FEDERAL RESERVE BANK of NEW YORK

COMMUNITY DEVELOPMENT

FLOOD RISK AND THE TRISTATE HOUSING MARKET

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October 2024

Key Takeaways

- More than 1 in 10 properties in New York, New Jersey, and Connecticut—over 1 million in total—are at serious risk of flooding. These properties rank among the top 25% of riskiest properties nationally, a category that includes homes in coastal Florida, Texas, and Louisiana.
- These properties are home to 1.6 million households, or 4 million people, both renters and owners.
- Flood risk is not just found in coastal communities or in New York City. Inland communities like Buffalo, Syracuse, and Newark face substantial risk from heavy rainfall, flash flooding, and overflowing rivers. This risk has grown in recent years and is projected to continue increasing.
- Some communities face concentrated risk, where nearly all properties are at serious risk of flooding. These include places like Long Beach, NY, and Keansburg, NJ, where 90% of properties are at risk.
- Flooding is costly, involving direct costs like property damage and damaged infrastructure and indirect costs like falling property values, rising insurance premiums, and displacement risk.

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Introduction

Americans are increasingly concerned about the impact of extreme weather on their homes and businesses. From flooding to extreme heat to high wind, between one-half and two-thirds of renters and homeowners are at least somewhat concerned about weather-related events affecting their homes in the next five years, and more than half of homeowners are more concerned than they were five years ago.[1,2,3]

There is good reason for this concern. Three-quarters of homeowners report having felt the impacts of weather-related events in their area over the last five years.[4] More than 18 million rental units are located in areas expected to sustain "substantial losses" due to extreme weather, and more than a third of renters report having experienced weather-related damage to their residences.[5,6] Businesses have also experienced the impact of severe weather. In 2018, 65% of businesses mentioned weather as impacting business results, and in 2023, more than a third of commercial property owners reported damage caused by a natural disaster within the last five years.[7] For communities at substantial risk of natural disasters, property values can decline, which puts pressure on homeowners' balance sheets, investor portfolios, and municipal finances.[8,9,10] Nationally, the average annual damage from billion-dollar disasters has grown from $94 billion in the 2010s to $145 billion between 2020 and 2022.[11] In 2021 alone, almost 15 million homes were affected by climate-related hazards, with $57 billion in damages exerted by just the largest of these hazards.[12]

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[1] Over Half of Homeowners Fear Effects of Climate Change, Including Impact on Home Insurance Costs (https://www.lendingtree.com/insurance/climate-change-survey/)
[2] Homeowners Are Growing More Concerned about the Effects of Severe Weather (https://www.freddiemac.com/research/consumer-research/20221005-homeowners-are-growing-more-concerned-about-effects)
[3] Consumer Concerns with Weather-Related Events and Impact on Insurance Premiums, National Housing Survey Special Topics Report (https://www.fanniemae.com/media/50876/display)
[4] Millennials More Concerned Than Other Generations by Weather-Related Effects on Housing (https://www.freddiemac.com/research/consumer-research/20230602-millennials-more-concerned-than-other-generations-by-weather-related-effects-on-housing)
[5] America's Rental Housing, Joint Center for Housing Studies of Harvard University (https://www.jchs.harvard.edu/sites/default/files/reports/files/Harvard_JCHS_Americas_Rental_Housing_2024.pdf)
[6] Consumer Concerns with Weather-Related Events and Impact on Insurance Premiums, National Housing Survey Special Topics Report (https://www.fanniemae.com/media/50876/display)
[7] Nationwide Survey: Widespread Concern About the Toll of Severe Weather. (https://agentblog.nationwide.com/commercial-insights/general-industries/nationwide-survey-widespread-concern-about-the-toll-of-severe-weather/)
[8] Floodplain Management Plan, Borough of Keansburg, New Jersey (https://keansburgnj.gov/wp-content/uploads/2015/03/2015-Keansburg-Floodplain-Management-Plan_9.28_15_FINAL.pdf)
[9] Impact of Natural Disaster Risk on Property Values (https://www.landgate.com/news/impact-of-natural-disaster-risk-on-property-values)
[10] The consequences of extreme weather on property values and pocketbooks (https://www.bankrate.com/real-estate/extreme-weather-impact-on-real-estate/)
[11] Joint Center for Housing Studies, Improving America's Housing 2023 (https://www.jchs.harvard.edu/sites/default/files/reports/files/JCHS-Improving-Americas-Housing-2023-Report.pdf)
[12] Preserving, Protecting, and Building Climate-Resilient Affordable Housing (https://www.urban.org/sites/default/files/2024-01/Preserving_Protecting_and_Building_Climate-Resilient_Affordable_Housing.pdf)

Recent research demonstrates that these disasters can lead to broad and substantial negative impacts on financial health for both property owners and renters. For both groups, financial strain resulting from disasters includes unexpected borrowing and cash outlays, lost income, and reduced credit scores. In more serious cases, the financial fallout from disasters can include bankruptcy and, for property owners, foreclosure. The effects persist and can even grow over time.[13]

Some of these impacts affect owners and renters similarly: both face health and safety risks, both may be temporarily or permanently displaced, and both may lose access to transportation, childcare, and other amenities. Other impacts vary by renter versus owner status.

For owners, many of the costs are borne directly. The owner will need to pay for reconstruction in the event of damages and will directly bear the cost of flood insurance should the owner purchase it. In the event of a loss in income, owners could experience foreclosure and lose their homes.

For rental properties, it is the building owner who experiences a shock to cash flow, who must pay for reconstruction, and who purchases insurance, though those costs can be passed on, at least in part, to their renters. The renters themselves face unique challenges. It is far less common for rental properties to receive federal recovery funding compared to homeowners, and even when the property receives recovery funding, the owner often has no obligation to continue renting to existing residents or to keep rents unchanged. This, combined with the fact that rents have been found to increase and rental supply has been found to decrease in the wake of natural disasters, puts serious pressure on renters. This explains, in part, why renter status has been found to be a key indicator of disaster vulnerability.[14]

Among property owners, even if a property is not directly hit by extreme weather, requirements to purchase insurance can cost thousands of dollars. For example, households with government-backed mortgages in areas designated as high risk for flooding are required by law to purchase flood insurance. Even for households not required by law to purchase such insurance, mortgage lenders may still require the household to have a policy.[15] Homeowners understand this risk: 7 in 10 households believe that extreme weather will make home insurance more expensive in the coming years.[16]

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[13] Insult to Injury: Natural Disasters and Residents' Financial Health (https://www.urban.org/sites/default/files/publication/100079/insult_to_injury_natural_disasters_2.pdf)
[14] Disasters and the Rental Housing Community (https://www.brookings.edu/wp-content/uploads/2023/09/Disasters-and-the-Rental-Housing_final.pdf)
[15] FEMA, Who's Required to Have Flood insurance? (https://www.floodsmart.gov/am-i-required-have-flood-insurance)
[16] Over Half of Homeowners Fear Effects of Climate Change, Including Impact on Home Insurance Costs (https://www.lendingtree.com/insurance/climate-change-survey/)

These financial risks and burdens are especially concerning for low- and moderate-income (LMI) households, many of whom are renters. LMI individuals and families are already more likely to live in inadequate housing that needs updates and retrofits and are already spending a larger share of their income on basic home maintenance.[17] Even absent a disaster, the deteriorating quality of the housing and equipment serving LMI households threatens their health and safety and puts the stock of affordable housing at risk.[18] When disaster does strike, LMI households are hit harder and spend a larger share of their income on repairs and recovery.[19,20] They also face serious risk of displacement and higher rents.[21,22]

Building on previous research,[23,24] this report analyzes the impacts of one of the most common extreme weather events in New York, New Jersey, and Connecticut: flooding. Flood risk has substantial implications for the economic well-being of households and the region. The direct costs of flooding include tens of thousands of dollars of property damage and financial hardship for households,[25,26] hundreds of millions to billions of dollars in damages to infrastructure,[27] and lost jobs and shuttered businesses.[28,29] Just the risk of flooding can present a financial burden for households due to rising premiums for flood insurance.[30] At the community level, the risk can also

[17] Improving America's Housing 2023 (https://www.jchs.harvard.edu/sites/default/files/reports/files/JCHS-Improving-Americas-Housing-2023-Report.pdf)
[18] Ibid.
[19] Ibid.
[20] Insult to Injury: Natural Disasters and Residents' Financial Health (https://www.urban.org/sites/default/files/publication/100079/insult_to_injury_natural_disasters_2.pdf)
[21] Disasters and the Rental Housing Community (https://www.brookings.edu/wp-content/uploads/2023/09/Disasters-and-the-Rental-Housing_final.pdf)
[22] New Research Reveals Disasters Lead to Higher Rents in Impacted Areas; HUD Long-Term Disaster Recovery Assistance Slows Post-Disaster Rent Growth (https://www.nlihc.org/resource/new-research-reveals-disasters-lead-higher-rents-impacted-areas-hud-long-term-disaster)
[23] Flooding Impacts on Household Finances: Insights from Focus Groups in New York City (https://www.newyorkfed.org/outreach-and-education/climate/flooding-impacts-on-household-finances-insights-from-focus-groups-in-new-york-city)
[24] Flood Risk and Basement Housing in New York City: The Impact of Extreme Weather on Vulnerable Housing Stock (https://www.newyorkfed.org/outreach-and-education/climate/flood-risk-and-basement-housing-in-new-york-city)
[25] Ibid.
[26] Flooding Impacts on Household Finances: Insights from Focus Groups in New York City (https://www.newyorkfed.org/outreach-and-education/climate/flooding-impacts-on-household-finances-insights-from-focus-groups-in-new-york-city)
[27] The 4th National Risk Assessment (https://assets.firststreet.org/uploads/2021/11/The-4th-National-Risk-Assessment-Climbing-Commercial-Closures.pdf) & The Cost of Climate (https://firststreet.org/research-library/the-cost-of-climate)
[28] Expecting Floods: Firm Entry, Employment, and Aggregate Implication (https://www.nber.org/system/files/working_papers/w30250/w30250.pdf)
[29] The Impact of Flood Hazards on Local Employment (https://www.researchgate.net/publication/24068523)
[30] How Much Does Flood Insurance Cost? (https://www.forbes.com/advisor/homeowners-insurance/flood-insurance-cost/)

lead to broad-based declines in property values, which can have serious implications for household finances, investor portfolios, and municipal budgets.[31,32,33]

To assess the at-risk housing stock, we use CoreLogic Climate Risk Data, which contain structure-level data on climate risk for properties in the United States. We assess the overall size of the at-risk housing stock, the characteristics of at-risk census tracts, and which cities and towns are most at risk. We also examine four case studies of places that illustrate the risks that communities face. These include Keansburg and Hoboken in New Jersey and Syracuse and Brooklyn in New York.

Sizing the At-Risk Housing Stock

To assess risk, we use a measure in the CoreLogic data called average annual loss (AAL). AAL is the average total loss value, as a share of insurable value, caused by a climate peril to a structure in a given year and under a given climate scenario.[34] In our analysis, AAL represents the damage a property can expect to sustain in a given year due to flooding, as a share of that property's insurable value, which CoreLogic defines as the cost of reconstruction.[35]

We find that in New York, New Jersey, and Connecticut, there are over 2.1 million properties with an AAL over the national 50th percentile, over 1 million properties with an AAL over the national 75th percentile (our definition of at risk), and almost 460,000 properties with an AAL over the national 90th percentile.[36] In other words, over 1 million properties in New York, New Jersey, and Connecticut—1 in every 10—have a flood risk greater than three-quarters of all properties that face flood risk nationwide, including households in coastal states like Florida and Louisiana.

[31] Floodplain Management Plan, Borough of Keansburg, New Jersey (https://keansburgnj.gov/wp-content/uploads/2015/03/2015-Keansburg-Floodplain-Management-Plan_9.28_15_FINAL.pdf)
[32] Impact of Natural Disaster Risk on Property Values (https://www.landgate.com/news/impact-of-natural-disaster-risk-on-property-values)
[33] The consequences of extreme weather on property values and pocketbooks (https://www.bankrate.com/real-estate/extreme-weather-impact-on-real-estate/)
[34] Our analysis uses 2023 for the year and what CoreLogic considers the "base" scenario.
[35] The cost of reconstruction differs from market value. As CoreLogic describes it: "Market value is the estimated price at which a property would be sold on the open market between a willing buyer and seller under all conditions for a fair sale. Replacement cost is the estimated cost to construct, at current prices, a property worth the amount of the property being appraised." Reconstruction cost does not include the cost of land, whereas market value does, as a key example of their difference. (https://www.corelogic.com/intelligence/market-value-vs-replacement-cost/)
[36] To determine whether a given property is at risk, we compare the AAL for that property with the AAL of all structures of that property type with non-zero AALs nationwide. To illustrate, imagine an apartment building called Building A. To assess the relative risk of Building A, we take all apartment buildings nationally, remove those with AALs equal to zero, and then compare Building A's AAL to these non-zero values. We can then determine into which percentile of loss Building A falls.

	AT-RISK PROPERTIES	TOTAL PROPERTIES	SHARE AT-RISK* (%)
Multifamily	155,078	1,108,731	14.0
Nonresidential**	126,681	913,035	13.9
Single Family	784,682	6,528,018	12.0
Total	1,066,441	8,549,784	12.5

* At risk is defined as having an AAL over the national 75th percentile of AAL.
** The "nonresidential" row includes the following categories: commercial, hotels/motels, commercial condominiums, retail, service, office buildings, warehouses, financial institutions, hospitals, parking, amusement-recreation, industrial, industrial light, industrial heavy, transport, utilities, agricultural, miscellaneous, and exempt. We exclude vacant properties.
Source: Estimates generated using CoreLogic Climate Risk data.

We estimate that these 1 million at-risk properties are home to over 1.6 million households. We estimate that this translates to over 4 million people who live in properties at serious risk of flooding.[37]

While single-family properties represent the majority of properties at risk, given that multifamily buildings house multiple households, the breakdown of households and people at risk is more balanced across building types. We estimate that there are around 850,000 households and just below 2.1 million people living in at-risk multifamily properties, compared to around 780,000 households and just below 2 million people in at-risk single-family properties.

	AT-RISK HOUSEHOLDS*	TOTAL HOUSEHOLDS	SHARE AT-RISK** (%)
Multifamily	851,195	5,835,035	14.6
Single Family	784,682	6,528,018	12.0
Total	1,635,877	12,363,053	13.2

* Household values are imprecise estimates that we calculate rather than directly observe.
** At risk is defined as the property having an AAL over the national 75th percentile of AAL.
Source: Estimates generated using CoreLogic Climate Risk data, American Community Survey (5-year, 2022, 2020 for CT), New York City Department of City Planning Primary Land Use Tax Lot Output (PLUTO) data.

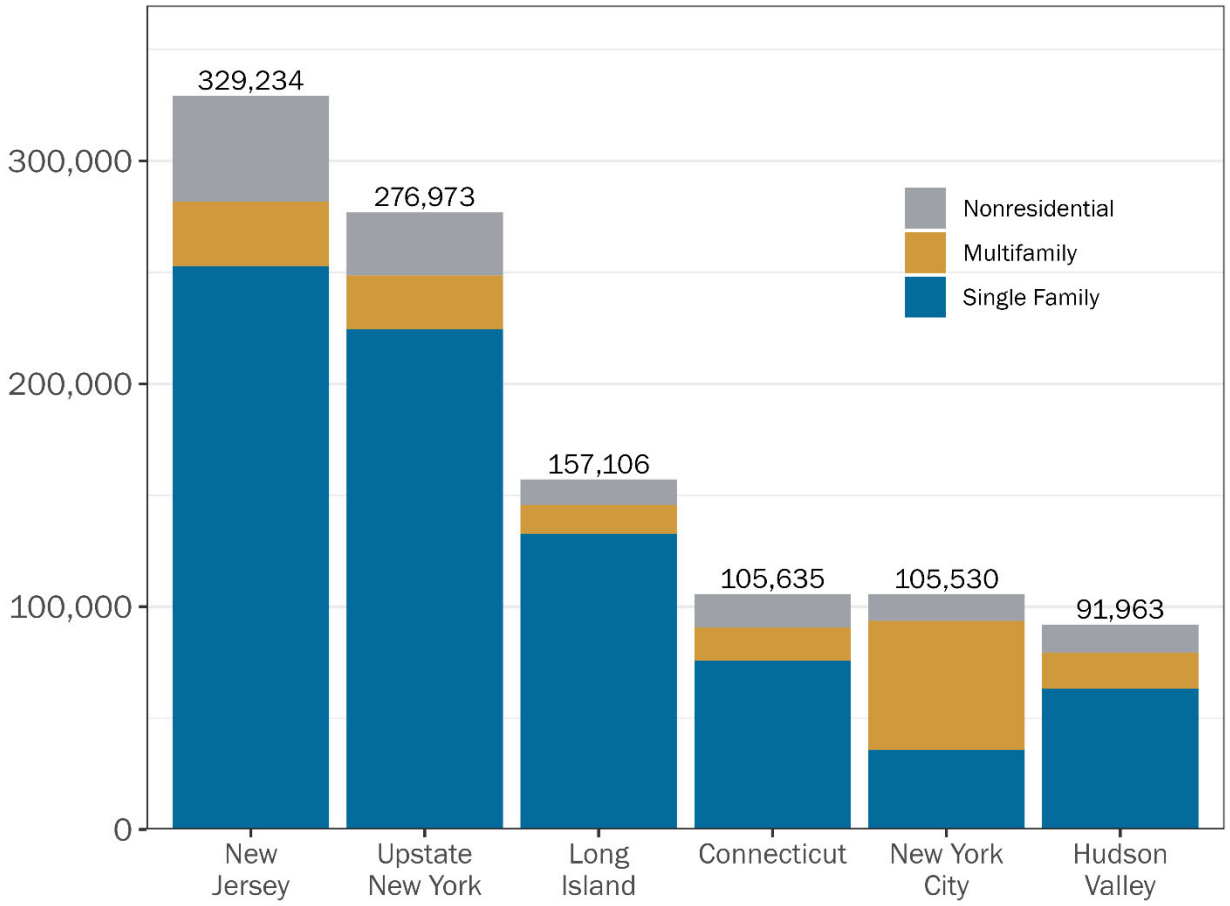
[37] To estimate the number of households and people at risk, we generate an estimate of households per property, by property type. We assume one household per unit of single-family housing. For multifamily properties, we use the 5-year American Community Survey (2022, 2020 for Connecticut) to estimate the number of multifamily buildings and the number of units within multifamily buildings in New Jersey, Connecticut, New York City, and New York excluding New York City. We divide the number of units by the number of buildings to estimate the number of units per multifamily building in each of these geographic areas. As with single-family homes, we assume one household per unit. To estimate the total number of households at risk, we multiply the number of buildings at risk by the estimated number of households in that given building type. For example, we estimate that there are just under 8 units per multifamily property in Connecticut. We then multiply each at-risk multifamily property in Connecticut by 8 to estimate the number of at-risk households. To estimate the number of people, we multiply the number of households by the estimated number of people per household from the 5-year ACS. We do this at the tract level. For example, if a given tract in Connecticut has 5 multifamily properties at risk, we would estimate that 40 multifamily units in that tract are at risk. If the ACS tells us that in that tract each household contains 3 people, we would estimate that 120 people are at risk.

At-risk properties are spread across New York, New Jersey, and Connecticut. While coastal flood risk in New York City and New Jersey is substantial, riverine flooding and flash flooding from heavy rainfall affect communities throughout the region, including inland communities in the central and northern regions of New York.[38]

Different areas of the region have different property types most commonly at risk. For example, in Connecticut and Long Island, most of the at-risk properties are single-family homes. In New York City, by contrast, most of the at-risk properties are multifamily properties.

Hundreds of thousands of properties are at risk across New York, New Jersey, and Connecticut

Number of properties at risk (AAL above national 75th percentile)



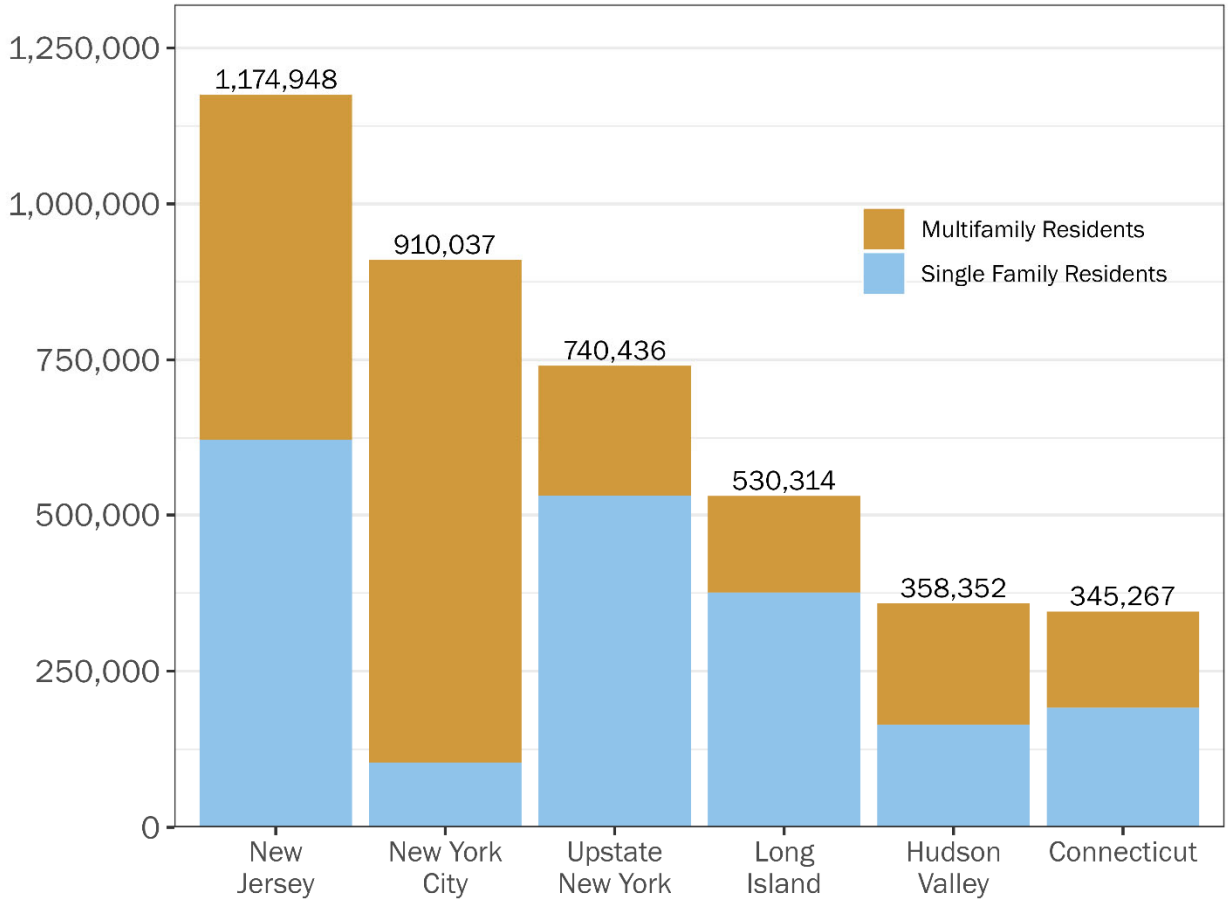
Source: Estimates generated using CoreLogic Climate Risk data.

[38] New York City is defined as the five boroughs: Manhattan, Bronx, Queens, Brooklyn, and Staten Island. Long Island is defined as Nassau and Suffolk counties. Hudson Valley is defined as Putnam, Rockland, Westchester, Dutchess, Orange, Ulster, Columbia, Rensselaer, Albany, Greene, and Sullivan counties. Upstate counties are all remaining counties in New York.

While the number of properties at risk in New York City is relatively low, this is largely due to the concentration of multifamily properties in the city. When looking at the number of households and people living in at-risk properties by region, New York City is second only to New Jersey in the number at risk.

Millions of people face flood risk across New York, New Jersey, and Connecticut

Number of people at risk (property in which they reside has an AAL above national 75th percentile)



Source: Estimates generated using CoreLogic Climate Risk data, New York City Department of City Planning Primary Land Use Tax Lot Output (PLUTO) data, American Community Survey (5-year, 2022, 2020 for CT).

Overall, more than 2.5 million people in the state of New York, nearly 1.2 million people in New Jersey, and almost 350,000 people in Connecticut live in at-risk properties. These include homeowners in single-family homes and renters in apartment buildings that range in size from a couple of units to thousands.

	AT-RISK* PROPERTIES	AT-RISK** HOUSEHOLDS	AT-RISK PEOPLE
Connecticut	105,635	139,026	345,267
New Jersey	329,234	507,158	1,174,948
New York	631,572	989,692	2,539,139

* At risk is defined as the property having an AAL over the national 75th percentile of AAL.
** Household and people values are imprecise estimates that we calculate rather than directly observe.
Source: Estimates generated using CoreLogic Climate Risk data, American Community Survey (5-year, 2022, 2020 for CT), New York City Department of City Planning Primary Land Use Tax Lot Output (PLUTO) data.

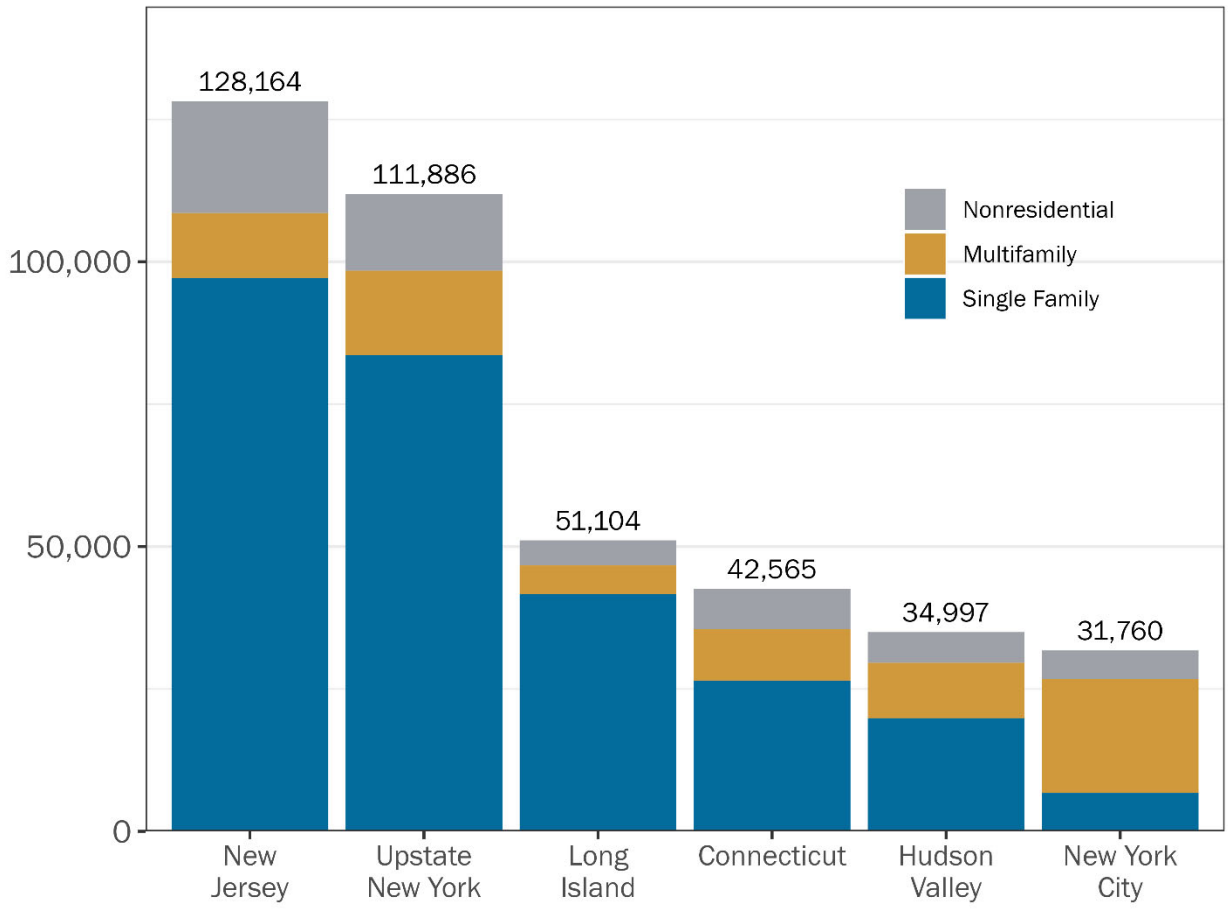
Research shows that while flooding negatively affects all households, low- and moderate-income households are often hit hardest while simultaneously being least prepared to bear the burden.[39] We find that of the more than 1 million properties that are at risk in New York, New Jersey, and Connecticut, 40%, or over 400,000, are in low- to moderate-income census tracts across the region.[40]

Two-thirds of at-risk properties in these low- to moderate-income communities are single-family residences. However, there are a sizable number of at-risk multifamily properties as well, particularly in New York City and the Hudson Valley. Overall, the share of at-risk properties that are multifamily is higher in low-income communities compared to higher-income communities.

[39] Insult to Injury: Natural Disasters and Residents' Financial Health (https://www.urban.org/sites/default/files/publication/100079/insult_to_injury_natural_disasters_2.pdf)
[40] For this calculation, we define an LMI census tract as one in which the median household income is less than 80% of the median household income for its respective metropolitan statistical area.

Hundreds of thousands of at-risk properties sit within low- to moderate-income census tracts

Number of properties at risk (AAL above national 75th percentile) in LMI census tracts

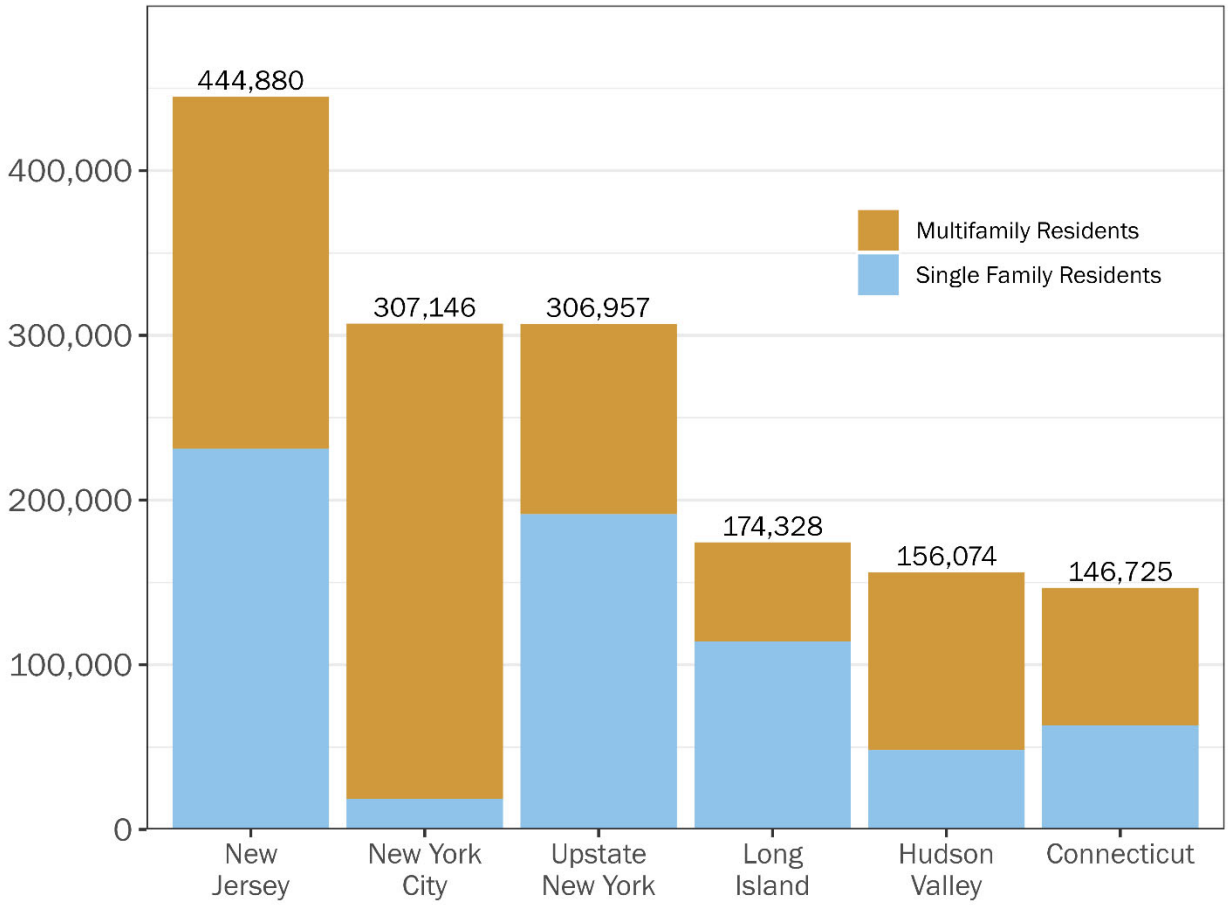


Source: Estimates generated using CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, American Community Survey (5-year, 2022, 2020 for CT), HUD Office of Policy Development and Research Section 8 Income Limits.

We estimate that these at-risk properties located in low- to moderate-income communities are home to over 630,000 households and over 1.5 million people. These households live across the region, from central New Jersey to upstate New York to Long Island. In other words, it is not just low-income households in New York City that are facing risk from flooding; there are thousands of LMI households living in inland communities at risk of flooding from overflowing rivers and heavy rainfall.

More than a million people live in at-risk properties that sit within low- to moderate-income census tracts

Number of people at risk (property in which they reside has an AAL above national 75th percentile) in LMI census tracts



Source: Estimates generated using CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, New York City Department of City Planning Primary Land Use Tax Lot Output (PLUTO) data, American Community Survey (5-year, 2022, 2020 for CT), HUD Office of Policy Development and Research Section 8 Income Limits.

Characterizing At-Risk Census Tracts

CoreLogic data are limited in terms of available property-level housing and resident characteristics. However, we can assess the characteristics of the tracts in which these properties are located. To do so, we label a tract "at risk" if more than 13% of the properties within the tract are at risk.[41]

We find that there are almost 3 million housing units in these at-risk tracts. Almost 1.7 million of these units are occupied by owners, while 1.3 million are occupied by renters. The share of

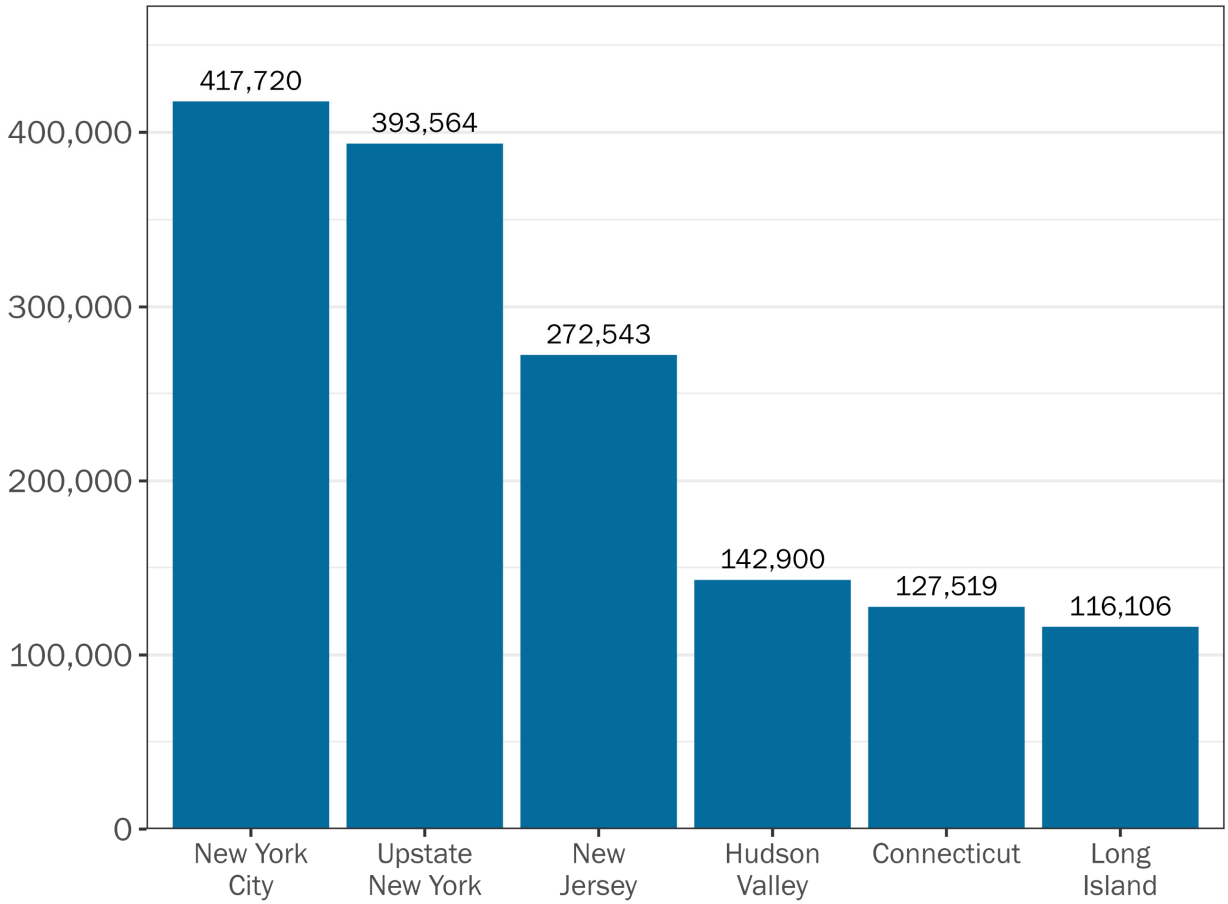
[41] The threshold of 13% is the cutoff for the 75th percentile of tracts in terms of share of buildings at risk in New York, New Jersey, and Connecticut. In other words, these are the top 25% of tracts with the greatest share of properties at risk in the region. We define a building as "at risk" if the average annual loss is greater than 75% of similar properties nationwide.

households that rent in these at-risk tracts—44%—is similar to the share in tracts that are not at risk, where 41% of households rent. The average age of these housing units is also similar across at-risk and not-at-risk-tracts, at 63 years old and 65 years old, respectively.

Household median income is lower in at-risk census tracts, at $78,000, compared to $88,000 in not-at-risk tracts. We estimate that there are almost 1.5 million LMI households in at-risk tracts distributed across the region, including inland communities in Upstate New York, the Hudson Valley, and New Jersey.[42] In fact, there are nearly as many low- and moderate-income households residing in at-risk tracts in upstate New York as there are in New York City.

Low- to moderate-income households are found in at-risk tracts across the region

Number of LMI households in at-risk census tracts, by region



Data: CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, American Community Survey (5-year, 2022, 2020 for CT), HUD Office of Policy Development and Research Section 8 Income Limits.

[42] Using the 5-year American Community Survey (2022, 2020 for Connecticut) and HUD Section 8 income thresholds data, we count a household as LMI if the household income is lower than 80% of the median income of the metropolitan statistical area. The ACS gives household income in a range (e.g., $30,000-34,999), so we take the median of the range as the household income.

Place-Based Analysis

While property- and tract-level analyses are useful to generate aggregate estimates, we also want to understand which cities, towns, and villages are most at risk. To do so, we connect each structure to the census place (city, town, etc.) within which it is located.[43] We then look at the number of total households and LMI households at risk in each place.[44]

Top 20 Places in New York, New Jersey, and Connecticut by Households at Risk

RANK	PLACE	HOUSEHOLDS AT RISK*	RANK	PLACE	HOUSEHOLDS AT RISK
1	**Brooklyn, NY**	**156,286**	11	**Stamford, CT**	**10,098**
2	**Queens, NY**	**119,848**	12	**Yonkers, NY**	**8,724**
3	**Manhattan, NY**	**86,551**	13	**Toms River, NJ**	**8,036**
4	**Bronx, NY**	**46,466**	14	**Bridgeport, CT**	**5,968**
5	**Jersey City, NJ**	**18,723**	15	**Cheektowaga, NY**	**5,852**
6	**Hoboken, NJ**	**14,598**	16	**Freeport, NY**	**5,837**
7	**Long Beach, NY**	**13,776**	17	**Troy, NY**	**5,745**
8	**Staten Island, NY**	**13,743**	18	**Oceanside, NY**	**5,526**
9	**Atlantic City, NJ**	**12,967**	19	**Syracuse, NY**	**5,253**
10	**Buffalo, NY**	**10,153**	20	**Norwalk, CT**	**5,141**

* Certain census places may overlap/share census tracts. As a result, these numbers should not be added to calculate state-wide values.
Source: Estimates generated using CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, American Community Survey (5-year, 2022, 2020 for CT).

The high population of major cities in the region, including New York City and Buffalo, means that they appear in this list despite having overall risk that varies from slightly below to slightly above average. Other cities, including Hoboken, Troy, and Oceanside, are relatively small, but have such elevated flood risk that the number of at-risk households is nonetheless high. Finally, while many such communities are too small to be included in this top 20 list— often home to just a few thousand residents— there are dozens of places where nearly every household is at risk of flooding. Long Beach is one of the largest of such communities, with over 90% of its 14,000 households at risk.

[43] Census places can be cities, towns villages, or "census designated places" (CDP) (https://mcdc.missouri.edu/applications/docs/maggot2022.html#place).
[44] For a given place, we use the following method to determine the number of households and LMI households at risk. For each tract within the place, we take the total number of households and LMI households and multiply it by the share of residential properties at risk in that tract. For the LMI households at-risk estimate, this is an imperfect proxy based on the assumption that LMI households are equally distributed across residential buildings within a tract. For each tract, this gives us an estimate of the number of at-risk households and LMI households, which we then aggregate up to the place level.

Keansburg in New Jersey and Island Park in New York are additional examples of such communities where flood risk is nearly ubiquitous.

The driver of risk differs across places. In some, like Keansburg, coastal risk from the Atlantic is of greatest concern (though riverine flooding and flooding from rainfall are also concerns). In others, like Syracuse, the concern is mostly about rainfall and flash flooding. In still others, like Brooklyn, different neighborhoods experience different sources of risk. We discuss this variety of flood risk in more detail in our case studies.

While the raw number of households at risk is an important indicator, the number of households that are both at high risk of flooding and have low to moderate incomes is also critical. These are the households most likely to experience flooding and the least equipped financially to handle it.

Top 20 Places in New York, New Jersey, and Connecticut by LMI Households at Risk

RANK	PLACE	LMI HOUSEHOLDS AT RISK*	RANK	PLACE	LMI HOUSEHOLDS AT RISK
1	**Brooklyn, NY**	**83,311**	11	**Toms River, NJ**	**4,311**
2	**Queens, NY**	**55,970**	12	**Bridgeport, CT**	**4,215**
3	**Manhattan, NY**	**36,109**	13	**Stamford, CT**	**4,057**
4	**Bronx, NY**	**29,252**	14	**Syracuse, NY**	**3,934**
5	**Atlantic City, NJ**	**9,308**	15	**Troy, NY**	**3,931**
6	**Buffalo, NY**	**7,211**	16	**Paterson, NJ**	**3,576**
7	**Long Beach, NY**	**6,825**	17	**Hoboken, NJ**	**3,564**
8	**Staten Island, NY**	**5,793**	18	**Cheektowaga, NY**	**3,503**
9	**Yonkers, NY**	**5,498**	19	**Newark, NJ**	**3,495**
10	**Jersey City, NJ**	**5,188**	20	**Freeport, NY**	**3,407**

* Certain census places may overlap/share census tracts. As a result, these numbers should not be added to calculate state-wide values.

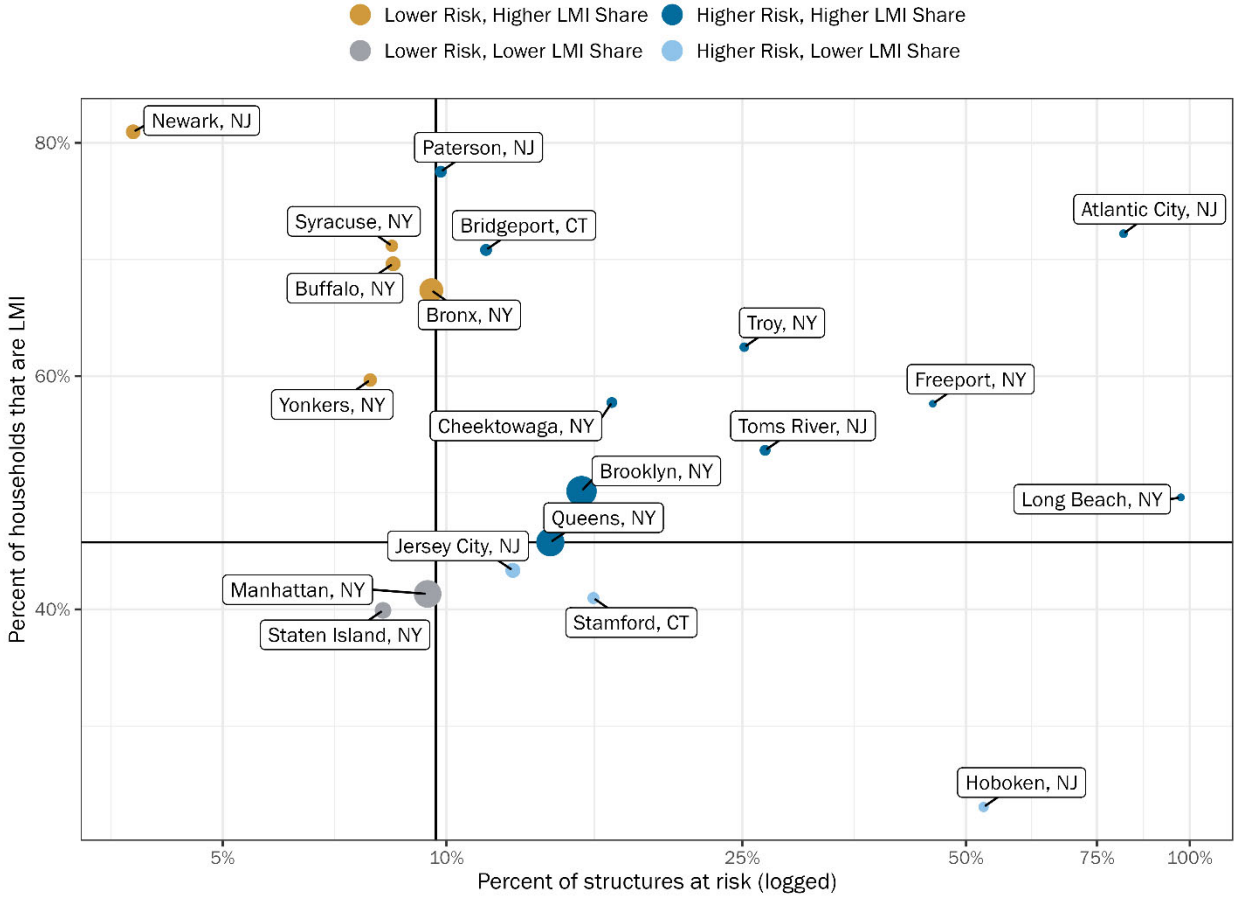
Source: Estimates generated using CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, American Community Survey (5-year, 2022, 2020 for CT), HUD Office of Policy Development and Research Section 8 Income Limits.

As with the top 20 places by total households at risk, there is variation among places by low- to moderate-income households at risk. Unsurprisingly, the list includes places like Long Beach, NY, which is a relatively small town where nearly half of households are LMI and over 90% of buildings are at risk. It also includes places with relatively low risk, like Newark; places with relatively low shares of LMI households, like Hoboken; and even places with relatively low risk and low shares of LMI households, like Manhattan.

This range of places is by design. Some places may not be at high risk relative to others but have such a high concentration of LMI households that even the smaller risk translates to many LMI households facing flooding (Newark). Other places may not have a large LMI population but have such high flood risk that of the LMI households that do live there, most are at risk (Hoboken). Other places simply have such a high population that even with relatively low risk and a low share of LMI residents, there is still a high raw number of LMI households at risk (Manhattan).

Percent of structures at risk versus share of households that are low- to moderate-income

Top 20 places by LMI households at risk, size of point based on total households in place. Vertical line shows median percent of structures at risk across all places. Horizontal line shows median share of LMI households across all places. X axis is logged.



Data: CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, American Community Survey (5-year, 2022, 2020 for CT), HUD Office of Policy Development and Research Section 8 Income Limits.

These places can be divided into four categories across two dimensions: level of risk and portion of population that is low to moderate income. We labeled a place as high risk if it had a higher share of structures at risk than the median place, and we labeled a place as high LMI if its share of LMI

residents was higher than the median place. Note that even those places in the "Lower Risk, Lower Share of LMI Residents" category have a high *raw* number of residents at risk.

Categorizing Communities by Flood Risk and LMI Household Share

	Lower Share of LMI Residents	Higher Share of LMI Residents
Lower Risk	*Manhattan, NY* *Staten Island, NY*	*Newark, NJ* *Syracuse, NY*
Higher Risk	*Hoboken, NJ* *Stamford, CT*	*Brooklyn, NY* *Keansburg, NJ*

Data: CoreLogic Climate Risk data, Missouri Census Data Center Geocorr 2022, American Community Survey (5-year, 2022, 2020 for CT), HUD Office of Policy Development and Research Section 8 Income Limits.

How stakeholders in these communities think about and address flood risk will likely differ based on these categories. Leaders in places with more resources, fewer LMI households as a share of total population, and less risk may aim for more targeted interventions funded via municipal resources, whereas leaders in places with widespread risk and many LMI households may look for more broad-based infrastructural investments funded, at least in part, by state or federal grants. While a deep analysis of these dynamics is outside the scope of this report, we examine four case studies.

Case Studies

To help illustrate what this risk looks like on the ground and to highlight measures that communities are implementing to mitigate that risk, we examined four communities in greater detail: Keansburg and Hoboken in New Jersey and Syracuse and Brooklyn in New York. We chose these locations to demonstrate how flood risk impacts a range of communities across dimensions such as population and geographic size, coastal versus inland location, and socioeconomic status.

Keansburg, New Jersey

KEANSBURG, NEW JERSEY	
Population[45]	9,648
Number of households	3,853
Households at risk	3,398
LMI households	2,668
LMI households at risk	2,377

Keansburg is a borough in Monmouth County in New Jersey. It is a relatively small and primarily residential coastal community, with a population just below 10,000 people and a total area of just one square mile, most of it low-lying. To the north of the town is the Raritan Bay and to the west is Waackaack Creek. Given the flood-prone nature of both the bay

[45] 2023 population estimate, Census (https://www.census.gov/quickfacts/fact/table/keansburgboroughnewjersey/COM100220)

and the creek, around 98% of the land in Keansburg is located within a flood hazard zone. The local government has identified flood risk from surface runoff, tidal events, nor'easters, hurricanes, and tropical storms. This risk is compounded by tidal action in Raritan Bay and nuisance flooding during rain events, especially those that take place during high tide. In the 2015 Floodplain Management Plan, the local government highlighted that flooding is a regular occurrence when it rains during high tide.[46]

Taken together, this means that almost all the properties in the borough fall within a 100-year floodplain. This was felt painfully when the area was struck by Superstorm Sandy in 2012, which inundated 50% of properties in the municipality. In the years following the storm, the borough sustained a 5.3% fall in home values and tax revenue: in all, almost 1,300 properties declined in value.[47]

Much of the borough is also classified as a "repetitive loss area," meaning that properties in the area have had two or more claims of more than $1,000 paid by the National Flood Insurance Program within a 10-year period. The average payout per loss for one of these properties was over $28,000 in 2018, and the average total payout across all losses was nearly $60,000.[48]

Our data provide further evidence of the challenging position the municipality finds itself in. Nine out of 10 households are at risk of flooding, totaling almost 3,400 households, 2,400 of which are LMI. Communities like Keansburg face *concentrated risk*, meaning that even if the total number of households at risk is smaller than in densely populated areas like Brooklyn, nearly everyone faces the prospect of flooding. In places with concentrated risk, mitigation and resilience can take on an almost existential importance.

The local government is aware of these issues and has embarked on a series of measures to address the risk. While a holistic accounting of these measures can be found in the 2015 Floodplain Management Plan, specific examples include maintaining and improving the borough drainage system; elevating 2,500 homes to higher standards and elevations; flood proofing existing stormwater pumps and adding additional ones; and developing a geographic information system (GIS) program to assess flood risk and catalogue infrastructure, both for public awareness and to inform local policymakers.[49]

[46] Floodplain Management Plan (https://keansburgnj.gov/wp-content/uploads/2015/03/2015-Keansburg-Floodplain-Management-Plan_9.28_15_FINAL.pdf)
[47] Ibid.
[48] Ibid.
[49] Ibid.

Government officials acknowledge that "not all activities can be completed immediately based on available funds" and that, as a result, they will "initially focus on those projects that are economically feasible and will aid in the recovery and resiliency of the Borough."[50] In addition, in light of limited funding and substantial need, leaders in the community have broken projects down into the following categories: high priority, medium priority, and low priority. High-priority projects are crucial, highly cost effective, and have funding that is either already secured or likely to be secured in the near future. Medium-priority projects are necessary and relatively cost effective, but funding is not yet secured and may be somewhat challenging to obtain. Low-priority projects are helpful, with benefits at least matching costs, but they are not as critical and/or funding may be particularly difficult to obtain. Projects already in the works are categorized as ongoing. For funding sources, Keansburg takes an "all-of-the-above" approach, funding projects with federal and state grants, FEMA programs, and borough general funds.

Select Projects in Keansburg

PROJECT	PRIORITY	FUNDING SOURCE(S)
Update the Floodplain Management Plan	**High**	**New Jersey Department of Community Affairs Grant**
Elevate 2,500 homes within the Borough to higher standards and elevations	**Medium**	**FEMA Hazard Mitigation Grant and FEMA Increased Cost of Compliance Grant; NJ Reconstruction, Rehabilitation, Elevation and Mitigation Program Grant**
Maintain and improve borough drainage system	**Ongoing**	**Borough General Funds**

Source: 2015 Keansburg Floodplain Management Plan

These lessons may be helpful for other similarly situated communities. When the need for investments outstrips available funding, it can be helpful to identify projects where the impact of co-benefits like economic development is high; prioritize projects based on need, feasibility, and available funding; and take an all-of-the-above approach to funding sources.

[50] Ibid.

Hoboken, New Jersey

HOBOKEN, NEW JERSEY	
Population[51]	57,010
Number of households	27,879
Households at risk	14,598
LMI households	6,429
LMI households at risk	3,564

Hoboken, home to over 57,000 people in just 1.25 square miles, is one of the most densely populated cities in the United States.[52] It is also one of the most at risk for flooding. By our estimates, around half of all households in the city are at high risk of flooding, including over 3,500 LMI households. The areas containing properties that are owned by the Hoboken Housing Authority are at particular risk. This is critical, given that the residents there are largely low income and/or elderly and thus particularly vulnerable to natural disasters.[53]

This risk flows from two areas: coastal flooding and inland flooding. The former is due to storm surges and high tides, and the latter is due to rainfall (typically coinciding with high tide). New Jersey's Department of Environmental Protection has identified several factors that contribute to this risk: low topography and proximity to waterways, impervious surface coverage (around 94% of Hoboken's surface is impervious due to buildings and paved areas), relatively old sewer infrastructure, and insufficient discharge.[54]

As in Keansburg, Superstorm Sandy made the severity of flood risk in Hoboken clear. Over half of the city (including more than two-thirds of low-lying areas) was flooded for weeks, with emergency services severely restricted, residents evacuated, and the National Guard deployed. Daily life was heavily impacted; power was not fully restored for weeks and the PATH station at Hoboken Terminal was not fully restored for several months. Private damages in the city totaled as much as $100 million, and public damages amounted to $10 million.[55]

In response to the storm, the Department of Housing and Urban Development (HUD) launched the Rebuild By Design competition, which encouraged teams to develop resiliency solutions that could help affected regions.[56] One winning proposal was the Resist, Delay, Store, and Discharge proposal for Hoboken (and some portions of neighboring Jersey City and Weehawken). The Resist portion of the plan calls for the construction of barriers and other interventions to improve resilience and reduce the magnitude and frequency of coastal flooding. The Delay, Store, and Discharge portion aims to improve the city's ability to capture, store, and discharge water into the Hudson. HUD

[51] 2023 population estimate, Census (https://www.census.gov/quickfacts/fact/table/hobokencitynewjersey/COM100222)
[52] Hoboken Ranked Third-Most Densely Populated City in America (https://thedigestonline.com/nj/hoboken-most-densely-populated-city/)
[53] Ibid.
[54] Rebuild By Design Hudson River: Resist, Delay, Store, Discharge: Scoping Document (https://dep.nj.gov/wp-content/uploads/floodresilience/attachment-1-scoping-document-rbd-hr-feis.pdf)
[55] Ibid.
[56] This program is now a national program, with projects around the country. (https://rebuildbydesign.org/)

awarded New Jersey $230 million to implement the "Resist" portion of the plan, and the city and its partners are advancing the "Delay, Store, and Discharge" portions.[57]

On the ground, the Resist portion of the plan combines "hard infrastructure," such as walls and floodgates, with "soft infrastructure," such as landscaping and park improvements.[58] Hoboken has already completed major work on this front, with the city completing a sewer separation modification project in July 2022, which separated the stormwater and sanitary sewer lines. Upcoming work on the project includes constructing almost 10,000 linear feet of floodwall, installing 28 floodgates, and improving Harborside Park.[59] Overall, the city anticipates that these and other related measures will reduce flood risk for 85% of the population in the 100-year floodplain.[60]

The city itself has advanced the Delay, Store, and Discharge component of the plan. Investments in that part of the comprehensive water management plan have totaled more than $150 million and have reduced inland rainfall flooding events by 90%. That means that for 9 out of every 10 rainstorms, the city does not experience flooded streets in areas that would have previously flooded.[61]

While a specific estimate for Hoboken is not available, Rebuild By Design estimates that in nearby New York City, every dollar of investment in such projects generates more than two dollars in return.[62] Applying those numbers to Hoboken would suggest that these federal and local investments have generated hundreds of millions of dollars in returns for the city.

Taken together, this serves as an example of a federal initiative and federal funding spurring initial action and investment, with a relatively well-resourced municipality subsequently continuing to implement interventions.

[57] Coastal Flood Mitigation: Comprehensive Strategy for Urban Stormwater Management and Flood Risk Mitigation in Hoboken, New Jersey (https://cityofhoboken.maps.arcgis.com/apps/Cascade/index.html?appid=6d8bbfc535fc40bbbcf2bc9584f83656)
[58] Coastal Defense - Resist Alignment Construction Fact Sheet (https://dep.nj.gov/wp-content/uploads/floodresilience/rbdh-construction-factsheet-eng.pdf)
[59] Rebuild By Design - Hudson River (https://dep.nj.gov/floodresilience/rebuild-by-design-hudson-river/)
[60] Coastal Defense - Resist Alignment Construction Fact Sheet (https://dep.nj.gov/wp-content/uploads/floodresilience/rbdh-construction-factsheet-eng.pdf)
[61] Interview with the chief resilience officer of Hoboken
[62] Blue-Green Infrastructure: A New Business Case for NYC (https://rebuildbydesign.org/uncategorized/bgi-for-nyc/)

Syracuse, New York

Syracuse is not traditionally thought of as an area at high risk of flooding. It is not a coastal city, and while the Onondaga Creek does flow through it, damages from severe storms, wind, and snowfall are typically considered the greatest hazards, rather than flooding.

SYRACUSE, NEW YORK	
Population[63]	145,560
Number of households	58,424
Households at risk	5,353
LMI households	41,471
LMI households at risk	3,934

However, in recent years, flash flooding, flooding caused by heavy rainfall, and overflows from surrounding waterways have become regular events, occurring every one to two years.[64] According to the City of Syracuse, in recent years Onondaga Creek, Harbor Brook, Ley Creek, Meadowbrook, and Onondaga Lake have all reached flood levels, leading to property damage.[65]

Historically, these floods can cost millions of dollars and have fatal results.[66,67] Onondaga County and Syracuse anticipate that a 1% annual chance flood[68] would cause almost $100 million in damages to the building stock alone, not including damages to public infrastructure like roads or the impact on households' financial well-being and health. The cost of damages to the building stock rises to almost $850 million in the event of a 0.2% annual chance flood.[69]

This is particularly relevant given the high number and share of LMI households that reside in Syracuse. While the share of structures at risk is not as high as in some other cities and towns in New York (though the share at risk is expected to grow), the sheer number of LMI households means that this relatively lower risk translates into almost 4,000 LMI households at high risk of flooding in the CoreLogic data. Research by the Urban Systems Lab and the Kresge Foundation corroborates this, finding that communities at risk of flooding in Syracuse are disproportionately low income.[70]

[63] 2023 population estimate, Census (https://www.census.gov/quickfacts/fact/table/syracusecitynewyork/COM100222)
[64] Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update: Municipal Annex, City of Syracuse (http://ongov.net/planning/haz/documents/Section9.33CityofSyracuseFINAL.pdf)
[65] Syracuse Floodplain Information (https://www.syr.gov/Departments/Engineering/Floodplains#section-5)
[66] Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update: Municipal Annex, City of Syracuse (http://ongov.net/planning/haz/documents/Section9.33CityofSyracuseFINAL.pdf).
[67] Brandon Closure died while trying to help another resident escape a flooded area in 2015 (https://www.syracuse.com/crime/2015/07/28-year-old_man_presumed_dead_after_plunging_into_manhole_during_flooding.html).
[68] A 1% annual chance flood refers to a flood that has a 1% chance of being equaled or exceeded in any given year, indicating a flood of relatively high magnitude and severity. A 0.2% annual chance flood refers to a flood that has a 0.2% chance of being equaled or exceeded in any given year, indicating a flood of very high magnitude and severity
[69] Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update: Risk Assessment – Flood (http://ongov.net/planning/haz/documents/Section5.4.3-FloodFINAL.pdf).
[70] The Environmental Justice of Urban Flood Risk and Green Infrastructure Solutions, Syracuse, New York (https://static1.squarespace.com/static/552ec5f5e4b07754ed72c4d2/t/61533e61526ba849326308bb/1632845411310/Syracuse+Factsheet+FINAL.pdf)

Not only is the physical risk of flooding present, especially for low-income households, but the financial burden caused by the threat of flooding has also increased. In recognition of rising flood risk, FEMA increased the size of the Special Flood Hazard Area for Onondaga Creek within Syracuse by 175 acres and added nearly 1,200 residential and commercial structures to the area in 2016. Many of these structures are home to low-income households, and their addition to the Special Flood Hazard Area means that households must purchase flood insurance.[71] Given that FEMA's annual "Risk-Based Cost of Insurance" is almost $1,300 in Syracuse,[72] and given that the typical household in Syracuse makes just $45,000 per year,[73] this presents a meaningful financial challenge and demonstrates a fundamental tension: policies to improve resilience and preparedness, like mandatory insurance, are often necessary to help protect vulnerable households against severe risk, but these very policies can impose unmanageable short-term financial burdens on those who can least afford it.

Protecting residents who can neither afford to be flooded nor afford to spend constrained resources on resilience measures is a challenge that cities across the country are confronting. In this instance, to alleviate the financial burden, the Syracuse Common Council passed an ordinance giving tax exemptions for residents in Special Flood Hazard Areas. The exemption can total up to $81,000 and is applicable if the resident's property is insured by federally backed flood insurance.[74]

While insurance can help cover financial risk following a flood, Syracuse and Onondaga County have also recognized the need to mitigate flood risk itself. In 2019 they released the Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update, in which they detail steps the city is taking to reduce flood risk. These include dredging and cleaning Onondaga Creek; repairing deficient sewers; replacing old sewers with greater capacity systems; separating combined storm and sanitary sewers; and studying the use of a local park, Arsenal Park, for flood storage to reduce peak discharges from Onondaga Creek.[75]

Onondaga County, where Syracuse is located, has a history of water management through the combination of grey and green infrastructure, which may provide experience to draw on when implementing flood-mitigation interventions. In the late 1980s, a federal judge required the county to

[71] Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update: Municipal Annex, City of Syracuse (http://ongov.net/planning/haz/documents/Section9.33CityofSyracuseFINAL.pdf)
[72] Cost of Flood Insurance for Single-Family Homes under NFIP's Pricing Approach (https://www.fema.gov/flood-insurance/work-with-nfip/risk-rating/single-family-home)
[73] Census Profiles, Onondaga County, NY (https://data.census.gov/profile?q=Syracuse%20NY&d=ACS%201-Year%20Estimates%20Detailed%20Tables)
[74] Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update: Risk Assessment – Flood (http://ongov.net/planning/haz/documents/Section5.4.3-FloodFINAL.pdf).
[75] Onondaga County Multi-Jurisdictional Hazard Mitigation Plan Update: Municipal Annex, City of Syracuse (http://ongov.net/planning/haz/documents/Section9.33CityofSyracuseFINAL.pdf)

reduce the occurrence of combined sewer outflows, which is when rainwater overloads the combined sewer system, causing untreated stormwater and domestic sewage from homes and businesses to flow into local waterways,[76,77] Initially, interventions mostly consisted of grey infrastructure, including improvements to the main sewage treatment plant in the county. In 2009, a judge approved a plan to incorporate green infrastructure as well, including bioswales, green roofs, and rain gardens. The interventions implemented by this program, called "Save the Rain," have captured 200 million gallons of stormwater since 2010 and substantially reduced the volume of combined sewer overflows, which has meaningfully improved water quality in Onondaga Lake.[78] While water quality improvement was the main goal of these interventions, they demonstrate how a resource-constrained municipality or county can prioritize and fund interventions more broadly. Such lessons can be applied to interventions aimed at mitigating flood risk and improving resilience, particularly given that some of the projects completed under the program included an explicit secondary goal of flood mitigation.[79]

Brooklyn, NY

Although Brooklyn's *share* of total structures at risk of flooding is just above average, the *quantity* of households at risk is higher than anywhere else in New York, New Jersey, and Connecticut. In addition to the magnitude of households at risk, the size of the borough, in terms of both geography and population, means there is great diversity in flood-risk type as well as the physical and financial resilience of the population. The poorest 20% of census tracts in Brooklyn have a median household income below $55,000, while the richest have a median income greater than $100,000. There are inland communities with low incomes, inland communities with high incomes, coastal communities with low incomes, and coastal communities with high incomes. Even within neighborhoods, there can be substantial socioeconomic variation across just a few blocks.

BROOKLYN, NEW YORK	
Population[80]	2,561,225
Number of households	997,957
Households at risk	156,286
LMI households	500,355
LMI households at risk	83,311

[76] Onondaga Lake Amended Consent Judgement (https://onondagalake.org/combined-sewer-overflow-cso-abatement/ammended-consent-judgement-acj)
[77] Combined Sewer Overflows (CSOs) (https://www.epa.gov/npdes/combined-sewer-overflows-csos)
[78] See: Save the Rain (https://savetherain.us/about/)
[79] Green Separation CSO 052 At South & Mitchell Avenues (https://savetherain.us/projects/green-separation-cso-052-at-south-mitchell-avenues/)
[80] 2023 population, Census (https://www.census.gov/quickfacts/fact/table/kingscountynewyork/COM100222)

The borough recognizes this risk: the Office of the Brooklyn Borough President's comprehensive plan for Brooklyn prominently features flood risk.[81] The risk comes from two main sources: coastal flooding, exacerbated by tides, and inland flooding from extreme rainfall.

The community of Canarsie demonstrates the risk that coastal flooding presents in Brooklyn. Located on the southeast waterfront against Jamaica Bay, around two-thirds of the roughly 12,000 residential buildings in the community are in a FEMA-defined floodplain.[82] As with other communities in the area, Hurricane Sandy revealed just how at risk these properties are. Virtually all residents (98%) experienced flooding of some sort during the storm, and at least a third reported damages. Partially because of this experience, the number of households in the area with active flood insurance policies shot up by 123% between 2012 and 2017, compared to an increase of just 30% citywide.[83,84] According to FEMA, the annual "Risk-Based Cost of Insurance" for single-family homes in Brooklyn is over $1,200.[85] This represents a real financial burden for the typical Brooklyn household, which makes under $75,000 a year.[86] This burden is especially pronounced for lower-income households that make even less.

While we do not have numbers for Canarsie specifically, less than half of multifamily properties in New York City that are in areas of high flood risk, as defined by FEMA's 2007 Flood Insurance Rate Map, are insured through the National Flood Insurance Program. The areas at high risk have only grown since 2007, which likely means that an even smaller share of at-risk multifamily properties have insurance. This leaves them, and by extension their residents, exposed to serious financial risk in the event of a flood. Of those that do have insurance, premium costs are rising and putting pressure on cash flows, which may be passed on to residents in the form of reduced services or increased rents. And even for these multifamily properties with flood insurance, average claims payments may fall well short of total direct damages, to say nothing of indirect damages such as operating losses. Following Hurricane Sandy, multifamily properties with flood insurance faced an average of more than $64,000 in damages that were not covered.[87]

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[81] The Comprehensive Plan for Brooklyn (https://www.brooklynbp.nyc.gov/the-comprehensive-plan-for-brooklyn/)
[82] Note: In this report, when discussing Canarsie, we use the boundaries set by NYC Planning in its Resilient Neighborhoods report on the community (https://www.nyc.gov/assets/planning/download/pdf/plans-studies/resilient-neighborhoods/canarsie/summary-report-canarsie.pdf?r=1)
[83] Resilient Neighborhoods: Canarsie (https://www.nyc.gov/assets/planning/download/pdf/plans-studies/resilient-neighborhoods/canarsie/summary-report-canarsie.pdf?r=1)
[84] Another contributing factor may be FEMA's requirement that recipients of FEMA flood aid must purchase flood insurance. Flood Insurance and FEMA Assistance (https://www.fema.gov/fact-sheet/flood-insurance-and-fema-assistance)
[85] Cost of Flood Insurance for Single-Family Homes under NFIP's Pricing Approach (https://www.fema.gov/flood-insurance/work-with-nfip/risk-rating/single-family-home)
[86] Census Profiles, Kings County, NY (https://data.census.gov/profile?q=brooklyn,+ny&d=ACS+1-Year+Estimates+Detailed+Tables)
[87] Multifamily Flood Insurance Affordability Study (https://www.nyc.gov/html/planyc/downloads/pdf/publications/HR-A-Multifamily-Flood-Insurance-Affordability-Study-2016.pdf)

FEMA does allow property owners to access lower premiums for federal flood insurance policies, but only if they implement retrofits, which can cost more than $100,000.[88] This demonstrates the challenge that stakeholders face when trying to balance the need for resilience and preparedness measures like flood insurance with considerations of households' financial well-being.

The New York City Department of City Planning has highlighted that additional federal support could help households retrofit their properties, simultaneously reducing risk and lowering insurance premiums. They have also highlighted additional measures that New York City could pursue for the area, which include adjusting zoning to allow for retrofitting and flood resilience investments; installing green infrastructure such as bioswales; and coastal resiliency measures like waterfront parks, breakwaters, and even hurricane barriers for the whole Jamaica Bay region.[89,90] As in Syracuse, the City's approach is to combine financial support for low-income households with infrastructure investments that reduce overall risk.

While Hurricane Sandy highlighted the severity of coastal flooding risk, the remnants of Hurricane Ida revealed the extreme risk presented by stormwater and inland flooding, especially in outer boroughs like Brooklyn. The storm caused hundreds of millions of dollars in damages and killed 13 New Yorkers, a majority of whom were in unregulated basement apartments.[91,92] These instances of extreme rainfall and the consequent flooding are becoming more common and are expected to increase in frequency in the coming years and decades.[93,94]

The City is planning and undertaking a series of steps to address this increasing risk of inland flooding. These measures include creating thousands of rain gardens in Brooklyn and Queens, adding 300,000 linear feet of porous pavement in Brooklyn and the Bronx, and investing hundreds

[88] Resilient Neighborhoods: Canarsie (https://www.nyc.gov/assets/planning/download/pdf/plans-studies/resilient-neighborhoods/canarsie/summary-report-canarsie.pdf?r=1)
[89] Ibid.
[90] Resilient Neighborhoods: Sheepshead Bay (https://www.nyc.gov/assets/planning/download/pdf/plans-studies/resilient-neighborhoods/sheepshead-bay/summary-report-sheepshead-bay.pdf?r=1)
[91] Immediate Injury Deaths Related to the Remnants From Hurricane Ida in New York City, September 1-2, 2021 (https://www.cambridge.org/core/journals/disaster-medicine-and-public-health-preparedness/article/immediate-injury-deaths-related-to-the-remnants-from-hurricane-ida-in-new-york-city-september-12-2021/69BD8C527FD016A2CAC703C7023B2251)
[92] Flood Risk and Basement Housing in New York City: The Impact of Extreme Weather on Vulnerable Housing Stock (https://www.newyorkfed.org/outreach-and-education/climate/flood-risk-and-basement-housing-in-new-york-city)
[93] PlaNYC: Getting Sustainability Done (https://climate.cityofnewyork.us/wp-content/uploads/2023/06/PlaNYC-2023-Full-Report.pdf)
[94] New York City Panel on Climate Change 4th Assessment Climate Risk and Equity: Advancing Knowledge Toward a Sustainable Future (https://climate.cityofnewyork.us/wp-content/uploads/2024/04/Climate-Risk-and-Equity-Advancing-Knowledge-Toward-a-Sustainable-Future.pdf)

of millions of dollars in sewer infrastructure upgrades.[95,96,97,98] The city is also improving its early warning and detection systems by investing millions in a program to track flooding, using equipment such as flood sensors and alarms.[99] Together, these investments aim to identify, capture, store, and discharge water to reduce the frequency and severity of flooding.

Brooklyn demonstrates the challenge that many larger places face: even if the share of properties at risk is near average, the number of households at risk, as well as the variation in their incomes and social vulnerability, will be high. In addition, the risk presents itself in multiple forms, with thousands of properties at risk in one coastal area and thousands of others at risk relatively far inland, each situation requiring distinct investments, interventions, and responses.

Conclusion

Our analysis of the CoreLogic Climate Risk data demonstrates that New York, New Jersey, and Connecticut face considerable flood risk. Over 1 million structures, home to 1.6 million households and more than 4 million people, are at a high risk of flooding. More than 400,000 of these structures, home to over 1.5 million people, sit within low- to moderate-income communities.

Properties at risk are distributed across the region, not just near the coast or in New York City, but also in inland communities far from the coast, including in the Hudson Valley, Upstate New York, and New Jersey. As time goes on, the risk to these and other properties is expected to increase.

The type of flood risk differs across communities. Places like Hoboken face severe coastal risk, places like Syracuse face inland and flash flooding from storms, and places like Brooklyn face both coastal and inland flood risk. All of these types of flooding require some degree of unique and targeted responses, in addition to general measures that are common to all types of flood mitigation.

How the flood risk presents itself also differs across communities. There are smaller communities, like Keansburg, where even if the raw number of households at risk is low, the overall risk is high,

[95] Increasing Stormwater Resilience in the Face of Climate Change: Our Long Term Vision (https://www.nyc.gov/assets/dep/downloads/pdf/climate-resiliency/increasing-stormwater-resilience-in-the-face-of-climate-change.pdf)
[96] $54 Million Storm Sewer Project Alleviates Flooding Along Third Avenue in Gowanus, Brooklyn (https://www.nyc.gov/site/ddc/about/press-releases/2023/pr-071223-Gowanus.page)
[97] Mayor Adams, DEP Honor First Anniversary of Hurricane Ida, Announce Suite of Stormwater Infrastructure Initiatives to Make NYC More Resilient to Intense Rainfall (https://www.nyc.gov/office-of-the-mayor/news/637-22/mayor-adams-dep-honor-first-anniversary-hurricane-ida-suite-stormwater#/0)
[98] CDBG-DR Action Plan for the Remnants of Hurricane Ida (https://www.nyc.gov/assets/cdbgdr/documents/amendments/Ida_Amendments/2_NYC_Hurricane_Ida_Action_Plan_SA1_HUD_Approved_(8.8.23).pdf)
[99] New York City expanding FloodNet sensors in flood-prone neighborhoods, like Hamilton Beach, Queens (https://www.cbsnews.com/newyork/news/new-york-city-expanding-floodnet-sensors-in-flood-prone-neighborhoods-like-hamilton-beach-queens/)

meaning that the share of households at risk is nearly 100%. In these communities, flooding presents a community-wide and near-existential risk. On the other hand, there are larger places like Brooklyn, where even if the share of the community at risk is closer to average, its sheer size means that the risk translates to a substantial number of at-risk households. Addressing these unique situations will require additional deliberation and intentionality. It will also require new and improved investment tools for financing resiliency measures in a broad (and growing) number of communities.