TAKING STOCK ··················

Natural Hazards and Federally Assisted Housing

A joint report by

The Public and Affordable Housing Research Corporation &
The National Low Income Housing Coalition

PAHRC
Public and Affordable Housing Research Corporation

**NATIONAL LOW INCOME
HOUSING COALITION**

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About NLIHC

Established in 1974 by Cushing N. Dolbeare, the National Low Income Housing Coalition is dedicated solely to achieving socially just public policy that ensures people with the lowest-incomes in the United States have affordable and decent homes. NLIHC educates, organizes, and advocates to ensure decent, affordable housing for everyone.

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About PAHRC

The Public and Affordable Housing Research Corporation (PAHRC) is a non-profit research center dedicated to conducting research that promotes the national conversation about the importance of affordable housing. PAHRC spotlights the impact, outcomes, and value affordable housing brings to the families it serves and to the communities it supports, delivering data and tools that assist researchers, practitioners, and advocates to build an evidence-based case for why affordable housing matters.

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Executive Summary

As the costs and frequency of severe weather events climb, fully understanding and planning for their potential impact on affordable housing is critical. Federally assisted rental properties represent roughly five million homes and account for more than 10% of the nation's rental stock. They provide housing stability to some of our nation's most marginalized people with the fewest resources, who are often least able to prepare for a disaster and face significant hurdles during recovery.

This report examines the locations of project-based federally assisted properties in relation to the Federal Emergency Management Agency's National Risk Index (NRI). The NRI compares across locations the risk of harm from 18 different types of weather, geological, and climate events. Using this measure and other data about the frequency and risk of natural hazards, we find that:

- Nearly one-third of the federally assisted housing stock is in areas with very high or relatively high risk of negative impacts from natural hazards compared to one-quarter of all renter occupied homes and 14% of owner occupied homes.

- Federally assisted households are less likely than their low-income unassisted peers to have the supplies and resources needed to adequately to evacuate or prepare to weather a natural hazard.

- Households of color in HUD-assisted housing are more likely than white HUD-assisted households to live in areas with greater risk. The Public Housing program has the largest share of units (40%) in areas of very high or relatively high risk of natural hazards.

- USDA programs have the smallest share of units (7%) in areas with very high or relatively high risk of natural hazards.

- Tornadoes pose the largest risk to the federally assisted housing stock among the natural hazards studied in this report, though there could be increasing risk from hurricanes and flooding as these events intensify.

Natural hazards pose a significant threat to federally assisted housing, while its residents are especially vulnerable to adverse impacts. We encourage federal, state, and local stakeholders to assess the vulnerability of the federally assisted housing in their communities and improve strategies and resources for equitable planning, mitigation, and recovery. The Reforming Disaster Recovery Act and the Disaster Learning and Life Saving Act, two bills under consideration in Congress, provide direction an resources towards this goal.

The U.S. has seen a significant increase in the frequency and intensity of weather and climate-related events, such as fires, hurricanes, and flooding, as well as a surge in the damages incurred from them.[1] The impacts of these events have cost more than $1.9 trillion (in 2021 dollars) since 1980. Over the last decade, the U.S. has experienced at least ten disasters per year whose overall costs have exceeded $1 billion each.[2] Disasters place a significant burden on households with low incomes, who are more likely to live in older homes more vulnerable to disaster and who often lack the resources to evacuate in the face of danger or find similar quality housing in the aftermath of loss.[3] Residents of federally assisted rental housing may be particularly vulnerable to disasters.

Research suggests rental housing can experience greater damage and recover more slowly from disasters than owner-occupied housing.[4] Multifamily and duplex structures are typically slower to recover than single-family structures.[5] Multifamily properties may sustain more damage and be more costly to repair when exposed to a natural hazard due to the scale of the physical building and its related systems. Additionally, renters and landlords might not have the same incentives as homeowners to make long-term investments in mitigation features.[6] Rental housing is also less likely to benefit from recovery resources.[7] Landlords are not eligible for Federal Emergency Management Agency (FEMA) repair assistance, and Community Development Block Grant – Disaster Recovery (CDBG-DR) funds have historically been disproportionately allocated to programs serving homeowners.[8]

Lower-cost rental housing is likely at even greater risk of damage and negative recovery outcomes because it is more often characterized by lower physical quality and located in less desirable and more risk-prone areas.[9] Many lower-cost rental units, including those that are federally assisted, are older, making them more susceptible to damage due to wear, a lack of upgraded building materials, and older systems than those found or required in newer properties.[10]

Owners of lower-cost rental properties may find it especially challenging to repair or rebuild their housing due to limited rental income to pay for repairs and meet newer mitigation standards.[11] These owners may need to raise rents or sell to new owners with sufficient capital, jeopardizing affordability. In weaker markets where they cannot raise rents, landlords may be harder pressed to rehabilitate their housing at all. Owners of federally assisted rental housing may face an even greater challenge to generate funds to repair or rebuild after a disaster, because rent increases are typically restricted. Without further subsidy for recovery, these owners may be unable to rehab or rebuild their housing.

Residents of lower-cost rental housing in either the private or subsidized markets face significant risk of displacement. Displaced low-income renters, moreover, are likely to experience higher housing cost burdens than displaced homeowners.[12] Low-income renters living in federally assisted housing may face even greater risks for displacement and loss of affordability. Research on Hurricane Katrina suggests that subsidized renters are least likely to return to their pre-disaster home compared to low-income homeowners or low-income market-rate renters.[13] Given that federally assisted units account for approximately 10% of the U.S. rental housing stock and its residents are at significant risk for permanent displacement and financial hardship, it is important to understand how much of the federally assisted housing stock may be vulnerable to natural hazards.[14]

This report estimates the potential for natural hazards to negatively impact the federally assisted rental housing stock. Natural hazards are severe weather, geological events, and other environmental occurrences that pose a risk to people and property. Not all natural hazards result in disasters with costly or catastrophic outcomes, yet they represent a risk and can also result in negative impacts on a smaller scale. The potential exposure of federally assisted housing to natural hazards is of interest given its inherent vulnerabilities and social value.

The report is divided into six sections.
The next section describes the methodology for this report. The third section estimates the number of federally assisted properties at risk of natural hazards. The fourth section explores the risk for people of color, older adults, and people with disabilities served by federally assisted housing. The fifth section examines differences in risk across federal housing programs. The final section provides policy recommendations to mitigate the impact of natural hazards and disasters for federally assisted properties and improve outcomes for residents.

Methodology

The federally assisted housing stock includes properties with below-market mortgage interest, federal tax credits, or federal subsidies to make rents affordable to low-income households.[15] Data identifying federally assisted homes come from the National Housing Preservation Database (NHPD), which is an address-level inventory of nearly all federally assisted rental housing properties.[16] The federal programs included in the NHPD include the Low Income Housing Tax Credit (LIHTC), Public Housing, Project-based Rental Assistance, USDA Section 515, 514, and 538 programs, Section 202 Direct Loans, HOME Assistance, HUD insurance programs, Mod Rehab, and Project Based Vouchers. To identify federally assisted properties at risk of natural hazards, we mapped subsidized properties with spatial data on natural hazards.

Our primary measure of natural hazard risk comes from FEMA's National Risk Index (NRI), which quantifies community-level risk of impacts from natural hazards.[17] The NRI incorporates eighteen types of natural hazards: riverine flooding, earthquake, tornado, hurricane, wildfire, wind, volcanic activity, avalanche, mudslide, coastal flooding, heat wave, cold wave, winter weather, ice storm, drought, hail, lightning, and tsunami. The NRI uses three main components to represent overall risk: expected annual loss, social vulnerability, and community resiliency. The NRI provides an overall score for all three components combined, or individual scores for each component, and is available at the county or census tract level. Expected annual loss is a combination of the value of property and the number of people exposed to a natural hazard event (exposure), the annualized frequency or probability of the event occurring (frequency), and the value of previous damage due to natural hazard events (loss ratio). The value of previous damage due to natural hazards includes damage to buildings, agriculture, and people.[18] Social vulnerability represents the degree to which people living in an area would suffer from a natural hazard occurrence. The social vulnerability measure is composed of 29 socio-economic indicators such as median age, per capita income, percent without health insurance, and percent of persons living in poverty.[19] Community resiliency represents the degree to which people in a given area are prepared for a natural hazard and could quickly recover. It includes 49 indicators falling into six categories: human well-being, economic, community capital, housing/infrastructure, institutional capacity, and environment. The indicators include food supply, evacuation routes, transportation options, civic organizations, medical care capacity, disaster training, and mental health support.[20]

The NRI creates an overall relative risk score of 0 to 100 with 100 indicating the greatest risk, as well as scores for individual hazards. Based on this score, communities' risk to natural hazards is categorized as very high, relatively high, relatively moderate, relatively low, and very low. The NRI is a comprehensive measure of risk, but it may overestimate risk to properties in heavily populated areas where damage is likely more expensive and it may underestimate risk in less populated areas. It also increases risk scores in low-resourced areas housing more vulnerable populations, like those containing more federally assisted rental properties. The NRI may also underestimate risk to certain populations in high-resilience areas, who individually may have inadequate access to resources for recovery.

The NRI is a complex measure of risk based on multiple measures of loss, social vulnerability, and community resilience. To provide a simpler alternative to understanding the hazards facing the federally subsidized rental housing stock, we include other data sources focused on the frequency or expected frequency of specific natural hazards. These data sources include the Storm Prediction Center (SPC) and the National Hurricane Center (NHC) at the National Ocean and Atmospheric Association (NOAA), the US Geological Society (USGS), the Environmental Protection Agency (EPA), the Federal Emergency Management Agency (FEMA), the National Interagency Fire Center, the US Census Bureau, Silvus Lab at the University of Wisconsin, and the Fire Lab at the US Department of Agriculture (USDA). See Appendix A for a full list of these data sources.

Federally Assisted Homes and Natural Hazards

This section estimates the risk of natural hazards to federally assisted rental homes based on the properties' census tract NRI ratings. We consider the overall risks to the federally assisted rental housing portfolio and then discuss the risk of the more costly natural hazards: tornadoes, flooding, hurricanes, earthquakes, and wildfires. Interactive maps depicting federally assisted housing properties and the risk of these hazards can be found **here**.
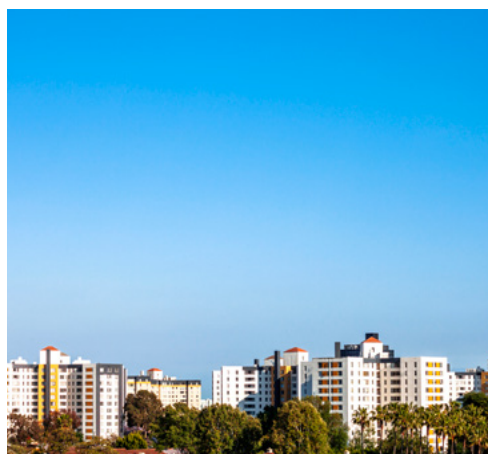
Overall Risk

More than 1.5 million federally assisted housing units, or 32% of the assisted stock, are at very high or relatively high risk of a negative impact from natural hazards. When we include only expected annual loss in the measure of risk (excluding the NRI's community resiliency and social vulnerability components), one-quarter of federally assisted units are in census tracts with very high or relatively high risk of loss of property and life.

Table: Federally Assisted Homes, Renter Occupied Homes, and Owner Occupied Homes by Overall National Risk Index (NRI) Rating of Census Tract

NRI (Overall) Risk Rating	Assisted Rental Homes		Renter Occupied Homes		Owner Occupied Homes	
	Number	Percent	Number	Percent	Number	Percent
Very High	533,521	11%	3,380,542	8%	2,689,173	3%
Relatively High	1,047,797	21%	8,117,791	19%	8,686,907	11%
Relatively Moderate	1,285,185	26%	10,964,893	25%	15,339,237	20%
Relatively Low	1,309,190	26%	11,343,362	26%	22,057,158	29%
Very Low	803,639	16%	9,662,475	22%	28,471,696	37%
Data Unavailable	868	0%	12,604	0%	30,210	0%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, and American Community Survey 2015-2019 (five-year estimates), matched to the National Risk Index (2020).

Federally assisted units are more likely to be located in areas of very high or relatively high risk of a negative impact from natural hazards than renter occupied units and have a similar risk of monetary loss. Twenty-seven percent of renter occupied units are located in census tracts rated as having a very high or relatively high overall risk and 24% are located in areas rated as having a very high or relatively high risk of annual monetary loss. In contrast, just 14% of owner occupied units are located in very high or relatively high areas of overall risk and 17% are located in areas with a very high or relatively high annual expected loss risk. Renter occupied units, including federally subsidized units, are likely located in more densely populated and commercial areas that would have greater potential losses from natural hazard damage leading to a higher risk of annual expected loss. Federally assisted units serve more vulnerable populations, which factor into the socio-economic indicators embedded in the NRI, potentially contributing to a higher overall risk of negative impacts from natural hazards in areas where these properties are sited.
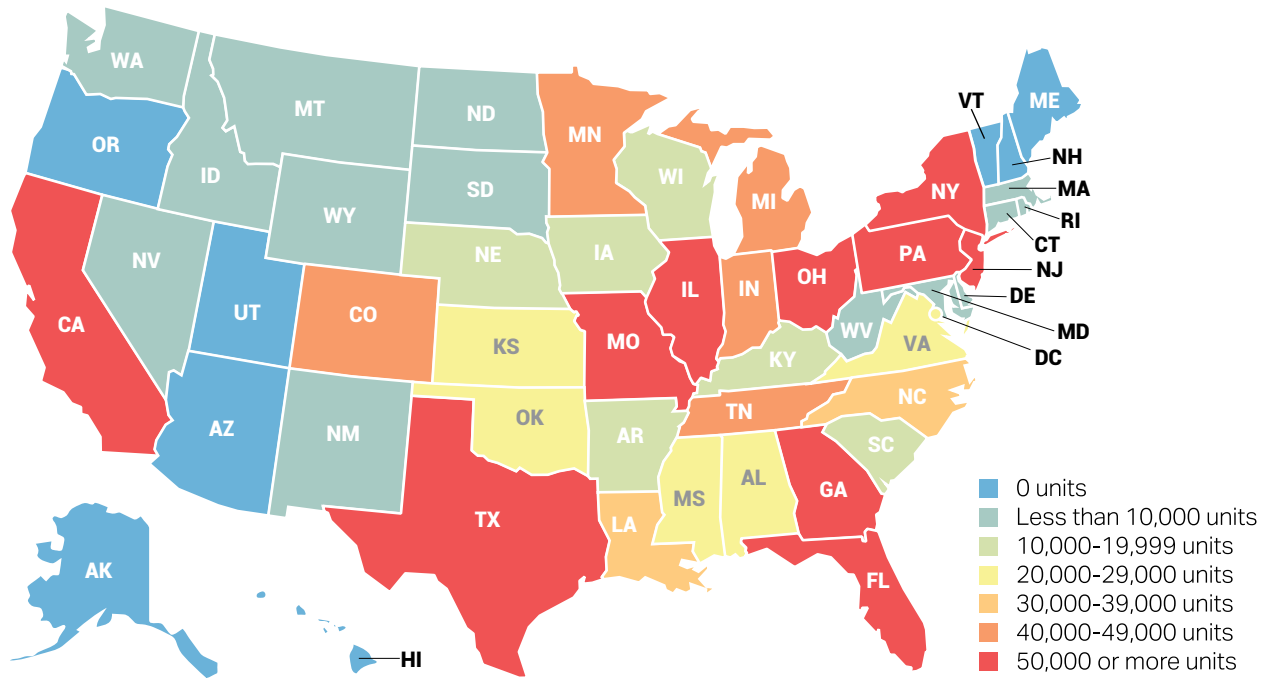
Table: Federally Assisted Homes, Renter Occupied Homes, and Owner Occupied Homes by NRI Overall Expected Annual Loss of Census Tract

NRI Overall Expected Annual Loss	Assisted Rental Homes		Renter Occupied Homes		Owner Occupied Homes	
	Number	Percent	Number	Percent	Number	Percent
Very High	281,812	6%	2,711,830	6%	2,793,240	4%
Relatively High	940,920	19%	7,954,499	18%	9,673,030	13%
Relatively Moderate	1,359,615	27%	11,278,944	26%	16,055,834	21%
Relatively Low	1,398,388	28%	11,195,342	26%	21,353,034	28%
Very Low	999,418	20%	10,329,122	24%	27,370,495	35%
Data Unavailable	47	0%	11,930	0%	28,748	0%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, and American Community Survey 2015-2019 (five-year estimates), matched to the National Risk Index (2020).

Ten states, including California, Florida, Georgia, Illinois, Missouri, New York, New Jersey, Pennsylvania, Ohio, and Texas, have more than 50,000 federally assisted rental units in census tracts very high or with elatively high risk ratings.

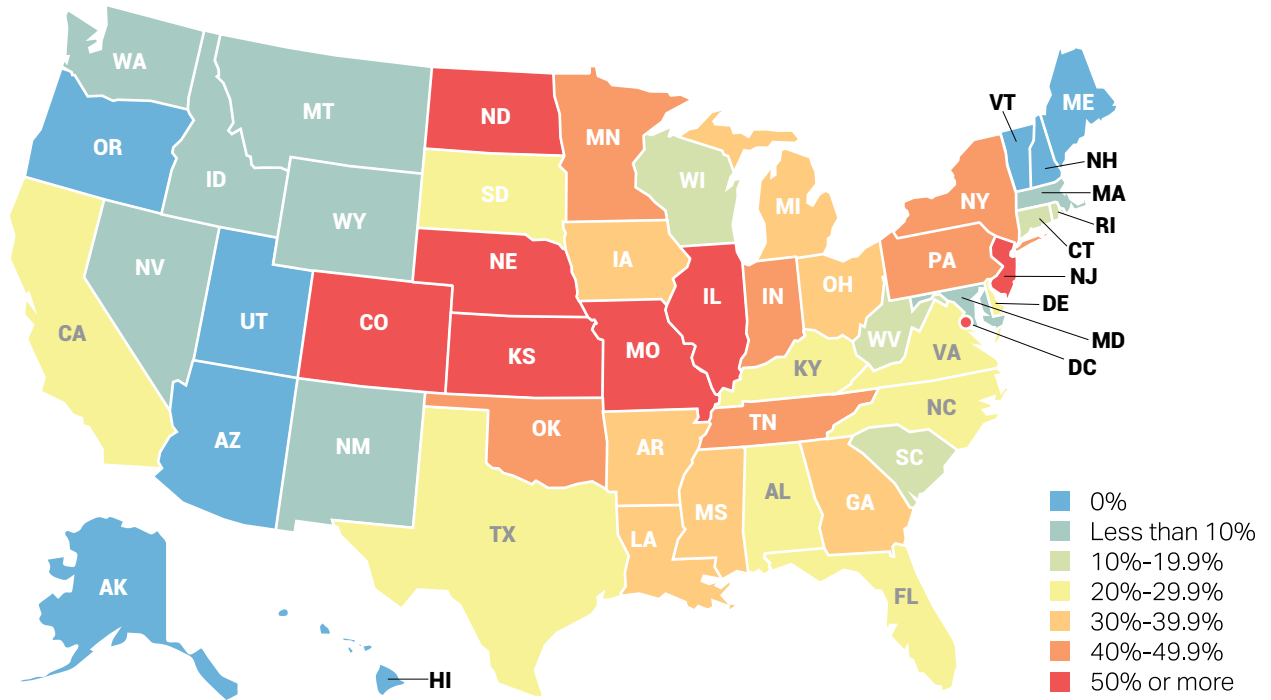**Map:** The Number of Federally Assisted Rental Homes with Very High or Relatively High Risk of Negative Impacts from Natural Hazards (All Hazards) by State

Legend:
- 0 units
- Less than 10,000 units
- 10,000-19,999 units
- 20,000-29,000 units
- 30,000-39,000 units
- 40,000-49,000 units
- 50,000 or more units

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020).

While fewer in absolute numbers, states in the Midwest tend to have the largest share of their federally assisted portfolios at risk from natural hazards likely due to the widespread risk of tornadoes. States in the west and New England tend to have the lowest shares of their federally assisted housing stock at risk.

Map: The Percent of Federally Assisted Homes by State with Very High or Relatively High Risk of Negative Impacts from Natural Hazards (All Hazards)

Legend:
- 0%
- Less than 10%
- 10%-19.9%
- 20%-29.9%
- 30%-39.9%
- 40%-49.9%
- 50% or more

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020).

Most federally assisted housing units face very high or relatively high risk for at least one natural hazard. Eighty-five percent of federally assisted units are in census tracts at high risk for at least one of the 18 natural hazards included in the NRI. The most common threats to federally assisted rental units include tornadoes, strong wind, lightning, winter weather, and heatwaves.

Table: Top Five Natural Hazards (NRI) Impacting Federally Assisted Homes.

Hazard Type	Assisted rental homes in census tracts with relatively high or very high hazard risk ratings	
	Number	Percent
Any natural hazard	4,218,571	85%
Tornado	1,796,732	36%
Strong wind	1,517,290	30%
Lightning	1,371,697	28%
Winter weather	1,247,513	25%
Heatwave	1,198,061	24%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020).

Tornadoes

Tornadoes represent a growing risk to federally assisted housing as the traditional 'tornado alley' shifts east towards larger population centers and the average number of storms occurring on a given day increases.[21] Tornadoes can raze buildings or leave them uninhabitable due to damage to the structure or building systems like heating, plumbing, and electrical power. Thirty-six percent of federally assisted units are located in census tracts with very high or relatively high tornado hazard risk.

According to NOAA data on the frequency of past tornadoes, 37% of federally assisted units (1.8 million) were located within 25 miles of a tornado's path (any intensity) at least once per year, on average, over the last 30 years. Many more federally subsidized housing units have been near the path of past tornadoes whose wind speeds can cause considerable damage, though not with such frequency. More than half of federally assisted units (2.5 million) are within 25 miles of the path of at least three tornadoes capable of considerable damage (EF2+) since 1990.[22]

Table: Federally Assisted Rental Homes' Risk and Previous Exposure to Tornadoes

Sited in location that has…	Number of Units	Percent of Units
Very high or relatively high tornado hazard risk rating (NRI)	1,796,732	36%
Experienced 1 tornado (EF0+) per year, on average, since 1990	1,828,923	37%
Experienced 1 tornado capable of considerable damage (EF2+) per decade since 1990	2,518,788	51%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to NOAA: SVRGIS Severe Weather Report 1990-2019 and the National Risk Index (2020). Excludes properties located in Alaska and Hawaii.

While the number of properties directly impacted by tornadoes in a given year may be small, the fact that over one-third of federally assisted homes are in areas with a high frequency of tornadoes suggests housing providers and policymakers should review their level of preparedness, current mitigation practices, and recovery resources for homes at risk of tornadoes.

Riverine Flooding

Flooding of waterways and low-lying areas can cause significant property damage and tenant displacement. One inch of flooding can cause $26,000 in damage and lead to mold or other health concerns.[23] Sixteen percent of federally assisted housing units are in census tracts with very high or relatively high risk of negative consequences from riverine flooding.

FEMA's National Flood Hazard Layer (NFHL) indicates fewer federally assisted rental homes at risk of a major flood than the NRI. FEMA created the NHFL map to assist property-owners in determining flood risk and to support the National

Flood Insurance Program, which underwrites property losses not always covered by private insurance in flood-prone areas.[24] Yet the NFHL may underestimate the risk of flood. A recent analysis by First Street found that the number of properties at substantial risk of flooding was 1.7 times the number in FEMA's 100-year flood hazard layer.[25] The disparity between the number of federally assisted units at risk using the NRI versus the NFHL suggests that a more in-depth consideration of flood risk beyond the NFHL may be needed when siting subsidized housing properties or recommending flood mitigations for these properties.

Over 200,000 federally assisted rental homes are located within a regulatory floodway or within FEMA's 100-year flood plain, which identifies areas with a 1% annual chance of a flood. An additional 242,000 federally assisted units, or 5% of the stock, are located in the 500-year flood plain, which are areas with a .2% annual chance of a flood. Nine percent of federally assisted units are in areas of undetermined flood hazard by the NFHL.

Table: Federally Assisted Rental Homes' Risk and Potential Exposure to Riverine Flooding

Sited in location that is…	Number of Units	Percent of Units
Very high or relatively high riverine flooding hazard risk rating (NRI)	821,325	16%
in the 100 year floodplain or a Regulatory Floodway	224,608	5%
in the 500 year floodplain	241,525	5%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to NFHL (2020) and the National Risk Index (2020).

Hurricanes

Hurricanes and tropical storms pose a significant risk to property and can cause long-term displacement of tenants. Annual costs across the residential, commercial, and public sectors due to property damage from hurricane wind, storm surge, and rain is estimated at $54 billion.[26] Hurricanes are growing stronger and intensifying more rapidly due to climate change, which puts more of the housing stock at potential risk for severe damage.[27] Five percent of federally assisted units are at very high or relatively high risk of a negative impact from hurricane winds based on the NRI.

Yet examining historical storm tracks compiled by NOAA, we find that 10% of federally assisted housing units are within 50 nautical miles of at least one hurricane per decade, on average. Over 100,000 of federally assisted rental units, or 2%, are in areas that are, on average, within 50 nautical miles of at least one category three, four, or five hurricane per decade. Even if the frequency of hurricanes does not increase, more federally assisted rental units will likely face high risk as storms continue to intensify.

Table: Federally Assisted Homes' with Risk and Previous Exposure to Hurricanes

Sited in location that is…	Number of Units	Percent of Units
Very high or relatively high hurricane risk rating (NRI)	253,681	5%
Within 50 nautical miles of at least 1 hurricane each decade, on average, since 1990	516,013	10%
Within 50 nautical miles of at least 1 category 3-5 hurricane each decade, on average, since 1990	104,540	2%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to NOAA International Best Track Archive for Climate Stewardship 1900-2019 historical hurricane tracks (2020) and the National Risk Index (2020).

Coastal flooding from storm surges due to tropical storms and hurricanes also puts residents at risk of displacement. The Congressional Budget Office (CBO) estimated residential sector property losses from hurricane and tropical storm-related flooding to be approximately $20 billion per year in 2017 dollars.[28] Based on the NRI, 1.5% of federally assisted units are at very high or relatively high risk of negative impacts from coastal flooding, which could increase as sea levels rise due to climate change. The National Housing Trust and Climate Central estimate that three times as many federally assisted and naturally occurring affordable housing units could be at risk of coastal flooding by 2050 due to sea level rise.[29] This projection would put nearly 5% of federally assisted units at risk of coastal flooding by 2050.

NOAA's coastal flooding zones indicate a greater potential risk of coastal flooding for the federally assisted housing stock than the NRI. More than 475,000 federally assisted rental units, or 9%, are at risk of storm surge from a major – category 3, 4, or 5 – hurricane. Nearly 250,000 units, or 5%, are at risk of storm surge during a Category 1 or 2 hurricane. The higher number of units in NOAA's coastal flooding zones than in NRI high risk areas suggests that many areas in NOAA's coastal flooding zones may not yet have experienced actual flooding-related losses, which are included in the NRI. This gap may close as development along the coast and the severity of coastal storms both increase.

Table Seven: Federally Assisted Rental Homes' Risk and Potential Exposure to Coastal Flooding

Sited in location that …	Number of Units	Percent of Units
At very high or relatively high coastal flood risk rating (NRI)	76,973	1.5%
Could experience coastal flooding in a major (category 3-5) hurricane	470,875	9%
Could experience coastal flooding in a category 1 or 2 hurricane	248,388	5%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to NOAA National Storm Surge Hazard Maps (2018) and the National Risk Index (2020).

Earthquake

Earthquakes cost $6.1 billion annually in damage to the building stock according to USGS and FEMA.[30] According to the NRI, 13% of federally assisted units are located in census tracts with very high or relatively high risk for impacts from earthquakes. More generally, we estimate with USGS data units, that 6% of federally assistance units have a 10% chance of experiencing moderate to heavy damage from ground shaking within 50 years. Retrofitting existing properties to mitigate earthquake damage, such as reinforcing structural walls and supports, is critical where applicable.[31]

Table Eight: Federally Assisted Rental Homes' Risk and Potential Exposure to Earthquakes

Sited in location that…	Number of Units	Percent of Units
Has a very high or relatively high earthquake risk rating (NRI)	646,690	13%
Has a 10% chance of experiencing ground motion that could incur moderate to heavy damage over 50 years	307,608	6%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to USGS National Seismic Hazard Model for the conterminous United States (2018), Alaska Seismic Hazard Model (2007), and the Hawaii Seismic Hazard Model (1998) and the National Risk Index (2020).

Wildfire

The annual cost of wildfires, including preparedness, suppression, evacuation, and losses can range from $71 billion to $341 billion.[32] Only 2% of federally assisted units, however, have a very high or relatively high risk for experiencing a wildfire, according to the NRI. According to the USGS, less than 1% of federally assisted rental units have been within the perimeter of a wildfire since 2000.

Wildland-Urban Interface (WUI) perimeters represent the spatial relationship between housing density and nearby wildland vegetation that can sustain wildfires. Fire spreads more easily in areas with plentiful vegetation for fuel and residential development.[33] Twenty-two percent of federally assisted housing units are in WUIs associated with a higher-than-average risk of fire, three percent of which are in low-density WUIs, where the space between houses and areas of vegetation for fuel are enough to create an even greater risk of exposure to wildfire.[34]

Wildfire season duration and damage appear to be increasing due to climate change, previous wildfire suppression policies, and increased development in vegetated areas or WUI's.[35] Moreover, serious droughts exacerbate wildfire risk. An average of 12% of federally assisted units were located in areas experiencing at least six months of moderate to exceptional drought annually since 2009, and 7% of units were located in areas with severe to exceptional drought. These trends may indicate more federally assisted housing stock will be at risk for wildfire in the future.

Sited in location that …	Number of Units	Percent of Units
Has a very high or relatively high wildfire risk rating (NRI)	94,772	2%
Is in the perimeter of a previous wildfire	2,356	.05%
Is in a Wildland-Urban Interface (WUI)	1,087,736	22%
Is in a low-density WUI	70,060	3%
Has experienced a severe to exceptional drought for half the year each year, on average, since 2009	325,992	7%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched Silvus Lab Wildland-Urban Interface (WUI) Change 1990-2010 Data (2018), National Interagency Fire Center: Historical Wildfire Perimeters 2000-2018 (2020), and the National Risk Index (2020).

Residents of Federally Assisted Housing

Renters living in federally assisted properties tend to have more health and financial challenges than their low-income unassisted renter peers.[36] Federal assistance programs disproportionately serve people of color, older adults, individuals with disabilities, and families with children.[37] Nearly half of householders living in these properties are older adults, living with a disability, or both. Households receiving federal housing assistance also have lower incomes, on average, than their unassisted low-income peers.[38]

Preparedness Among Low-Income Households

Federally assisted renters may find it more difficult to prepare for or evacuate and recover from a disaster due to their limited financial resources and possible health limitations. The American Housing Survey indicates that federally assisted households are less likely than their low-income unassisted peers to have an adequate supply of bottled water, money to cover a short evacuation, or access to a vehicle for evacuation. Only 30% of low-income federally assisted households report having savings or credit card balances to fund evacuation expenses up to $2,000 compared to 48% of low-income unassisted renters. Additionally, only 63% of low-income federally assisted households reported having access to a vehicle to evacuate their family compared to 84% of low-income unassisted renters. They are also less likely than unassisted households to have access to key financial information, a communication plan if phone service is disrupted, an emergency kit, or a predetermined meeting place if household members are separated. With fewer resources for preparedness, federally assisted households are more vulnerable to negative impacts from disasters than their low-income counterparts and other households.

Household has…	Low-Income Federally Assisted Renter Households	Unassisted Low-Income Renter Households	All Unassisted Households, Any Income (renters and homeowners)
3 gallons of water per person	54%	58%	60%***
3 days of non-perishable food	78%	77%	83%***
Access to vital financial information	74%	75%	83%***
Communication plan if cell service disrupted	33%	30%	27%**
Pre-determined meeting location if household members are separated	39%	39%	37%
Access to vehicle	63%	84%***	94%***
Emergency kit	51%	51%	54%*
Evacuation funds of $2,000	30%	48%***	81%**

*PAHRC tabulation of American Housing Survey 2017. Difference between group and assisted renters is statistically significant: * p=<.05 **p<=.01***p<=.001. Low-income is defined as income below 200% of poverty level. In some high-cost areas, assisted renters may have incomes above 200% of the poverty level.*

Residents of Federally Assisted Homes Vulnerable to Displacement

Evidence from hurricanes Harvey, Katrina, and Andrew demonstrate that low-income households and people of color are hit the hardest by severe natural hazards and experience higher long-term displacement rates.[39] These trends likely arise because investments in preparedness and mitigation strategies are lower in communities of color.[40] People of color are more likely to live in older, segregated, and disaster prone areas[41], and have less economic, social, and cultural capital to prepare and respond to a disaster.[42]

Since federally assisted properties disproportionately assist people of color, older adults, and families with children – residents who may have greater vulnerabilities to disasters – we compare the risk of these households relative to other tenants of federally assisted properties, using the NRI. To do so, we identify households in HUD-assisted housing in which the head is a person of color, an older adult (62+ years of age), or has children living in the household. We included in this analysis Public Housing and Section 202, Section 811, and Project-Based (Section 8) Rental Assistance. Resident characteristic data are not widely available for LIHTC, FHA, USDA, or HOME properties. We find that households of color in HUD-assisted housing are more likely than white HUD-assisted households to live in areas with greater risk.

Households of Color

Forty-three percent of HUD-assisted households of color live in areas with very high or relatively high risk of natural hazards, compared to 28% of HUD-assisted white households. Meanwhile, 28% of HUD-assisted households of color live in relatively low or very low risk areas, compared to 46% of white HUD-assisted households. This pattern may be slightly overstated since HUD-assisted properties predominantly serving people of color may be located in more populated areas, which the NRI weights more heavily for risk. Nonetheless, pre-disaster planning, mitigation strategies, and recovery must include marginalized populations to ensure equitable outcomes.

Table: HUD-assisted Households' Risk of Natural Hazards (NRI) by Race/Ethnicity

National Risk Index Rating	Head of household is person of color		Head of household is white	
	Households (1.3M)	Percent	Households (872k)	Percent
Very High	217,155	16%	80,387	9%
Relatively High	359,335	27%	164,656	19%
Relatively Moderate	380,070	29%	228,843	26%
Relatively Low	268,229	20%	244,507	28%
Very Low	104,167	8%	153,883	18%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020) and Picture of Subsidized Households (2020).

Older Adult Households

Older adults living in federally assisted housing have lower levels of mobility and more medical conditions than unassisted low-income older adult households.[43] They may have more difficulty leaving their homes during an evacuation. According to the NRI, 38% of HUD-assisted households with a householder or spouse aged 62 years or older live in census tracts with a very high or relatively high risk of a natural hazard, which is similar to the share of HUD-assisted households with younger householders. Nonetheless, pre-disaster planning and disaster response and recovery should consider the location of older HUD-assisted households given their potentially limited ability to respond to a disaster.

Table: HUD-assisted Households' Risk of Natural Hazards (NRI) by Age

National Risk Index Rating	Head of household or spouse is 62+ years of age		Head of household or Spouse is under 62 years of age	
	Households (1.0M)	Percent	Households (1.2M)	Percent
Very High	137,997	13%	159,539	14%
Relatively High	252,742	25%	271,227	23%
Relatively Moderate	276,814	27%	332,093	28%
Relatively Low	239,555	23%	273,152	23%
Very Low	123,983	12%	134,087	11%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020) and Picture of Subsidized Households (2020).

Households with Children

Low-income families with children may have special concerns during evacuation or potential displacement, such as an adequate supply of infant food and diapering materials and temporary housing with adequate sleeping arrangements. According to the NRI, 36% of HUD-assisted households with children live in census tracts with a very high or relatively high risk of a natural hazard, compared to 38% of those without children.

Table: HUD-assisted Households' Risk of Natural Hazards (NRI) by Presence of Children

National Risk Index Rating	With Children		Without Children	
	Households (637k)	Percent	Households (1.3M)	Percent
Very High	82,983	13%	182,118	14%
Relatively High	145,975	23%	318,069	24%
Relatively Moderate	181,804	29%	356,969	27%
Relatively Low	151,727	24%	299,205	23%
Very Low	75,289	12%	144,070	11%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020) and Picture of Subsidized Households (2020).

Social Vulnerability and Community Resiliency

A community's ability to respond to and recover from a disaster due to a natural hazard depends on the community's resources and capacity of its residents.[44] The NRI's social vulnerability component, which reflects the level of difficulty community residents may face in responding to the negative impacts of a disaster, includes demographic and economic factors like median age of residents, per capita income, poverty rate, percent of female-headed households, and other indicators that represent residents' capacity to prepare for, respond to, and successfully recover from a disaster.[45] Communities with fewer social and economic resources will likely face greater challenges after a disaster. Federally assisted units are more likely to be located in areas of very high or relatively high levels of social vulnerability than rental occupied units in general and owner occupied units. Forty-one percent of the federally assisted housing stock is in census tracts with very high or relatively high levels of social vulnerability compared to 22% of renter occupied units and 13% of owner occupied units.

Table: Federally Assisted Homes, Renter Occupied Homes, and Owner Occupied Homes by Social Vulnerability Index (NRI)

Social Vulnerability Index	Assisted Rental Homes		Renter Occupied Homes		Owner Occupied Homes	
	Number	Percent	Number	Percent	Number	Percent
Very High	211,456	4%	563,489	1%	581,233	1%
Relatively High	1,852,865	37%	9,253,791	21%	9,106,375	12%
Relatively Moderate	1,894,805	38%	16,913,159	39%	26,715,039	35%
Relatively Low	857,505	17%	13,358,788	31%	30,040,153	39%
Very Low	162,701	3%	3,379,836	8%	10,801,371	14%
Data Unavailable	868	0%	12,604	0%	30,210	0%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, American Community Survey 2015-2019 (five-year estimates), matched to the National Risk Index (2020).

The NRI's community resiliency component, which measures the ability of a community to prepare for and respond to a disaster, includes community factors such as social networks, volunteerism, local food supply, disaster training and experience, and evacuation routes, along with social and economic indicators.[46] Forty-two percent of federally assisted homes are in census tracts with very high or relatively high community resiliency. Federally assisted units are slightly less likely to be located in areas of very low or relatively low levels of community resiliency than renter occupied units in general, but are more likely to be in areas with very or relatively low community resiliency than owner occupied units. Twenty-six percent of the federally assisted housing stock is in census tracts with very low or relatively low levels of community resiliency compared to 28% of all renter occupied units and 21% of owner occupied units.

Table: Federally Assisted Homes, Renter Occupied Homes, and Owner Occupied Homes by Community Resiliency Index (NRI)

Community Resiliency Index	Assisted Rental Homes		Renter Occupied Homes		Owner Occupied Homes	
	Number	Percent	Number	Percent	Number	Percent
Very High	653,570	13%	5,177,027	12%	12,087,896	16%
Relatively High	1,461,427	29%	11,635,070	27%	23,651,784	31%
Relatively Moderate	1,593,952	32%	14,363,827	33%	24,726,297	32%
Relatively Low	1,077,391	22%	11,013,524	25%	14,975,775	19%
Very Low	193,813	4%	1,280,289	3%	1,803,881	2%
Data Unavailable	47	0%	11,930	0%	28,748	0%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, American Community Survey 2015-2019 (five-year estimates), matched to the National Risk Index (2020).

Together, the results of the NRI's Social Vulnerability Index and Community Resiliency Index suggest that a significant portion of federally assisted rental housing is in areas where residents may lack the tools to stave off negative impacts of a disaster, like displacement or income shocks. At the same time, a substantial portion of federally assisted housing units are in communities with infrastructure and community supports to aid recovery. These infrastructure supports must reach and aid the most vulnerable and marginalized populations living in these communities. Local planning and emergency management officials can identify federally assisted housing properties and work with the owners of these properties in advance to ensure that residents receive assistance if a disaster threatens the community.

The Risk of Natural Hazards by Federal Housing Program

One-third of the federally assisted housing stock is in census tracts with very high or relatively high risk of negative impacts from natural hazards, according to the NRI. Exposure or potential exposure to natural hazards, however, varies among federal housing programs. Public Housing might be at higher risk due to a history of building it on land not valued by the market.[47] Indeed, 40% of Public Housing units are located in very high or relatively high-risk areas, making it the program with the largest share of its units at risk. Developers utilizing other subsidies, like LIHTC, may also have found it easier to produce affordable rental housing in low-cost areas, potentially more vulnerable to natural hazards or with lower community resilience.[48] Yet, thirty percent of LIHTC units are located in very high or relatively high-risk areas compared to 27% of all rental units in the U.S. Some states have attempted to reduce risk by prioritizing LIHTC development in areas with lower natural hazard exposure.[49] USDA programs have the lowest share of units located in very high or relatively high risk areas.

Table: NRI Risk Rating of Very High or Relatively High by Subsidy Type

	Number of Units	Percent of Units
Low-income Housing Tax Credit (LIHTC) (2.5M)		
Very High/Relatively high	775,784	30%
Project-based Rental Assistance (1.5M)		
Very High/ Relatively High	531,277	35%
Public Housing (947k)		
Very High/Relatively High	374,278	40%
USDA Housing (435k)		
Very High/ Relatively High	31,869	7%
Other HUD-assisted housing (1.6M)		
Very High/ Relatively High	510,913	33%

PAHRC & NLIHC tabulation of NHPD, retrieved 2020, matched to the National Risk Index (2020).

While units subsidized through USDA programs are less likely located in very high or relatively high risk areas, the NRI may underestimate risks in rural communities. The NRI is weighted by previous losses and vulnerability to loss, so that more populated areas will necessarily score higher on the risk factors incorporated into the index. At the same time, the NRI's methodology increases risk scores in low-resourced areas housing more vulnerable populations, like those containing more federally assisted rental properties.

Conclusion and Policy Recommendations

One-third of the federally assisted rental housing stock is located in areas at very high or relatively high risk of natural hazards. This housing, which is the result of major public investments, provides affordable and stable housing to some of the nation's lowest-income renters and is difficult to replace. We must ensure that this housing supply, and the residents who rely upon it, are protected in the face of growing risks.

The bipartisan Reforming Disaster Recovery Act, a bill introduced and passed in the House of Representatives during the 116th Congress, includes key improvements to federal recovery policy that would benefit federally assisted housing. The Act would permanently authorize the Community Development Block Grant – Disaster Recovery (CDBG-DR) program and make important reforms to achieve more equitable disaster recovery and resilience. CDBG-DR is one of the most important federal resources for infrastructure and housing recovery after disasters. Permanently authorizing the CDBG-DR program will expedite the distribution of funds to impacted communities by requiring HUD to allocate CDBG-DR funds within 60 days of approval by Congress. This will help ensure that recovery funds reach federally assisted properties and their residents more quickly and shorten the recovery process.

The Reforming Disaster Recovery Act requires federal recovery dollars to prioritize one-for-one repair or replacement of federally assisted rental housing damaged or destroyed by a disaster, while requiring that the housing rebuilt or substantially repaired using federal recovery dollars in flood-prone areas meets mitigation standards. The Act also requires HUD to release recovery data disaggregated by race, geography, and any classes protected under federal fair housing and civil rights laws. These data will allow community advocates and survivors to hold states accountable for ensuring racial equity during recoveries, including for the residents of federally assisted housing. The Act also requires states to develop plans for compliance with federal fair housing obligations in recovery contexts.

The Disaster Learning and Life Saving Act, a bill reintroduced in the current Congress by Senators Brian Schatz (D-HI) and Bill Cassidy (R-LA), would establish an independent National Disaster Safety Board (NDSB) modeled on the National Transportation Safety Board (NTSB). The NDSB would investigate the underlying causes of disaster-related fatalities and property damage after disasters and make evidenced-based recommendations for all levels of government to improve community resiliency. The NDSB would also include a special office with a focus on mitigating disaster impacts for socially vulnerable populations such as people with low incomes, the elderly, people with disabilities, and communities of color.

A thorough assessment of federal housing programs is needed to determine which properties and populations are most at risk and, consequently, which mitigation strategies might be most needed and effective. For example, at the national level, tornadoes pose the greatest risk to the federally assisted housing stock. Additional mitigation strategies for wind may need to be reviewed and further incentivized through funding mechanisms for the subsidized housing stock. When it comes to flood mitigation, the federal government has already taken important steps. The Biden Administration's recent reinstatement of the Federal Flood Risk Mitigation Standard (FFRMS) will help ensure housing constructed through federal funds is located in areas safe from the future effects of climate change-driven sea level rise. The White House, however, should direct HUD to implement these standards quickly.

Federal agencies could also provide more resources to help local housing providers assess their own risks and access the appropriate mitigation resources. At the same time, templates for business continuity planning and other disaster planning aids could assist local housing providers prepare for future impacts from natural hazards. Resources for resident preparedness are also critical as assisted renters are less likely to be prepared for a disaster than low-income unassisted renters.

At the state and local level, policy and planning can help preserve federally assisted housing after disasters and mitigate risk. LIHTC, the largest federal rental housing production program, is administered by state housing finance agencies (HFAs). HFAs can use their Qualified Allocation Plans (QAP) to incentivize the development of LIHTC projects in census tracts with lower exposure to natural hazards and encourage robust preparedness efforts, while also prioritizing credits for communities hardest hit by disasters. When scoring proposed housing developments for LIHTC awards, for example, Alabama includes points in their QAP for properties with a storm shelter on site, Arizona prohibits tax credit awards in a 100-year flood plain, and Indiana awards points to projects rehabilitating properties left vacant due to disasters.[50]

At the local level, housing providers can engage emergency managers to ensure their residents' needs are considered in pre-disaster planning and mitigation strategies improve disaster resilience for their properties.[51] Likewise, emergency managers can reach out to HUD-assisted and USDA housing providers and homeless shelter and service providers to integrate their residents into current local planning processes and ensure mitigation investments benefit vulnerable communities.

Low-income families living in federally assisted housing properties may be the most vulnerable to displacement or financial hardships after disasters. Continuing to enhance our planning, mitigation, and recovery resources for the federally assisted housing stock is critical to helping these families improve their outcomes after disaster.

Appendix A: Methodology

Methodology: Assessing Vulnerability to Natural Hazards

Natural Hazard	Methodology
Tornado	Tornado point and path data from 1990 to 2019 was obtained from NOAA's SVRGIS Severe Weather Report.[52] Coordinates of tornado start points between 1990 and 2019 were converted to polylines, if necessary, by adding .0001 to the end lat/long coordinates if they were missing an end point. North America Albers Equal Area Conic was used for the mapping using an equal area projection. A fishnet grid of 80km per grid was created over the contiguous 48 states and storm paths were intersected with the grid and then clipped to the 80km grid cells. Storm paths and the grid layer were spatially joined. The joined data was then extracted to calculate the average number of EF0+, EF2+, and EF4+ tornadoes per time period in each grid cell and any storms passing through a grid repeatedly were de-duplicated. These data were then rejoined to the grid cells.

The EF0+, EF2+, and EF4+ tornadoes per time period in each polygon grid cells were then converted to raster grid cells and were smoothed by applying a low pass 3x3 filter. The smoothed raster was converted to points and IDW interpolation was applied (using a cell size of 80km, Power 2, and a fixed radius 360km) to further smooth the data. Contours following NOAA's 30-year severe weather climatology maps were then created from the smoothed raster file[53]. Contours were clipped to the contiguous US boundaries and the layer re-projected to WGS_1984_Web_Mercator_Auxiliary_Sphere. This layer was then spatially joined to NHPD data with point locations of federally assisted housing properties to estimate the number of properties in grids within 25 miles of various storms. This method applies a modified version of the method described in FEMA Benefit-Cost Analysis Reengineering (BCAR): Tornado Safe Room Module Methodology Report[54]. |
| Earthquake | Peak horizontal acceleration (pga) with a 10% probability of exceedance in 50 years (site class D) estimates were obtained from the USGS 2018 National Seismic Hazard Model for the conterminous United States[55], 2007 Alaska Seismic Hazard Model[56], and the 1998 Hawaii Seismic Hazard Model.[57] Estimates for soil type D (rock) are presented in this report because site class B/C (stiff soil) estimates are not available in Alaska and Hawaii. Earthquake peak ground acceleration values were projected using GSC_WGS_1984 as specified by USGS. This point data was converted to .05 degree raster grid cells and contours following USGS probabilistic seismic hazard maps were created. The raster was then re-projected to WGS_1984_Web_Mercator_Auxiliary_Sphere and reclassified as a polygon feature clipped US contiguous boundaries. AK and HI data were then appended to the polygon. This feature was spatially joined to NHPD property locations. Areas with a 10% chance of experiencing pga values exceeding .34g over 50 years were classified as capable of experiencing an earthquake that could incur moderate to heavy damage, |
| Riverine Flooding | National Flood Hazard Layer (NFHL) was obtained from Esri's 2020 USA Flood Hazard Areas map service.[58] The polygon features were re-projected to the WGS_1984_Web_Mercator_Auxiliary_Sphere coordinate system. The features were then spatially joined to NHPD property locations. |

Wildfire	Wildland-Urban Interface (WUI) boundaries for 1990, 2000, and 2010 were obtained through Silvus Lab[59], wildfire perimeters from 2000 to 2018 were obtained by the National Interagency Fire Center[60], and 2020 wildfire hazard potential index were obtained by the USDA.[61] The polygon and raster features were re-projected to the WGS_1984_Web_Mercator_Auxiliary_Sphere coordinate system. The features were then spatially joined to NHPD property locations.
Hurricanes	Hurricane path data from 1990 to 2019 was obtained from NOAA's International Best Track Archive for Climate Stewardship[62] and coastal storm surge estimates by hurricane intensity were obtained from NOAA's 2018 National Storm Surge Hazard Maps.[63] SVRGIS Severe Weather Report.[64] Storm tracks were re-projected to the North America Albers Equal Area Conic coordinate system. 50km grid cells were imported from: https://www.epa.gov/crwu/coastal-storm-surge-scenarios-water-utilities to follow EPA's hurricane frequency map and re-projected to the North America Albers Equal Area Conic coordinate system. A 50 nautical mile buffer was applied to each storm track and spatially joined one to many to identify which grid cells each storm intersected. These data were exported and aggregated by grid cell accounting for duplicate storms (the strongest version of each storm within 50 nautical miles of each grid was counted). They were then joined to the grid layer and re-projected to WGS_1984_Web_Mercator_Auxiliary_Sphere to spatially join to NHPD property locations to estimate the number of properties in grids 50 nautical miles from various storms and the storm surge depth by hurricane intensity.
NRI	National risk index, expected annual loss, social vulnerability, community resilience rating, and individual hazard risk ratings by census tracts were obtained by FEMA's 2020 National Risk Index data[65] and matched to NHPD property locations.

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