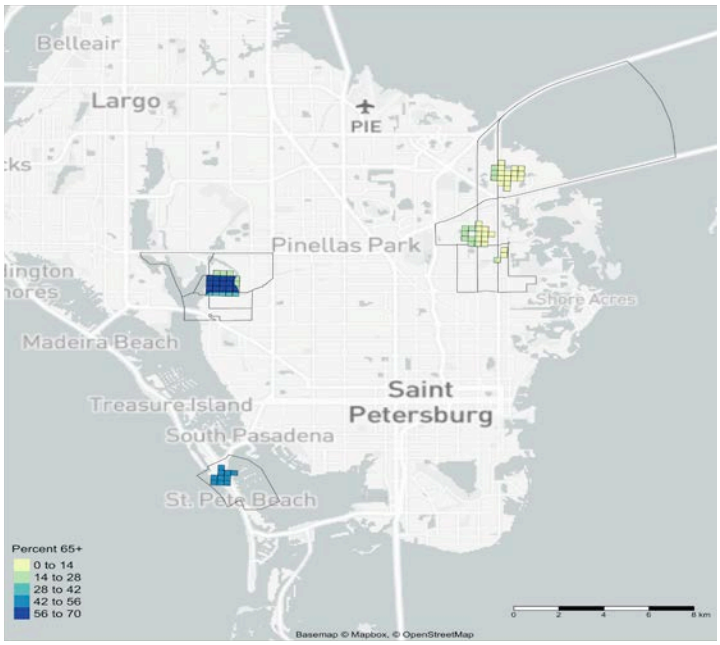


Figure 79:

Percent Elderly of Highest Risk Hot Spots in Pinellas County

Figure 78 displays the distribution of minority percentages throughout the highest risk neighborhoods. Visually, there does not appear to be a systematic relationship between densely concentrated, highly exposed affordable units and race. Throughout the Kenneth City and St. Pete Beach neighborhoods there is a low percentage of minority populations. In Pinellas County, the minority population represents approximately 20% of the entire population. Only the West Pinellas Park and Gandy Bridge neighborhoods have minority percentages equal to or larger than the county average.

The third social vulnerability indicator describes the percentage of a census tract population above the age of 65. **Figure 79** displays this map. The highest concentration of elderly populations are found in Kenneth City and St. Pete Beach. While these neighborhoods have lower percentages of minorities relative to the county, their percentages the of elderly population is much higher. Additionally, the neighborhoods with higher percentages of a minority population, have lower than average percentages of an elderly population. County wide about 24% of the population is 65 years or older. The percentage of the population identified as elderly in the Kenneth City and St. Pete Beach locations are more than double the percentage in the County.

It is important to recognize that the demographic composition of highly exposed census tracts include both high concentrations of minorities as well as high concentrations of elderly individuals. However, these social vulnerability measures do not appear to overlap in these hot spot neighborhoods. This distinctions may be important when considering different types of flood mitigation techniques and funding sources.

Sarasota County Analyses

Sarasota Density Analysis

Sarasota County has 29 Assisted Housing Inventory (AHI) properties funded through government subsidies with over 2,400 units. This places Sarasota at the lower end of the Compact with respect to the number of subsidized units per county. 82% of these subsidized properties receive funding through state and local programs. This has them tied with Hillsborough County with the highest percentage of properties subsidized by state and local programs. More than 55% of these properties are exposed to high frequency storm surge, which makes storm surge the largest flooding threat to assisted housing in Sarasota County.

Mobile homes in Sarasota are highly exposed to flooding. Collectively, Sarasota has the highest percentage of their mobile home stock exposed to each of the flood hazards except for the 1% annual flood event. In particular, 98% of the mobile home stock is exposed to low frequency storm surge hazards. Additionally, nearly one third of Sarasota's mobile home stock is exposed to 10 year storms under the 2070 intermediate high sea level rise scenario. Sarasota affordable housing is the most at risk to sea level rise hazards of all counties in the Compact.

Key Points:

- More than 80% of the mobile home units in Sarasota are exposed to storm surge hazards.
- Affordable housing is highly exposed to flood hazards, but is not highly concentrated.
- Multi-family affordable units make up the largest housing group exposed to flooding in Sarasota.

	Annual Flood				Storm Surge				Intermediate High 2070			
	1%		0.2%		Category 3		Category 5		SLR		SLR + 10 Year Surge	
Housing Type	N	%	N	%	N	%	N	%	N	%	N	%
Sarasota												
AHI	712	29	1254	51	1219	49	1997	81	61	2	323	13
Mobile Homes	4864	41	8740	73	10326	86	11672	98	1540	13	3842	32
Multi-Family	5561	28	8804	44	9727	49	17130	86	2090	10	3177	16
Single Family	1572	20	3322	43	4296	56	6414	83	225	3	481	6
Total NOAH	11997	30	20866	53	24349	61	35216	89	3855	10	7500	19

Figure 80:

Sarasota County - Total Counts and Percentages of Affordable Units Exposed to different flood hazards

NOAH properties in Sarasota County have the lowest percentage of their affordable housing stock exposed to floods from the 1% and 0.2% annual flood zones. However, flooding from surge events presents a significant risk to these affordable housing types threatening more than 43% of the entire NOAH stock. Similar to the other affordable housing typologies, there is a significant increase in the level of exposure between the annual flood events and storm surge. Multi-family affordable housing is more exposed to flooding than their single family counterpart. However, even thought the percent of the flood exposed multi-family stock is not the biggest, multi-family units make up the largest absolute count of flood exposed affordable housing within Sarasota.

While Sarasota County does have counts and percents of flood exposed affordable housing, these properties are fairly spread out within the County. In general, affordable housing is disperse with the hot spot analysis of all affordable units only capturing 54% of the total affordable housing stock. Affordable housing exposed to high frequency storm surge is the most clustered of the analyzed flood events with 70% of the exposed stock captured by the hot spot analysis. However, the percentage of affordable housing captured by the hot spot analysis for low frequency storm surge drops down to 57%, providing further evidence that many of the affordable properties in Sarasota are exposed to low frequency storm surge. Yet, they are scattered throughout the county.

	All Affordable		Annual Flood				Storm Surge			
			1%		0.2%		Category 3		Category 5	
	N	%	N	%	N	%	N	%	N	%
Citrus	10596	42	1567	26	3221	38	5241	74	5583	69
Hernando	12376	59	1999	42	2149	41	1238	75	4700	79
Hillsborough	17647	26	4467	32	4526	32	4118	37	8563	28
Manatee	14698	75	3666	65	4134	69	5200	66	13593	76
Pasco	34428	59	8469	58	12368	62	19387	85	24093	80
Pinellas	29930	36	9737	51	11399	42	15955	40	20900	38
Sarasota	**24995**	**54**	**7602**	**55**	**15706**	**65**	**19154**	**70**	**23755**	**57**

Figure 81:

Sarasota County - Counts and percents of exposed affordable units located in different flood zone hot spots

Sarasota Flood Zone Hazards

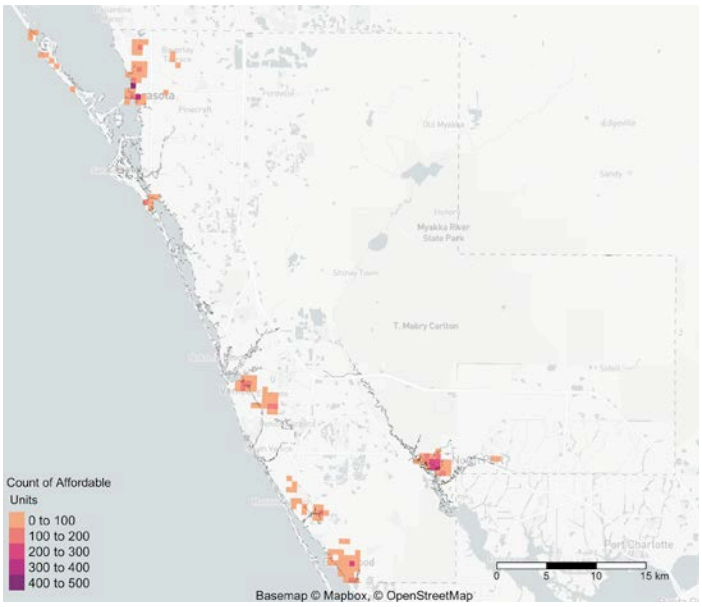


Figure 82:
Hot Spots of 1% Annual Flood Zones in Sarasota County

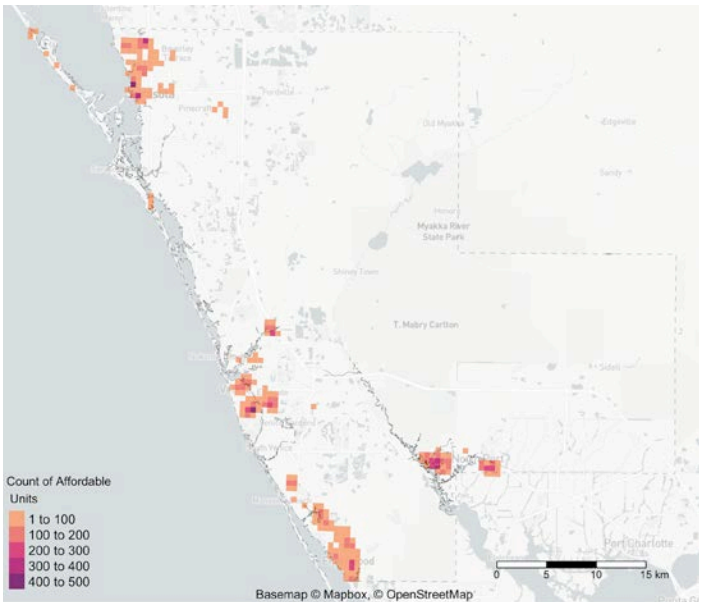


Figure 83:
Hot Spots of 0.2% Annual Flood Zones in Sarasota County

Figures 82 and 83 present the hot spots of highly concentrated, flood-exposed affordable housing neighborhoods for both the 1% and 0.2% annual flood hazards. The maps and subsequent analysis suggest that there is a moderate level of clustering exhibited by affordable housing units in Sarasota. High density neighborhoods, also referred to as hot spots, exposed to the 1% annual flood zone contain 7,340 NOAH and mobile home properties in addition to 262 AHI units. All of the affordable units identified in these flood hot spots make up 55% of the total affordable units exposed to the 1% annual flood hazards. Focusing on the 0.2% annual flood zones, the hot spot analysis captures 15,031 NOAH and mobile home units and 675 AHI units. This demonstrates a large jump in exposed affordable units between the 1% and 0.2% annual flood zones. These statistically identified hot spots highlight important action areas that should be further investigated for hazard mitigation approaches.

This density analysis allows for a further break down of the characteristics defining the affordable properties within the hot spots for different flood hazards. Throughout the hot spots of the 1% annual flood zone, mobile homes make up the majority of the exposed affordable units. 3,489 units out of the 7,340 total non subsidized units are identified as mobile home properties. Multi-family affordable housing makes up the next largest count of affordable units within the 1% annual flood zone hot spots (2,899 exposed units). There is a significant jump in the count of non subsidized affordable units identified in the 0.2% annual flood zone, which is further displayed through the hot spot analysis. The count of mobile homes identified in the 0.2% annual flood zone represents the largest increase in exposed affordable housing types with over 7,600 mobile home units identified in these hot spots (4,171 unit increase). Multi-family and single family affordable units experience an increase of about 1,000 units each between the 1% and 0.2% annual flood zone hot spots.

Non subsidized affordable units in the 1% and 0.2% annual flood zone hot spots are on average similar in age. Within both of these hot spots, the average year of construction for non subsidized units is 1977. Within the 1% annual flood zone hot spots, the year with the most mobile home developments is 1984. Whereas for multi-family and single family units the year with the most constructed units is

1974 and 1960 respectively. Single family homes in the 1% annual flood zone hot spots make up the smallest percentage of non-subsidized homes and have the oldest average construction dates. Between the two flood zone hot spots (1% and 0.2% annual hazards) the year with the most multi-family unit construction is the same. However, the year with the most constructed mobile homes changes from 1984 to 1973 suggesting that mobile homes exposed to 0.2% annual flood zones but not 1% annual flood zones are older.

Throughout both flood zone hot spots the non-subsidized units are situated at average elevation between 3 to 5 meters. Specifically in the 1% annual flood zone hot spots single family affordable units sit at the highest average elevation of 3.17 meters while mobile home and multi-family averages are at 2.35 and 2.86 meters respectively. In the 0.2% annual flood zone hot spots there is a slight increase in average elevation for each of the non subsidized units. Again, single family homes are on average located at the highest elevation of 4.11 meters while mobile homes and multi-family units are elevated at 3.09 and 3.94 meters. When focusing on housing construction types between the two flood zone hot spots, the single family and multi-family homes have the highest counts of units with a masonry foundation. Whereas wooden structures represent the largest construction type for mobile home properties.

Within these hot spots the majority of assisted housing units receive funding through HUD and RD programs. For the 1% annual flood zone hot spots 210 units receive funding via HUD or RD programs while 52 units receive funding through state and local channels. When looking at the 0.2% annual flood zone hot spots there is a significant increase in the count of exposed assisted units with funding through state and local mechanisms (52 units to 368 units). The increase is smaller for HUD and RD exposed units with 307 units identified in the 0.2% annual flood zone hot spots (up from 210 units).

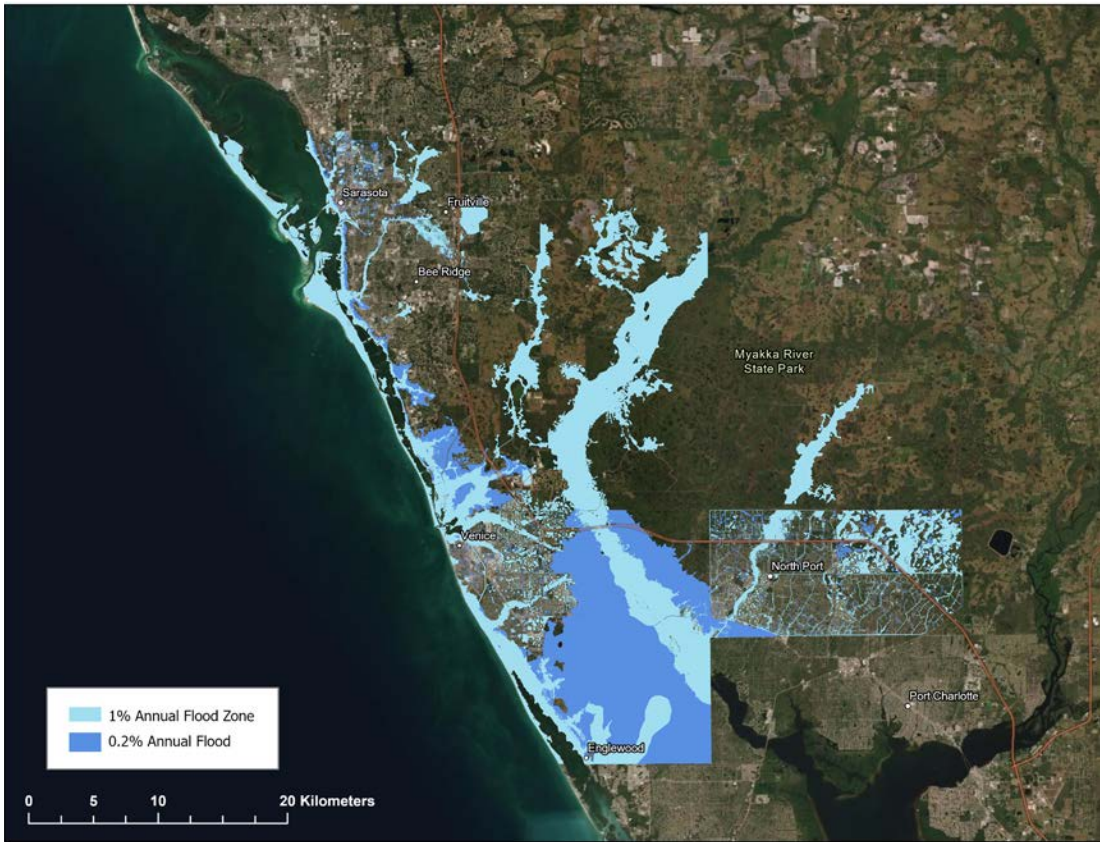


Figure 84:

Sarasota County 1% and 0.2% Annual Flood Zone

Sarasota Hurricane Storm Surge

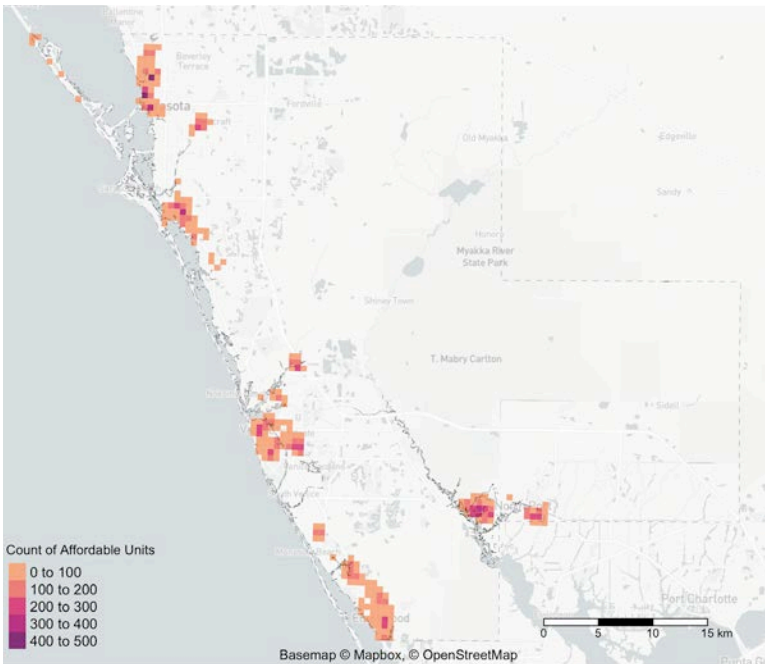


Figure 85:

Hot Spots of High-frequency Storm Surge in Sarasota County

Figure 85 displays high density neighborhoods of affordable housing that are exposed to high-frequency storm surge. Throughout this report high-frequency storm surge is identified as a Category 3 hurricane event ranking on the Saffir Simpson scale. Within these hot spots of high frequency storm surge 18,276 non subsidized units and 878 AHI units are identified. The affordable non subsidized units within the hot spots account for 75% of all non subsidized units exposed to high frequency storm surge and 72% of all AHI units exposed to high frequency storm surge. Overall 70% of all affordable units exposed to high frequency storm surge are identified within these hot spots. This suggests that there is low dispersion of affordable housing exposed to high frequency storm surge. Affordable units that are exposed to this high frequency storm surge are tightly clustered in locations that are near the coast.

Figure 86:

Sarasota County High Frequency Storm Surge

Sarasota Neighborhood Analysis

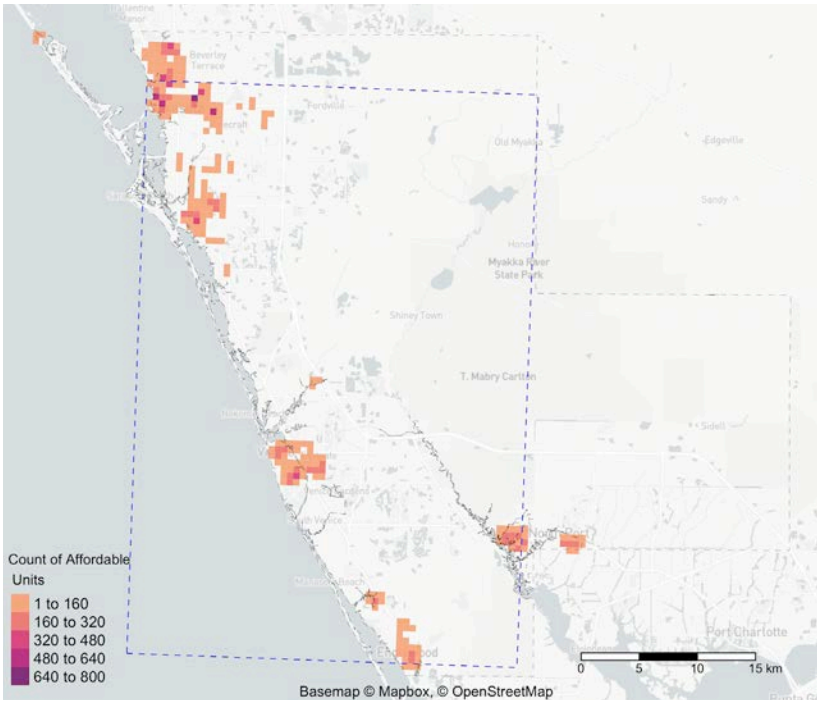


Figure 87:

Affordable Housing Hot Spots in Sarasota County

The density analysis helps identify specific neighborhoods with high concentrations of affordable housing that are acutely exposed to flood hazards. The next step of this analysis then identifies neighborhoods where the highest density clusters of affordable housing are exposed to multiple flood hazards. **Figure 87** presents a map of high density clusters of affordable housing throughout Sarasota County. On this map, the neighborhood study area is defined by a blue dotted square along the western portion of Sarasota County. There are five major hot spots that are spaced out along the western coast which provide the bounds of the neighborhood study areas. The hot spots in this map do not provide specific information on flood risk; instead, they demonstrate which areas throughout Sarasota County have high concentrations of affordable housing. However, the study area defined by the blue dotted box is created by identifying the locations of highly clustered affordable housing that are exposed to both the 1% annual flood zones and high-frequency storm surge.

With the neighborhood study area chosen, census tract statistics are used to characterize the areas with high concentrations of multi-flood hazard exposed affordable housing units. Census tract information is incorporated into this analysis to provide policy makers and other practitioners with additional information on the social vulnerabilities of these flood exposed locations.

The census demographics chosen for the social vulnerability analysis include the census tract median income (in 2019 dollars), the percentage of the minority population (Black and Hispanic), and the percentage of residents over the age of 65. These three statistics help provide a deeper understanding of the potential compounding social vulnerabilities associated with high flood exposure. The neighborhood analysis identifies acute flood exposed affordable housing neighborhoods at different locations throughout Sarasota County. The following sections describe the neighborhood demographics of these highly concentrated and highly exposed neighborhoods. Throughout these maps the blocks represent the highly exposed neighborhoods, and their filled color will represent different demographic statistics based on the census track a given neighborhood is located in.

Sarasota Comparison Map and Median Income

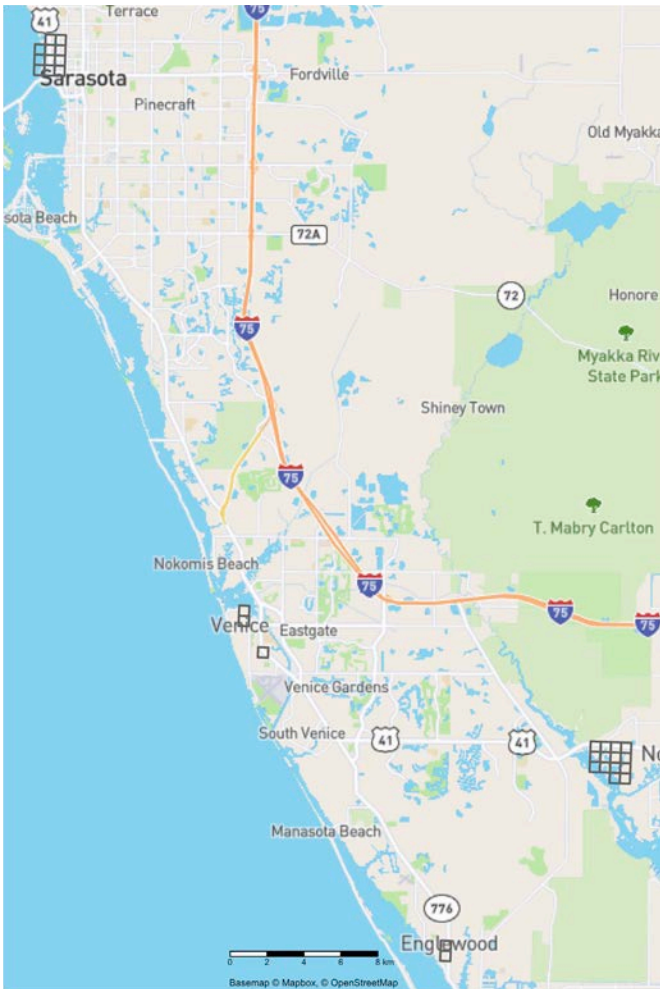


Figure 88:

Highest Risk Affordable Housing Hot Spots in Sarasota County

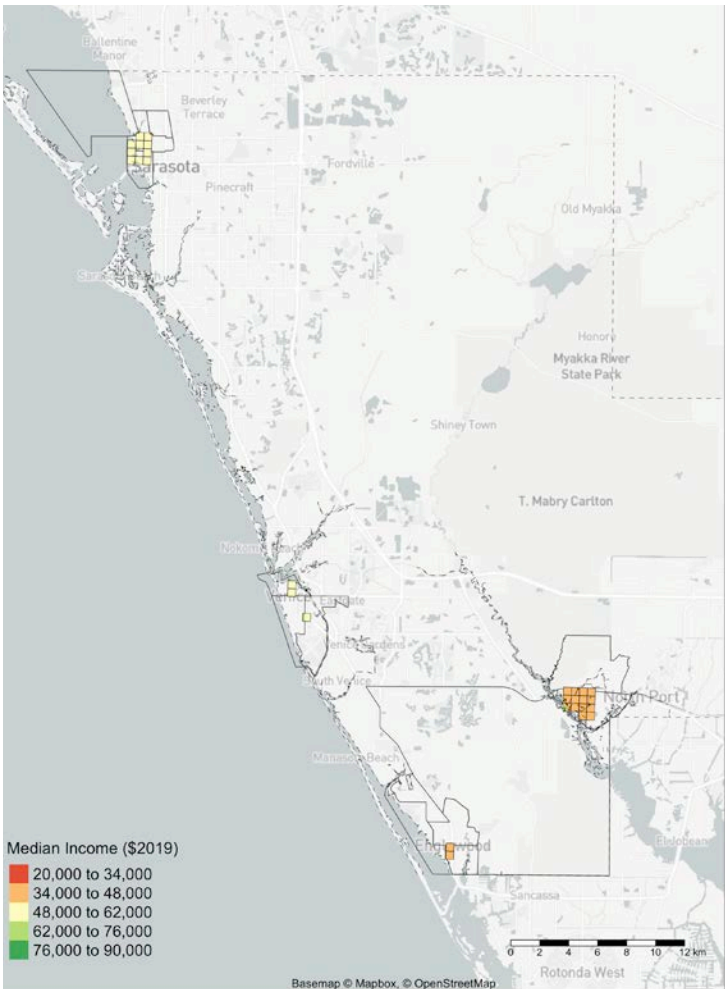


Figure 89:

Median Income of Highest Risk Hot Spots in Sarasota County

Figure 89 present the neighborhood analysis of median incomes in Sarasota County. Each of the neighborhoods identified in the study area are located within census tracts where the median income is lower than the County median. In Sarasota County the median income is $62,236 which is significantly greater than the median income ranges of the census tracts with highly flood exposed communities. The neighborhood clusters with median income ranges significantly lower than the County median are located more inland than the other high risk neighborhoods. However, proximity to the coast does not solely explain differences in neighborhood incomes. Specifically, neighborhoods near North Port have lower median income ranges, but neighborhoods near Sarasota also have census tract median incomes that half of the County median.

Sarasota Minority and Elderly Percentage

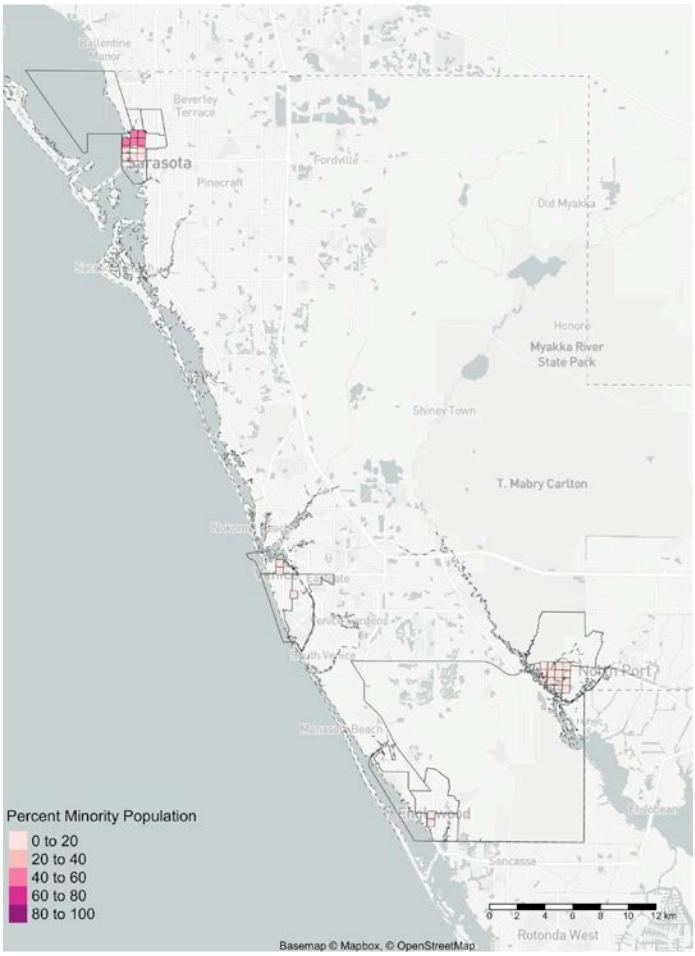


Figure 90:

Percent Minorities of Highest Risk Hot Spots in Sarasota County

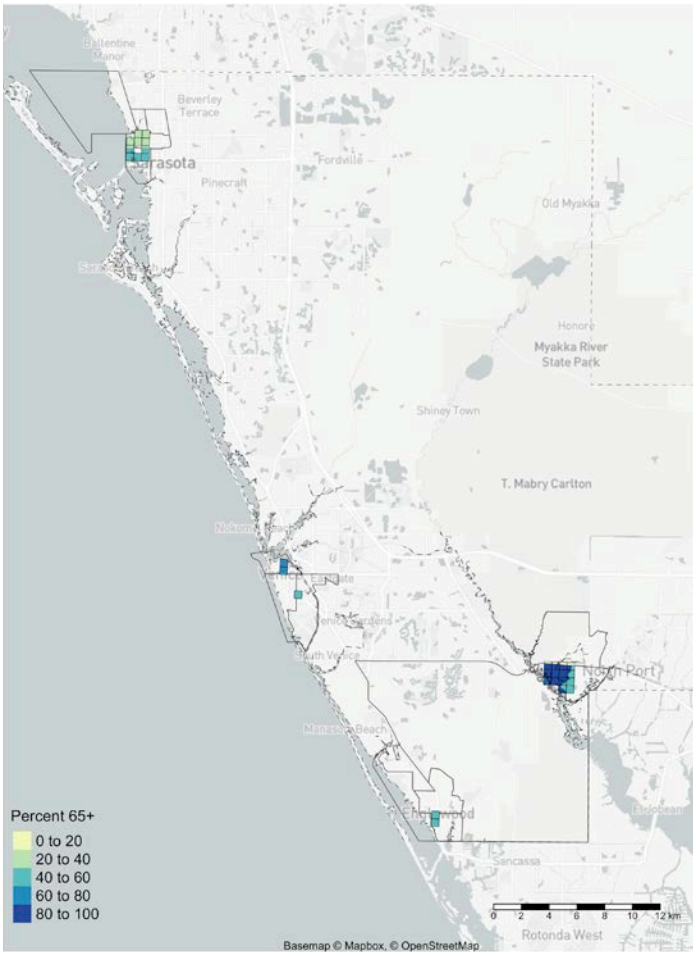


Figure 91:

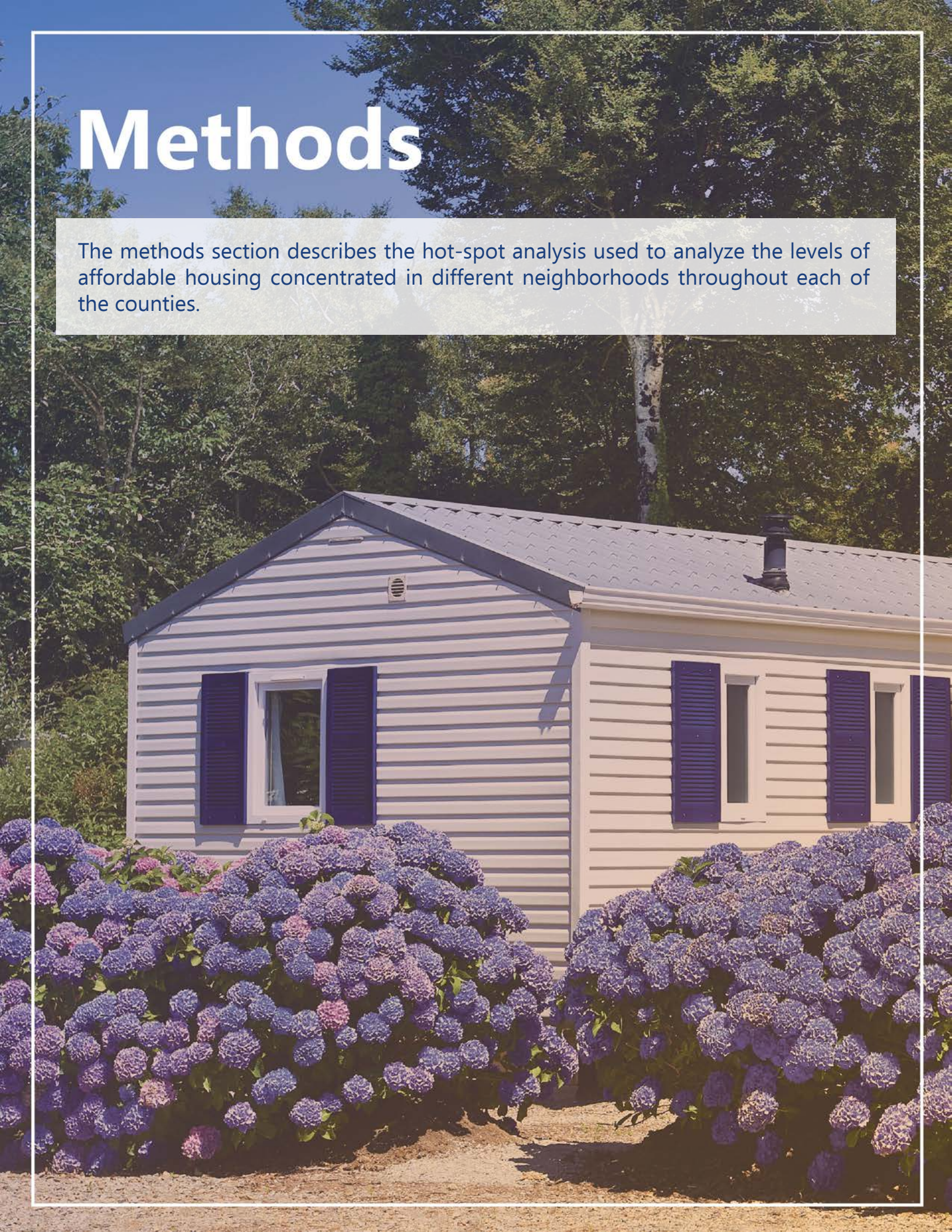
Percent Elderly of Highest Risk Hot Spots in Sarasota County

Figure 90 displays the distribution of minority percentages at the census tract level for the selected study neighborhoods. Overall, the population of Sarasota County is homogeneous. The minority population throughout the County makes up 14% of the total population. All of the neighborhoods identified as high flood risk locations have minority concentrations that are higher than the County average. The majority of the census tracts with high flood exposed neighborhoods have minority concentrations between 20% and 40% of the census tract population. However, some neighborhoods in the northern part of Sarasota have minority concentrations six to seven time larger than the county average.

Figure 91 displays the distribution of the elderly population at the census tract level within the selected study neighborhoods. In Sarasota County 36% of the population is 65 years or older. However, when looking at the high flood exposed neighborhoods, the majority of the census tracts have a higher concentration of elderly populations. As is observed in other counties, neighborhoods with higher minority concentrations have lower elderly concentrations and vice versa. Specifically when looking at the hot spot near North Port some of the high flood risk neighborhoods have between 80 to 100% of their population over the age of 65 and between 0 to 20% of their population identifying as a minority.

Methods

The methods section describes the hot-spot analysis used to analyze the levels of affordable housing concentrated in different neighborhoods throughout each of the counties.



Hot Spot Analysis

The hot spot analysis is conducted using the Getis Ord Gi* statistic introduced by Getis and Ord (1992). This statistic is a measure of relative concentrations, and helps identify abnormal clusters of similar spatial objects. As a demonstration we will walk through the steps to prepare the data for a hot spot analysis in Pinellas County, while noting that this process was conducted similarly for all other counties in the region. The first step in the analysis is to create a fishnet grid over the study area. We use the spatial extent of the parcels within Pinellas to determine the corners of the grid. We then divide the grid into squares with side lengths of 252 meters. This value is calculated by taking the smallest side of the rectangle formed by the grid and dividing by 100. Due to the projection of the grid, the spatial units are measured in meters.

In the next step we use a spatial join between the parcel features (which are converted to points via their centroids) and the grids. The parcel features are subset into different categories based on our questions of study. For example, when looking for hot spots of NOAH properties exposed to 100 year floods, we subset the parcel data to match this query and then aggregate the number of parcels that are observed within a given grid cell. This is carried out for a number of different subset specifications which identify exposure to the flood hazards discussed in the report.

After creating this data set, we carry out the hot spot analysis. This analysis requires computing the Getis Ord Gi* statistic described in Getis and Ord (1992). The formula is as follows:

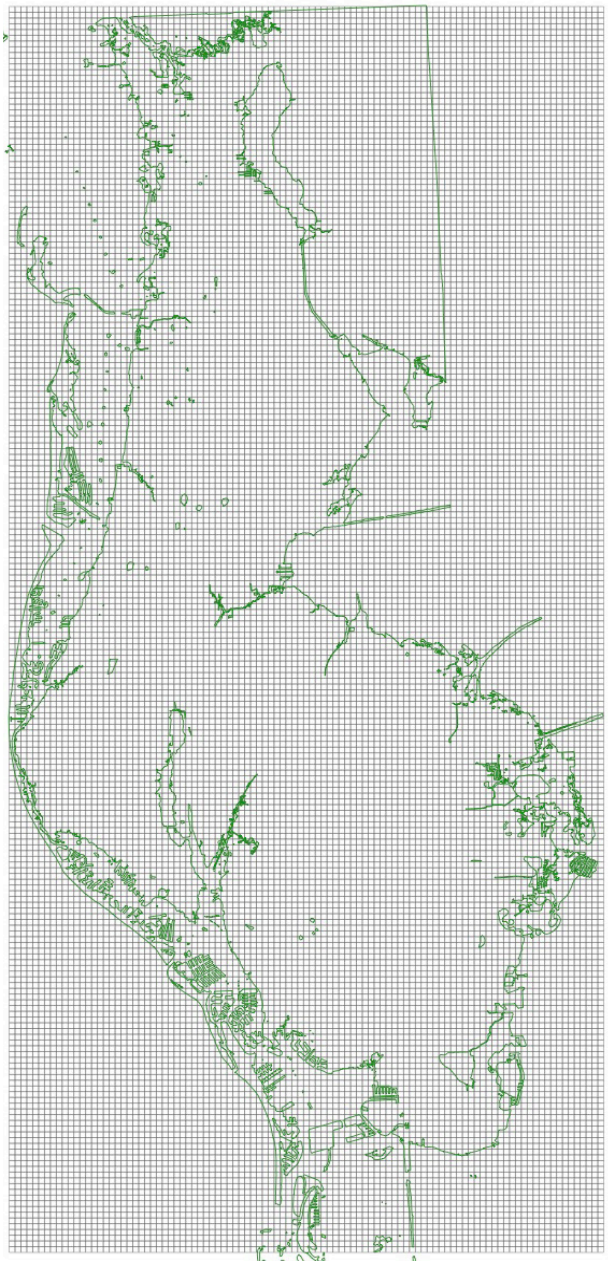


Figure 1A:
Example grid over Pinellas County

$$G_i^*(d) = \frac{\sum_j^n w_{ij}(d)x_j}{\sum_j^n x_j}$$

Here wij is a symmetric one/zero spatial weights matrix for observation i. Based on our choice of d, or our neighborhood statistic, wij = 1 for all grids within d and 0 for all grids outside of the neighborhood distance d. In this analysis we chose d = 800 meters.

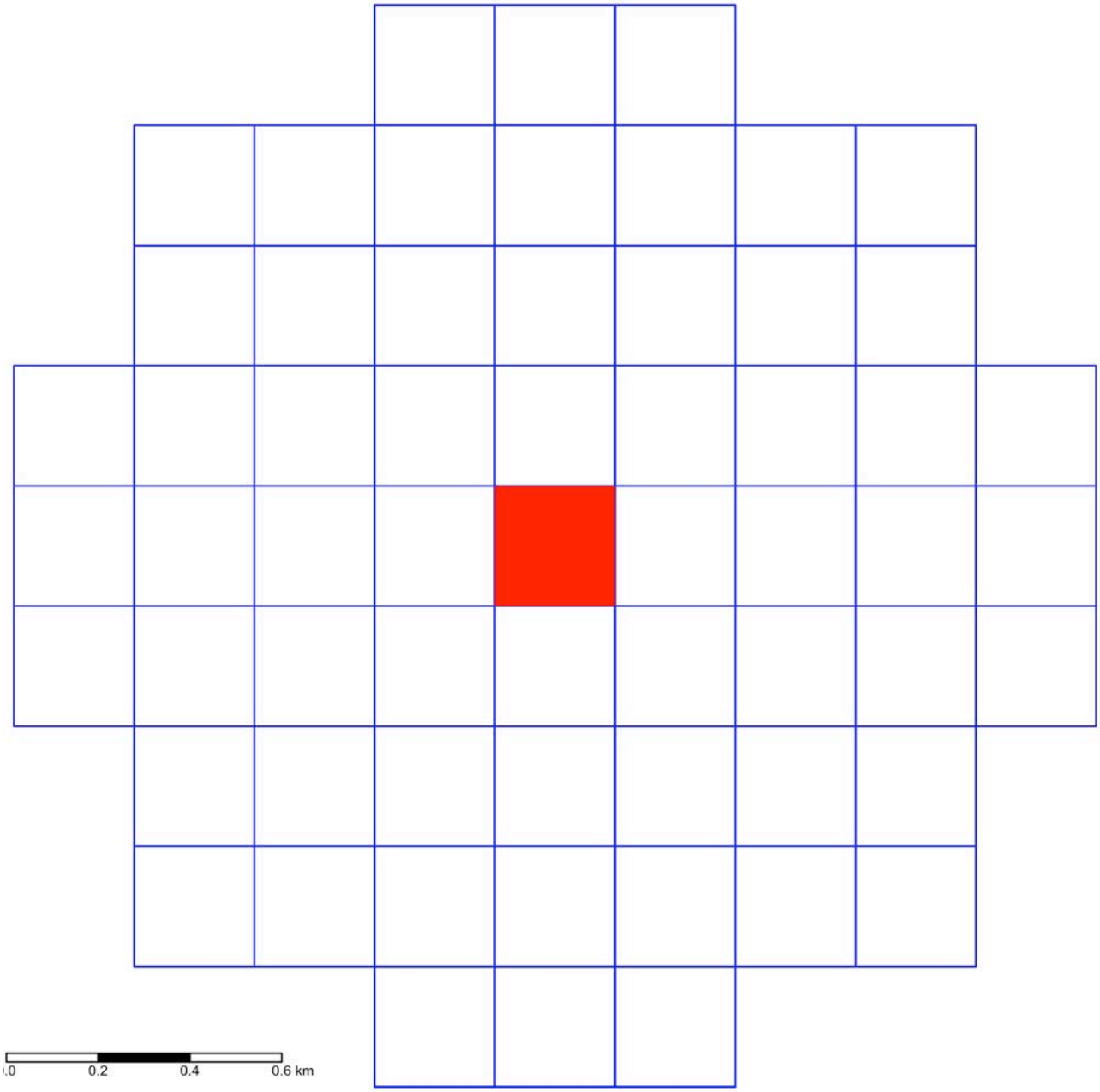


Figure 2A:
Example block and neighborhood

Figure 2A provides a zoomed in view of the neighbor identification process. The red grid in the middle is the object of interest and the surrounding blue outlined grids represent all neighbors within 800 meters of the red grid square. This process of neighbor identification is carried out for each of the grids. These neighbor grids all receive weights of 1 and grids outside this neighborhood receive weights of 0. Returning to the formula, the xj 's represent the count of properties within each grid that meet one of our subset specifications. For example, identifying hot spots of NOAH properties in the 100 year flood plain we calculate the count of parcels satisfying this subset within each grid. Since all grids outside the neighborhood receive 0 weights their values do not contribute to the sum of the numerator.

The denominator is the summation of all subset parcel counts throughout the region. Therefore, the Gi* represents a relative relationship between the count of parcels in a neighborhood compared to the entire study area.

The final step of calculating the Getis Ord Gi* statistic requires hypothesis testing to identify which hot spots are significant. The null-hypothesis assumes that the set of x values (parcel counts) within 800 meters of a given location are randomly sampled without replacement from the set of all parcels counts in the study area. We use the built in localG function from the spdep R package to carry out the analysis. This function calculates the Z statistic for each grid. Then, using the Bonferonni Correction for multiple hypothesis testing we identify which Z statistics are statistically significant at the 95% confidence level. Hot spots that are identified as significant are plotted on the resulting maps where higher Gi* statistics represent higher concentrations of parcels within our given subset query.