The Cost and Affordability of Flood Insurance in New York City

Economic Impacts of Rising Premiums and Policy Options for One- to Four-Family Homes

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Cover: Supermoon high-tide flooding in Broad Channel, Queens. Image used with permission of the New York City Department of City Planning. All rights reserved.

Preface

This report examines the cost of flood insurance in New York City and the ability of homeowners to afford it. It develops projections for how changes in flood maps and the pricing practices of the National Flood Insurance Program might increase premiums and analyzes the potential consequences of those increases on households and communities. It also develops and evaluates several different approaches for assisting households that have difficulty affording flood insurance. These include financial payments to households to offset the cost of flood insurance as well as mitigation grants and loans that reduce flood insurance premiums by making the home less susceptible to flood risk. This report builds on a previous work by the RAND Corporation on flood insurance in New York City, *Flood Insurance in New York City Following Hurricane Sandy* (Dixon et al., 2013).

In addition to informing New York City's efforts to make its communities more resilient to flood risk, this work is also relevant at the national level. Congress instructed the Federal Emergency Management Agency (FEMA) to develop an affordability framework in light of legislation that directs FEMA to gradually eliminate certain program subsidies and to collect additional program fees. This report provides data and analysis that also inform that effort and draws on two workshops convened by the National Academies of Sciences, Engineering, and Medicine on behalf of FEMA's Federal Insurance and Mitigation Administration (FIMA) to help FIMA explore options for a flood insurance affordability program.

The authors of this report are from a number of different organizations that collaborated to complete this report. Lloyd Dixon, Noreen Clancy, and Ben Miller are at RAND; Scott Choquette, Samara Ebinger, and Sue Hoegberg are at Dewberry Engineers, Inc.; Michael Lewis is at Gayron de Bruin Land Surveying and Engineering PC; Caroline Nagy and Kevin Wolf are at the Center for New York City Neighborhoods; Mel Hodges and Gayle Syck are at Torrent Technologies, Inc.; and Bruce Bender is at Bender Consulting Services.

This research was sponsored by the New York City Mayor's Office of Recovery and Resiliency.

The RAND Center for Catastrophic Risk Management and Compensation

The RAND Center for Catastrophic Risk Management and Compensation seeks to identify and promote laws, programs, and institutions that reduce the adverse social and economic effects of natural and human-caused catastrophes by improving incentives to reduce future losses; providing just compensation to those suffering losses while appropriately allocating liability to responsible parties; helping affected individuals, businesses, and communities to recover quickly; and avoiding unnecessary legal, administrative, and other transaction costs.

Questions or comments about this report should be sent to the project leader, Lloyd Dixon (Lloyd_Dixon@rand.org). For more information about the RAND Center for Catastrophic Risk Management and Compensation, see www.rand.org/jie/justice-policy/centers/catastrophic-risk-management or contact the director at ccrmc@rand.org.

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Introduction

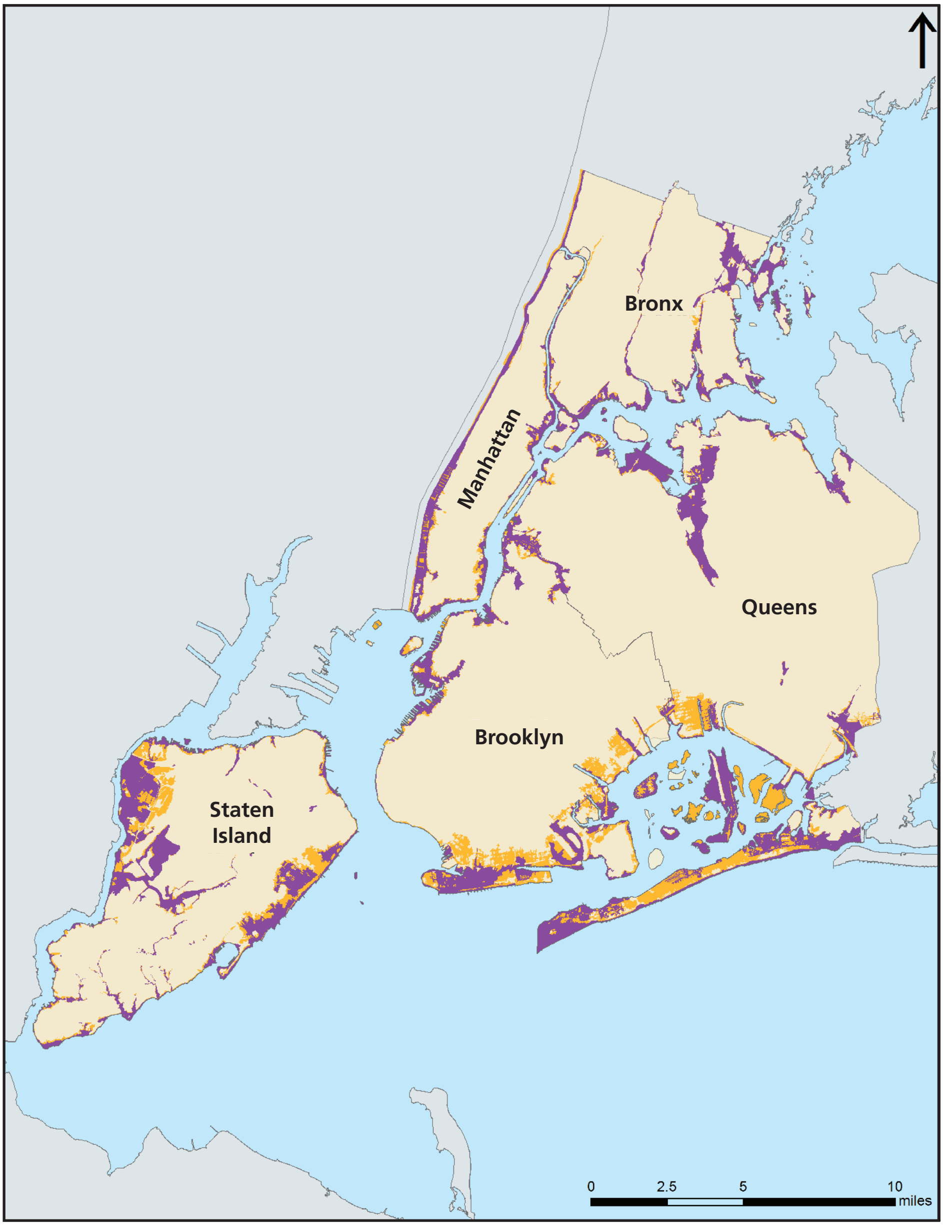
Hurricane Sandy struck New York City on October 29, 2012, with devastating consequences. The storm highlighted the importance of programs and policies that promote greater resilience to flood events. Flood insurance is an important part of this resilience strategy, but as in other parts of the country, coverage is inconsistent among one- to four-family properties in New York and may be difficult to afford for some households (City of New York, 2013, pp. 92–103). Contributing to the challenge is direction from Congress to phase out certain subsidies in the National Flood Insurance Program (NFIP), the primary source of flood insurance for one- to four- family properties across the country.[1] In addition, increasing risk and ongoing efforts to update the flood maps in New York City will likely result in higher flood insurance premiums for many households.

In this context, the New York City Mayor's Office of Recovery and Resiliency asked the RAND Corporation to answer four primary questions, with a focus on one- to four-family homes in areas of the city that are at high risk of flooding (the study area):

1. To what extent is purchasing flood insurance burdensome for households living in one- to four-family homes in the study area?
2. How might flood insurance premiums change in the study area?
3. What effect will flood insurance premium increases have on households and communities in the study area?
4. What are some promising options for a program that helps reduce the impact of higher flood insurance premiums in the study area and how much would they cost?

[1] These changes are specified in the Biggert-Waters Flood Insurance Reform Act of 2012 and the Homeowner Flood Insurance Affordability Act of 2014.

Figure S.1
Study Area



NOTE: Purple areas denote high-risk zones according to the 2007 Flood Insurance Rate Map (FIRM), and orange areas denote high-risk zones added by the PFIRM.
RAND *RR1776-S.1*

The study area is shown in Figure S.1 and covers the areas at high risk of flooding according to the Preliminary Flood Insurance Rate Map (PFIRM) that was released in June 2013. We break out results for five subareas in the study area that are either coterminous with or include communities that the New York City Department of City Planning considers particularly vulnerable to flooding and other shocks: (1) Canarsie in Brooklyn, (2) Gerritsen Beach and Sheepshead Bay in Brooklyn, (3) Broad Channel, Howard Beach, Old Howard Beach, and Hamilton Beach in Queens (jointly referred to as the Jamaica Bay subarea), (4) Rockaway Peninsula in Queens,[2] and (5) South Beach, Midland Beach, New Dorp Beach, and Oakwood in Staten Island (referred to as the East Shore subarea).

The analysis in this report is based on data from a sample of properties spread throughout the study area. Detailed information on household demographics and finances were collected from the 615 property owners who participated in the study, and information on structure type and elevation was collected for the primary structure on 485 of these properties.

The analysis is relevant to both New York City and the nation. Congress recognized the challenges the phase-out of subsidies could create for households and directed the Federal Emergency Management Agency (FEMA) to study "methods of establishing an affordability framework"—something FEMA is working on now.

Key Findings

We present the findings in terms of answers to the four primary study questions.

To What Extent Is Purchasing Flood Insurance Burdensome for Households Living in One- to Four-Family Homes in the Study Area?

The study area has about 48,100 one- to four-family properties, and slightly less than 90 percent of them are owner-occupied, primary residences (42,700). Just less than 40 percent of the households living in them are low income, and the percentage of low-income households is substantially higher in some of the five subareas examined. A considerable number of one- to four-family structures face substantial flood risk based on their elevation relative to water depth in a flood that occurs with a 1-percent annual chance (known as the Base Flood Elevation, or BFE). More than 85 percent of properties in the high-risk areas of the FIRM in effect at the time of this study (the 2007 FIRM) are below BFE and two-thirds are three or more feet below BFE. Overall, 83 percent of the one- to four-family structures are pre-FIRM structures, meaning they were built before the first FIRM for New York City was issued in November

2 The Rockaway Peninsula includes the Rockaway Park and Rockaway Beach communities, which are considered particularly vulnerable to flooding and other negative shocks.

1983 and before there were any building code requirements related to flood mitigation. These structures do not require that elevation measurements be submitted when purchasing flood insurance and are eligible for subsidized rates. Homes built after 1983 submit elevation measurements, and their flood insurance premiums are based on several measures, including the elevation of the structure relative to BFE.

The flood insurance take-up rate is an estimated 43 percent, substantially higher than the 23 percent in 2012, but even those property owners in the study area who have insurance are not fully covered for flood-related losses. Specifically, structure-replacement cost is greater than building coverage for about 45 percent of the structures with flood insurance. The average premium paid for flood insurance by those who had coverage as of June 2016 is about $1,880 (including fees) for owner-occupied one- to four-family properties in the high-risk zones of the 2007 FIRM and about $530 outside the high-risk zones (including fees).

Given this characterization of the study area, we frame the discussion of flood insurance affordability in terms of the ratio of homeownership costs to household income. Based on practices in the lending industry, we define homeowners as *housing burdened* if the ratio of mortgage principal and interest, property taxes, and property insurance (PITI) payments to income is greater than 0.4. Flood insurance premiums that contribute to a PITI-to-income ratio greater than 0.4 percent are considered burdensome and may be difficult to afford. Given this, flood insurance is burdensome for about 11,000 (25 percent) of the households in owner-occupied, one- to four-family properties in the study area that are primary residences. As expected, flood insurance is currently most difficult to afford for lower-income households. We found that flood insurance is burdensome for 64 percent of extremely and very low–income households and for 41 percent of low-income households. The proportion of households for which flood insurance is burdensome varies across the five subareas, with the highest percentage (54 percent) in Canarsie. Take-up rates are lower when housing costs are burdensome—33 percent when the PITI ratio is greater than 0.4 versus 41 percent when the PITI ratio is less than or equal to 0.3 and 57 percent when the PITI ratio is between 0.3 and 0.4.

How Might Flood Insurance Premiums Change in the Study Area?

The NFIP has already begun the process of phasing out pre-FIRM rates, and we examined the effect of eliminating the current pre-FIRM rate with the 2007 FIRM in place. We also projected premiums if the PFIRM were adopted. This allowed us to examine the effect of a map reflecting greater flood risk on premiums and to analyze the importance of grandfathering. Grandfathering in the current NFIP rate schedule allows premiums to be based on the flood zone and BFE of the earlier FIRM in some circumstances. Premiums without grandfathering and pre-FIRM rates are closer to risk-based rates than those with these rates.[3]

Slightly less than one-half of the 48,100 (22,200) properties are in the high-risk zones of the 2007 FIRM, and slightly more than one-half (25,900) are in the study area but outside the high-risk zones of the 2007 FIRM. The flood zone for the latter group (the so-called newly mapped properties) changes to high risk under the PFIRM.

Premium Projections Based on the 2007 FIRM

As shown in the first row of Table S.1, we project that the median flood insurance premium is $3,000 for the 22,200 one- to four-family properties in the high-risk zones of the 2007 FIRM under current conditions (2007 FIRM, April 2015 NFIP rate schedule, and the availability of pre-FIRM rates). This estimate assumes that the policies cover structure replacement cost or $250,000 if replacement cost is greater than $250,000. It also assumes the amount of contents coverage is 40 percent of the amount of building coverage. The $3,000 median payment is higher than that paid by current NFIP policyholders, partly because these coverage levels are greater than those currently purchased by NFIP policyholders. These higher coverage amounts are attractive from a public-policy perspective because they allow property owners to better recover following a flood.

Eliminating pre-FIRM rates under current conditions would affect relatively few property owners in high-risk zones of the 2007 FIRM because the pre-FIRM rates are already higher than the elevation-based rates for the majority of properties given the particular types of structures in the high-risk zones of the 2007 FIRM and their eleva-

Table S.1
Median Premium in Flood Insurance Scenarios Examined

FIRM in Effect and Premium Scenario	Median Premium for 22,200 Properties in High-Risk Zones of 2007 FIRM	Median Premium for 25,900 Newly Mapped Properties
2007 FIRM in effect		
With pre-FIRM rates (baseline scenario)	$3,000	$500
Without pre-FIRM rates	$3,100	$500
PFIRM in effect		
With grandfathering and without pre-FIRM rates	$3,100	$2,700
Without grandfathering or pre-FIRM rates	$5,600	$4,200

NOTE: Based on NFIP 2015 rate schedule.

3 The NFIP does not consider grandfathering a subsidy because the lower rates paid by some policyholders are offset by charging higher rates to other policyholders. Although this cross-subsidy does not come from outside the program, it nevertheless is a subsidy for certain policyholders.

tions relative to the BFE—the median premium is only $100 more when pre-FIRM rates are eliminated, as shown in the table.

Outside the high-risk zones, the median premium remains at $500, with or without pre-FIRM rates. This assumes that property owners continue to qualify for the Preferred Risk Policy (PRP) that is available to properties with limited past losses. Continued qualification for the PRP rates is not automatic: Another Sandy-type storm could generate a second claim for many households, making them ineligible for PRP rates and forcing them into the much higher standard rate that is available outside high-risk zones (with a premium of approximately $2,700).

Premium Projections Based on the PFIRM

Moving to the PFIRM has little effect on properties already in the high-risk zones of the 2007 FIRM if grandfathering is allowed—the first column under PFIRM in the table. The median premium with grandfathering is the same as that under the 2007 FIRM without pre-FIRM rates ($3,100). It should be noted, however, that there are various eligibility requirements for grandfathered rates, and property owners may fail to qualify for them. The results are very different for newly mapped properties. As shown in last column of the table, the median premium for the 25,900 newly mapped properties would gradually increase from $500 to $2,700, even with grandfathering.

The removal of grandfathering would have considerable consequences for all one- to four-family properties in the study area. For those already in the high-risk zones of the 2007 FIRM, the median premium would increase from $3,100 to $5,600, and at least 25 percent of property owners would pay premiums in excess of $12,300. For newly mapped properties, the median would increase from $2,700 to $4,200, and at least 25 percent of property owners would pay in excess of $4,700. Premium increases are particularly large on the Rockaway Peninsula.

Impact of Sea Level Rise

Sea levels around New York City are expected to rise 8 inches from the levels assumed in the PFIRM by sometime in the 2020s, and we assume this increase will translate into an 8-inch increase in BFE across the study area. We estimate that such an increase in BFE would cause the average full-risk rates projected using the PFIRM to increase by approximately 10 percent across the study area as a whole. However, more work is needed to better understand how changing sea levels will affect BFE.

What Effect Will Flood Insurance Premium Increases Have on Households and Communities in the Study Area?

The premium projections underscore the potential consequences of map changes and changes in the NFIP rating practices on one- to four-family properties in New York City. We found that, under current conditions, flood insurance is burdensome for 25 percent of the households in the study area; but these potential premium increases would both increase the number of households for whom flood insurance is burdensome and increase the burden on those for whom it is already burdensome. With the PFIRM in place and grandfathering eliminated, the percentage of housing-burdened households increases to 33 percent.

We also examined the effects that such a premium increase would have on property values, property tax revenue, and loan defaults. Based on observed patterns of insurance take-up, we assume that new homeowners only plan to purchase flood insurance for the duration of their 30-year mortgages. Research indicates that flood insurance premiums are capitalized into property values, which implies that increases in flood insurance premiums will result in decreases in property values. The last column of Table S.2 shows that newly mapped properties will see the value of their property decrease by roughly $10,000 to $100,000 if premiums increase from those projected in the first row of Table S.1 to those in the last row of Table S.1. Inside the high-risk zones of the 2007 FIRM, the effect is more variable and can be far more severe. The impact ranges from declines of $20,000 or less to the property value falling by hundreds of thousands of dollars. In the most extreme cases, the increase in the present value of the cost of flood insurance exceeds the current value of the property, and the property value falls to zero. Property values are influenced by a host of factors, and changes in these other factors can offset or reinforce declines because of premium increases. The declines in property value estimated here should be interpreted as changes from what would have been the case had the increases in flood insurance premiums not occurred.

This drop in property value has a variety of further implications. Lower property values reduce the value of the property tax base. Property tax revenue in the study area is likely to decrease by $22 million (not shown). In addition, declines in property value are also linked with higher mortgage default rates, and we estimate the default rate will increase by 50 percent in the study area, resulting in defaults rising from roughly just more than 300 per year to roughly 450 per year, or 1.5 percent of homes with mortgages per year. Most of these defaults will be in the high-risk zones of the 2007 FIRM.

Table S.2
Decline in Property Value Because of Change in Flood Insurance Premiums Under Current Conditions to Premiums with PFIRM in Place Without Pre-FIRM Rates or Grandfathering, Owner-Occupied Residences Only (2016 Dollars)

Percentile of the Change in Property Value	Properties in High-Risk Zones of 2007 FIRM	Newly Mapped Properties
5th	$0	$8,000
25th	$20,000	$44,000
50th	$40,000	$64,000
75th	$149,000	$73,000
95th	$527,000	$98,000
Mean	$137,000	$62,000

Some study areas, such as the Rockaway Peninsula, could be particularly hard hit by increased default rates.

Take-up of insurance is likely to increase for homes outside of the high-risk zones of the effective FIRM with mortgages because of the extension of the mandatory purchase requirement. However, the large increase in premiums may decrease take-up rates for homes not subject to the mandatory purchase requirement both inside and outside the current high-risk zones.

What Are Some Promising Options for a Program That Helps Reduce the Impact of Higher Flood Insurance Premiums in the Study Area and How Much Would They Cost?

We considered five different designs for a flood insurance affordability program (Table S.3). These designs were motivated by affordability programs in other settings and approaches discussed in the literature. The first three subsidize flood insurance premiums in different ways. The fourth makes flood insurance premiums more affordable by funding or subsidizing structure-specific mitigation measures, and the fifth combines mitigation assistance with a premium subsidy. The key program features used here are described in the table.

These programs aim to reduce the cost of flood insurance for households that find purchasing flood insurance burdensome. They are similar to pre-FIRM rates and grandfathering in that they attempt to reduce the cost of flood insurance for certain households. But in contrast to pre-FIRM rates and grandfathering, the affordability programs developed here are means tested to target households that find purchasing flood insurance burdensome.

Table S.4 summarizes some key outcomes for each design. The figures in the table are drawn from the base case for each design, assuming the 2015 NFIP rate schedule with pre-FIRM rates allowed and the 2007 FIRM in place.

Designs 1 and 3 provide financial assistance to 31,700 low-, moderate-, and middle-inome homeowners in the study area, but the subsidy based on housing burden (design 2) focuses benefits only on the 9,700 households that are housing burdened without the program. The result is that larger benefits are delivered to the target population by this design, even though the program cost is substantially less than that for the income-based subsidy (design 1). One downside of the housing burden–based subsidy is the extra information on mortgage, property taxes, and insurance costs that must be collected from households desiring to participate in the program, but the large savings may outweigh the additional administrative burden. As shown, the benefit costs for these first three designs, excluding administrative costs, range from $12 million to $33 million per year with full participation. The premium reductions and benefit costs for the deductible subsidy design (design 3) are more modest than in other programs. We have modeled a program in which the household buys a policy with a $10,000 deductible for building losses and a $10,000 deductible for contents coverage,

Table S.3
Flood Insurance Affordability Program Designs

Flood Insurance Affordability Design	Description	Key Design Features in Base Case
1. Income-based subsidy	Substantial premium subsidy for very low–income households, with more modest subsidies for low-, moderate-, and middle-income households	Subsidy is 80 percent of flood insurance premium for very low–income households and drops to zero as income increases
2. Subsidy based on housing burden	Subsidies for low-, moderate-, and middle-income households that are housing burdened	Households eligible when PITI ratio is > 0.4; subsidy equal to that part of flood premium that contributes to PITI > 0.4
3. Deductible subsidy	Reimbursement of a portion of the deductible for a high-deductible flood insurance policy; open to low-, moderate-, and middle-income households	Household buys a policy with $10,000 deductible, but when loss occurs, is reimbursed for deductible payments that exceed $2,000; benefit reduced for moderate- and middle-income households
4. Mitigation loans and grants	Grants for the low-income households and low-interest loans for moderate- and middle-income households to modify structure to reduce flood risk	Mitigation measure must be cost-effective for the structure
5. Mitigation loans and grants combined with income-based subsidy	Income-based subsidy program that requires households to implement cost-effective mitigation measures; open to low-, moderate-, and middle-income households	Mitigation measure must be cost-effective for the structure

NOTE: The light gray shading highlights a design option that makes flood insurance premiums more affordable by funding or subsidizing structure-specific mitigation measures. The dark gray shading highlights a design option that combines mitigation assistance with a premium subsidy.

and the premium reductions (and program costs) could be scaled up if even higher deductibles were allowed. More narrowly targeting designs 1 and 3 can reduce the benefits provided to households that are not housing burdened. However, there are trade-offs. Lowering the income eligibility cutoff, for example, excludes the relatively small number of middle-income households that are housing burdened from the program.

The results for the mitigation measures are disappointing given the 2007 FIRM and the 2015 NFIP rate schedule. Relatively few of the housing-burdened households in the study area would be eligible to participate in the program. A major reason for the low number of beneficiaries is that mitigation measures we considered are cost-effective for relatively few structures given the 2007 FIRM and the 2015 NFIP rate schedule.

The mitigation measures become considerably more attractive assuming risk-based rates based on the PFIRM. For example, the number of households eligible for a structure elevation program rises from 190 to 5,000 (not shown in table) when the

Table S.4
Summary of Outcomes for Flood Insurance Affordability Program Designs

Design	Beneficiaries: Flood Insurance Burdensome Without Program	Beneficiaries: Flood Insurance Not Burdensome Without Program	Benefit Cost with Full Participation[c]	Average Flood Insurance Premium for Beneficiaries for Whom Flood Insurance Is Burdensome Without Program: Without Program	Average Flood Insurance Premium for Beneficiaries for Whom Flood Insurance Is Burdensome Without Program: With Program
1. Income-based subsidy[a]	9,700	22,000	$33 million per year	$2,100	$650
2. Housing burdened–based subsidy[a]	9,700	0	$19 million per year	$2,100	$150
3. Deductible subsidy[a]	9,700	22,000	$12 million per year	$2,100	$1,600
4. Mitigation grants and loans[a]					
Flood vents	30	190	$2 million	$2,900	$1,400
Raise machinery and equipment	930	4,300	$28 million	$4,000	$3,300
Basement infill	750	2,400	$100 million	$4,400	$820
Structure elevation	190	0	$31 million	$10,500	$600
5. Mitigation loans and grants combined with income-based income subsidy[b]	Savings to government can be substantial, but only if the low-income households that qualify for the income-based subsidies continue to own and live in the property for at least ten years after the start of the program				

NOTE: The light gray shading highlights a design option that makes flood insurance premiums more affordable by funding or subsidizing structure-specific mitigation measures. The dark gray shading highlights a design option that combines mitigation assistance with a premium subsidy.

[a] Assumes that flood insurance premiums are based on the 2007 FIRM and the 2015 NFIP rate schedule with pre-FIRM rates.

[b] Assumes that flood insurance premiums are based on the PFIRM and the 2015 NFIP rate schedule without pre-FIRM rates or grandfathering.

[c] Does not include administrative cost.

higher rates are assumed. While moving to risk-based rates under the PFIRM increases the number of structures for which mitigation is attractive, it also increases the number of households that are housing burdened and the costs of the subsidy-based designs. Retaining grandfathering is one approach to reducing the impact of the PFIRM on New York City homeowners—we found that it substantially reduces the cost of the financial subsidy programs. However, it comes at the cost of reducing incentives to take risk-mitigation measures that would reduce flooding losses over time.

One attractive feature of combining an income-based premium subsidy with mitigation is that it counters the reduced incentive of households that receive a premium subsidy to mitigate risk. A second is that the cost of a combined mitigation and premium subsidy program to the government is potentially lower than with the premium subsidy alone. We illustrate that this can indeed be the case, with savings up to hundreds of millions of dollars in certain multiyear scenarios, assuming risk-based rates based on the PFIRM, but only if the low-income households that qualify for the income-based subsidies continue to own and live in the property for at least ten years after the start of the program.

Conclusions and Remaining Questions to Be Addressed

This report has found that flood insurance is already difficult to afford for one-quarter of the owner-occupied, one- to four-family homes that are primary residences in the study area. Flood insurance will likely become more difficult to afford as the NFIP phases out certain subsidies and the flood maps are updated. These findings are important because flood insurance that households find unaffordable puts downward pressure on take-up rates, which reduces the resilience of households and communities to flood events. Also, premium increases can reduce property values, increase loan defaults, lower tax revenue, and create hardships for current residents in flood-prone areas.

A number of questions on the implementation of a flood insurance affordability program remain to be addressed. First, what is the funding source for the program? Is it funded at the city, state, or federal level, and who bears the cost? Second, how should the program be administered? The administrative requirements for some of the designs are complex. For example, the mitigation grant and loan program would require a process to determine what mitigation measures were cost-effective for each structure. Third, how long should the program remain in effect? Should the program be available only to current residents or also be available to future buyers who subsequently find themselves with high housing costs relative to income? Finally, should program participants be required agree to a buy-out when the property is sold to reduce the need for future subsidies? The answers to these questions will be important in determining how best to proceed.

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Greg de Bruin at Gayron de Bruin Land Surveying and Engineering PC provided valuable advice on what mitigation-related information should be collected when the land surveyors visited the properties enrolled in the study.

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Finally, we would like to thank the many city residents who participated in the study and allowed land surveyors to take accurate elevation measurements of their properties.

Abbreviations

ACS	U.S. Census Bureau American Community Survey
AGOL	ArcGIS Online
AMI	area median income
BBL	New York City Borough Block and Lot
BFE	base flood elevation
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CAV	Federal Emergency Management Agency Community Assistance Visit
CLTV	current loan-to-value
CRS	Community Rating System
DCP	New York City Department of City Planning
DTI	debt to income
EC	elevation certificate
FEMA	Federal Emergency Management Agency
FHA	Federal Housing Administration
FIMA	Federal Insurance and Mitigation Administration (manages the National Flood Insurance Program)
FIRM	Flood Insurance Rate Map
GIS	geographic information systems
HAG	highest adjacent grade
HFIAA	Homeowner Flood Insurance Affordability Act of 2014
HUD	U.S. Department of Housing and Urban Development
ICC	increased cost of compliance
LAG	lowest adjacent grade
M&E	machinery and equipment
NFIP	National Flood Insurance Program

ORR	New York City Mayor's Office of Recovery and Resiliency
PFIRM	Preliminary Flood Insurance Rate Map
PIN	personal identification number
PITI	principal and interest, property taxes, and insurance
PLUTO	New York City Primary Land Use Tax Lot Output
PMF	policy master file
PRP	preferred risk policy
PV	present value
SBA	U.S. Small Business Administration
SLR	sea level rise
STAR	New York State School Tax Relief Program

CHAPTER ONE

Introduction

Hurricane Sandy struck New York City on October 29, 2012, with devastating consequences. It highlighted the importance of programs and policies that promote greater resilience to flood events. Flood insurance is an important part of this resilience strategy, but as in other parts of the country, coverage is inconsistent among one- to four-family properties in New York City and may be difficult to afford for some households (City of New York, 2013, pp. 92–103). Contributing to the challenge is direction from Congress to phase out certain subsidies in the National Flood Insurance Program (NFIP), the primary source of flood insurance for one- to four- family properties across the country.[1] Additionally, ongoing efforts to update the flood maps in New York City to reflect increasing flood risk will likely result in higher flood insurance premiums for many households.

A report by the RAND Corporation developed plausible scenarios for flood insurance premiums for one- to four- family homes in New York City as the NFIP rate schedule is revised and the Flood Insurance Rate Map (FIRM) is updated (Dixon et al., 2013). However, data were inadequate to determine how likely the different scenarios would be in practice. In particular, data on the elevation of structures relative to flood levels were not available—in part because of the large number of structures that were built before the first FIRM for New York City was issued (pre-FIRM structures), and information on elevation is not required to purchase insurance from the NFIP for pre-FIRM structures. The RAND report also reviewed programs that New York City might consider to make flood insurance more affordable. Examples included tax credits or vouchers that could offset the cost of flood insurance and mitigation grants and loans that could reduce risk and insurance premiums. The study analyzed the strengths and weaknesses of different approaches, but concluded that better data were needed on household income, housing costs, and structure elevation to assess the need for and the advantages and disadvantages of different approaches.

[1] These changes are specified in the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) and the Homeowner Flood Insurance Affordability Act of 2014 (HFIAA).

Purpose of This Study

This study addresses four main questions:

1. To what extent is purchasing flood insurance burdensome for households living in one- to four-family homes in the study area?
2. How might flood insurance premiums change in the study area?
3. What effect will flood insurance premium increases have on households and communities in the study area?
4. What are some promising options for a program that helps reduce the impact of higher flood insurance premiums in the study area, and how much would they cost?

This analysis is relevant not only to New York City, but also to the United States as a whole. Congress recognized the challenges that the phase-out of subsidies could create for households and directed Federal Emergency Management Agency (FEMA) to study "methods of establishing an affordability framework" (BW-12, Section 100206). To that end, FEMA sponsored two studies by the National Academies of Sciences, Engineering, and Medicine, and this report draws on their findings (National Academies of Sciences, Engineering, and Medicine, 2015 and 2016). At the time of this writing, FEMA is preparing an affordability framework to submit to Congress.

Study Approach

The analysis in this report is based on data from a sample of properties throughout the areas at high risk of flooding according to the Preliminary Flood Insurance Rate Map (PFIRM) that was released in June 2013.[2] To collect the data, we selected a stratified random sample of 2,800 of the 48,100 one- to four-family properties in the high-risk zones of the PFIRM (the study area).[3] The study area is shown in Figure 1.1 and includes the high-risk zones of the 2007 FIRM and those added by the PFIRM.[4] Special attention is paid to the following five subareas that are coterminous with or include

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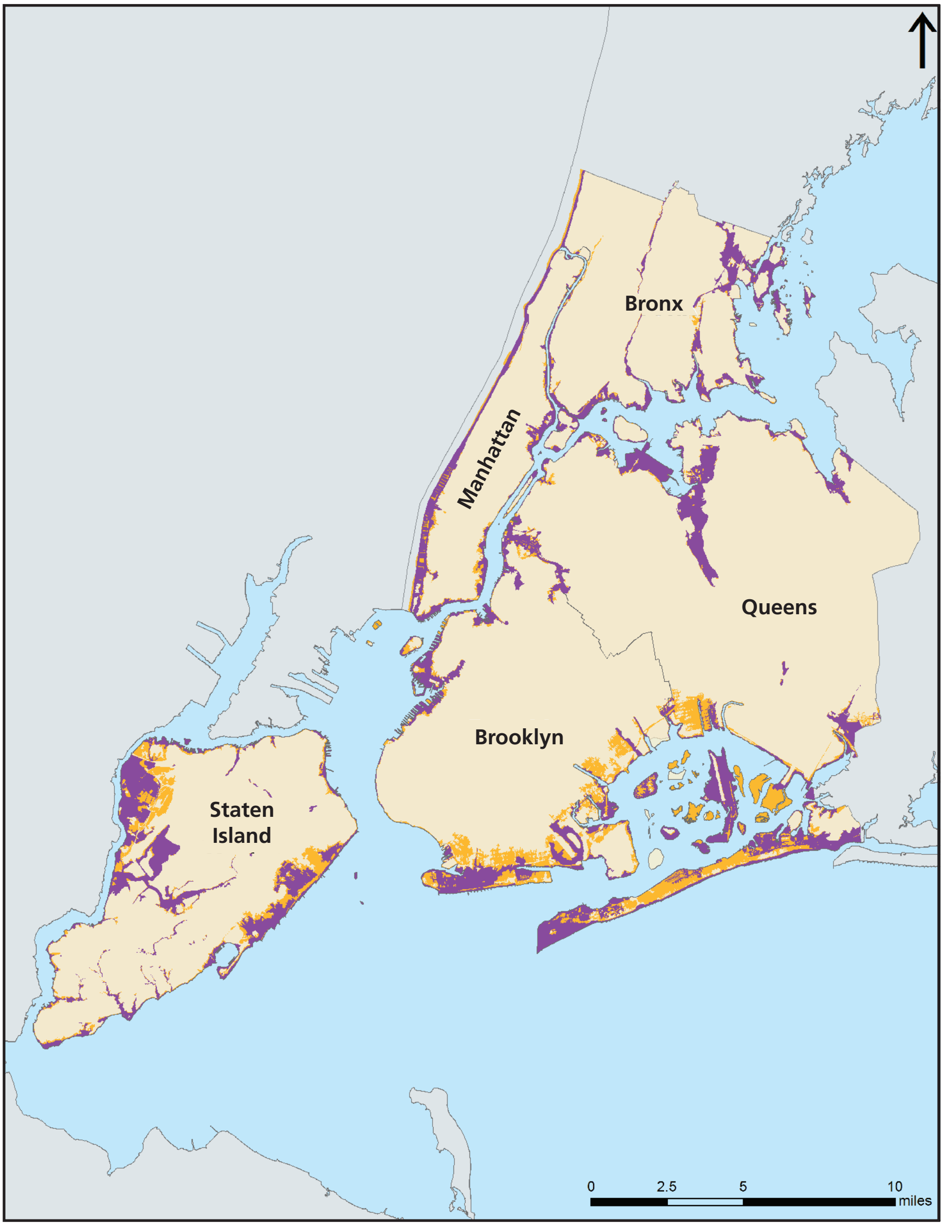
[2] The high-risk zones include flood hazard zones A, AE, AO, V, and VE on the New York City FIRMs. The PFIRM is now being revised using more precise data but nonetheless provides an initial evaluation of how current flood risk in New York City differs from that depicted by the 2007 FIRM (see FEMA, 2016b).

[3] Staff in the Mayor's Office of Recovery and Resiliency identified property parcels in the high-risk zones of the PFIRM, and staff in the New York City Department of Finance identified which of these contained one- to four-family structures.

[4] The first FIRM for New York City was issued in November 1983 and updated in February 1991, May 1992, July 1994, May 2001, and September 2007. These updates made some change in certain riverine areas but not in areas subject to coastal flooding. The riverine areas account for approximately 8 percent of the high-risk zones of the 2007 FIRM with the remaining portion subject to coastal flooding (Dixon et al., 2013, p. 7).

Figure 1.1
Study Area



NOTE: Purple areas denote high-risk zones according to the 2007 FIRM and orange areas denote high-risk zones added by the PFIRM.

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communities that the New York City Department of City Planning (DCP) considers particularly vulnerable to flooding and other shocks given the damage that they suffered during Hurricane Sandy and their struggle to rebuild and recover:

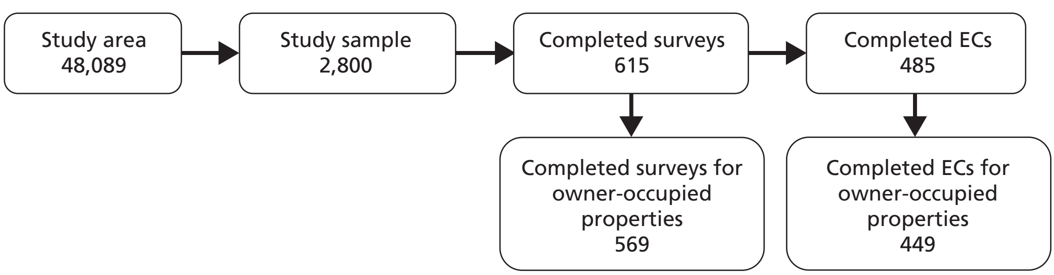
- Canarsie (in Brooklyn)
- Gerritsen Beach and Sheepshead Bay (in Brooklyn)
- Jamaica Bay (Broad Channel, Howard Beach, Old Howard Beach, and Hamilton Beach in Queens)
- Rockaway Peninsula (in Queens)[5]
- East Shore, Staten Island (South Beach, Midland Beach, New Dorp Beach, and Oakwood).

Maps showing the location of these subareas are provided in the discussion of our findings at the subarea level in Chapter Four.

The owners of the 2,800 selected properties were invited to participate in the study. To participate, the property owner was required to complete a survey that asked for information about household income, mortgage payments, utility costs, insurance payments, and mortgage balance (the instrument is included as Appendix H). The property owner also had to agree to allow a land surveyor to collect detailed elevation data on the structure.[6] In return for participating in the study, the property owner received a free elevation certificate (EC) valued at $800 to $1,000, a $50 gift card, and a fact sheet describing flood risk and the information contained in the EC. Having an EC can help property owners qualify for lower flood insurance premiums.

The multipronged strategy developed to enroll study participants is detailed in Appendix A. Data collection continued from November 2015 through November 2016, and as shown in Figure 1.2, ultimately surveys were completed for 615 properties (22-percent response rate) and a survey and EC were completed for 485 properties

Figure 1.2
Number of One- to Four-Family Properties in the Study Sample



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5 The Rockaway Peninsula includes the Rockaway Park and Rockaway Beach communities that are considered particularly vulnerable to flooding and other negative shocks.

6 This required access to the interior of the structure.

(17-percent response rate).[7] As described in Appendix A, sampling weights were developed to correct for differences in response rates among different groups and to extrapolate findings for the sample to the 48,100 one- to four-family properties in the study area. Separate sets of weights were used to extrapolate to the 48,100 one- to four-family homes from (1) the study sample, (2) the study sample with complete surveys, and (3) the study sample with complete surveys and complete ECs.

These rich data were used to characterize how flood insurance premiums might evolve under a number of different scenarios. They were used to analyze the economic consequences of premium increases for both families and communities, and they were used to model the outcomes of various flood insurance affordability program designs. Findings for a particular outcome are based on the data sample for which the most properties are available. For example, data on whether a property is owner occupied is collected in the survey, so findings on the distribution of properties by residency are based on the 615 households completing the survey. In contrast, data from the EC are required to project flood insurance premiums, and thus premium projections are based on the 485 properties for which an EC is available. Detailed demographic and housing expenditure data are collected only for owner-occupied, primary residences (one- to four-family properties in the study area that are the primary residence of the property owner) and, thus, much of the analysis in this report is based on this subset of properties. The number of completed surveys for owner-occupied, primary residences is shown in the second row of Figure 1.2.

A detailed pricing model was developed to estimate flood insurance premiums under various scenarios. To do this, we worked with Torrent Technologies to determine rates per $100 of coverage for a wide range of structure characteristics.[8] These include structure type (e.g., basement, crawlspace), flood zone, elevation relative to flood level, number of floors, location of machinery and equipment (M&E), occupancy (single family versus two to four family) and residency (primary versus nonprimary residence). Rates were developed for approximately 500 different combinations of structure characteristics. The premium model is described in Appendix E and was validated against the premiums paid by properties with flood coverage in 2012.

Organization of This Report

Chapter Two describes the types of one- to four-family structures in the study area and the households that live in them. It updates estimates of the flood insurance take-

7 Not all of the 615 property owners who filled out the survey followed through with having the site visit for the elevation measurements. Therefore, we only have completed ECs for 485 properties.

8 Torrent Technologies is a leading provider of flood insurance services to the "Write Your Own" companies that sell NFIP policies.

up rate in New York City provided in RAND's prior report (Dixon et al., 2013) and describes the amount of coverage purchased by those who have flood insurance. A measure of housing cost burden is then developed and an estimate of the percentage of households for whom flood insurance is burdensome is presented.

Chapter Three examines how flood insurance premiums might change over time. It uses the premium model to project premiums for the one- to four-family properties with and without two of the main features embedded in the current NFIP rate schedule that cause rates to diverge from risk-based rates. It examines how premiums have changed since 2012, which was before the premium increases required by Congress began to take effect, and it analyzes how adoption of the PFIRM would affect premiums. It projects the increase in rates that could result from sea level rise (SLR). It also examines the effects of these rate increases on housing burden.

While Chapters Two and Three focus on the study area as whole, Chapter Four explores how the results vary across the five study subareas.

Chapter Five examines the impact of changes in flood insurance premiums on property values, property tax revenue, defaults, and insurance take-up rates.

Chapter Six develops and analyzes various approaches for assisting low- and moderate-income households to pay for flood insurance. Attention is restricted to owner-occupied, primary residences in the study area. Five different program designs are developed and their performance simulated. The number of beneficiaries and cost of each design are projected and the impact on households for which flood insurance is burdensome absent the program assessed. The advantages and disadvantages of the alternative approaches are identified and compared.

Chapter Seven provides concluding comments.

The main body of the report is followed by eight appendixes that detail the methods and data used in the analysis:

- Appendix A describes the survey methods.
- Appendix B describes the methodology used to develop the geospatial database used throughout the project.
- Appendix C describes the methods used to estimate income, the income cutoffs used in the analysis, and findings on the correlation between household income and net worth.
- Appendix D provides additional detail on the housing costs for the households participating in the study and examines the relationship between the amount of flood insurance coverage that policyholders purchase, structure replacement costs, and mortgage balance.
- Appendix E describes the flood insurance premium model.
- Appendix F summarizes the eligibility requirements for pre-FIRM and grandfathered flood insurance rates.
- Appendix G describes the economic effects model.
- Appendix H contains the survey instrument.

CHAPTER TWO

The Affordability of Flood Insurance in New York City

This chapter first describes the number and types of one- to four-family properties in the study area, their flood risks, and the characteristics of households that live in them. It then examines the proportion of properties covered by flood insurance and the amount of coverage relative to the replacement cost of the structure. Finally, it explores the cost and affordability of flood insurance in the study area. The analysis is based on flood risk as characterized by the 2007 FIRM and on flood insurance policies in force as of June 30, 2016.

One- to Four-Family Properties in the Study Area

Table 2.1 presents an overview of the one- to four-family properties in the high-risk zones of the PFIRM (the study area).[1] There are 48,100 one- to four-family properties in the study area.[2] Slightly less than one-half of the properties in the study area are in the high-risk zones of the 2007 FIRM (A, AE, AO, V, and VE zones) with the remaining properties newly mapped into the high-risk zones by the PFIRM.[3]

A high percentage (84 percent) of the one- to four-family structures in the study area were constructed before the first FIRM was issued in 1983. These pre-FIRM struc-

1 Previous work has shown that one- to four-family parcels account for approximately 72 percent of all property parcels (residential, commercial, government, industrial, and other) in the high-risk zones of the PFIRM (Dixon et al., 2013, p. 40).

2 The number of one- to four-family properties in the study area is the number of one- to four-family tax parcels in the study area adjusted upward by the number of one- to four-family homes in the Breezy Point, Edgewater Park, and Silver Beach cooperatives. Breezy Point is on the Rockaway peninsula and Edgewater Park and Silver Beach are in the Bronx.

3 A and AE zones are areas with a 1 percent or greater annual chance of flooding. AO zones are areas with a 1 percent or greater chance of flooding each year and sheet flow, ponding, or shallow flooding. V and VE zones are coastal areas with 1 percent or greater annual chance of flooding and an additional hazard associated with storm waves. B and X zones are areas of moderate flood hazard, usually the areas between the limits of the 100-year and 500-year floods. C and X zones are areas of minimal flood hazard, usually the areas outside the limit of the 500-year flood zone (FEMA, 2007a). Those parts of the study area that are B, C, or X zones according to the 2007 FIRM are newly mapped as high-risk zones by the PFIRM.

Table 2.1
Characteristics of One- to Four-Family Properties in Study Area

	Number of Properties	Percentage of Properties	95% Confidence Intervals	
Total one- to four-family properties	48,100	100%	—	—
Flood zone according to 2007 FIRM[a]				
A and AE	21,000	44%	20,100–21,900	42–46%
V and VE	1,200	3%	900–1,600	2–3%
B, C, and X	25,900	54%	24,900–26,800	52–56%
Construction date of structure				
Pre-FIRM (pre-1983)	40,300	84%	—[b]	—
Post-FIRM (1983 on)	7,800	16%	—	—
Occupancy[c]				
Single family	32,400	67%	30,100–34,500	63–72%
Two- to four-family	15,700	33%	13,600–17,900	28–37%
Structure type[d]				
Basement	32,300	67%	29,500–34,400	61–71%
Slab	10,500	24%	9,400–13,700	20–29%
Crawlspace	800	1%	300–1,200	1–3%
Subgrade crawlspace	2,400	6%	1,700–4,200	4–9%
Enclosure	1,500	3%	600–2,800	1–6%
Party walls[d]				
No party walls	26,100	54%	23,500–28,600	49–60%
1 party wall	14,000	29%	11,700–16,500	24–34%
2 party walls	8,000	17%	6,300–10,100	13–21%
Property in Build It Back program[a]	11,000	23%	10,300–11,800	21–25%
Residency status[d]				
Owner-occupied, primary residence	42,700	89%	40,800–44,100	85–92%
Second home	1,000	2%	500–1,800	1–4%
Rental property	4,500	9%	3,100–6,300	6–13%

Table 2.1—Continued

	Number of Properties	Percentage of Properties	95% Confidence Intervals	
Flood zone of owner-occupied, primary residences according to 2007 FIRM				
A and AE	18,700	44%	16,700–20,800	39–49%
V and VE	500	1%	200–1,300	0.5–3%
B, C, and X	23,500	55%	21,400–25,500	50–60%

SOURCE: Property address and construction date were provided by the New York City Department and Finance and the Office of Recovery and Resiliency. Data on structure type and number of party walls were obtained from the ECs completed for the study. Flood zone is based on author analysis of the 2007 FIRM and the property parcel map for New York City. Addresses of properties in the Build It Back program were provided by the New York City Build It Back program. Residency status was reported by property owner in the property-owner survey.

[a] Based on the study sample of 2,800 properties.

[b] Based on all 48,100 properties in the study areas. Because all 48,100 properties are represented, confidence intervals are not necessary.

[c] Based on the study sample with complete surveys (*N* = 615).

[d] Based on the study sample with ECs (*N* = 485).

tures are eligible for "pre-FIRM construction rates" from the NFIP, or "pre-FIRM" rates for simplicity (FEMA, 2015a, p. RATE-2).[4] Pre-FIRM rates are on average less than actuarially based rates for the structures that take advantage of these rates.[5] However, as will become clear in Chapter Three, whether the rate is below the actuarial rate for any particular structure depends on the characteristics of that structure.

Two-thirds of the one- to four-family homes in the study area are single-family homes. More than 65 percent of the structures have basements, about 25 percent are on slabs (i.e., they have no basement, crawlspace, or enclosure), and about 10 percent have crawlspaces, subgrade crawlspaces, or enclosures. Just more than one-half (54 percent) of the structures are not attached to structures on adjacent properties. The remaining structures have one- or two-party walls.[6] Slightly less than 25 percent of the one- to four-family homes in the study sample are in New York City's Build It Back program.[7]

As shown in the penultimate set of rows in Table 2.1, nearly 90 percent of the one- to four-family properties in the study area are the primary residence of the prop-

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[4] We consider only the principal structure on the one- to four-family property.

[5] Pre-FIRM rates are thus often referred to as *pre-FIRM subsidized rates*.

[6] A *party wall* is a wall shared by structures on two adjacent property parcels. Whether the structures of adjacent properties are attached will be relevant in the analysis of structure elevation in Chapter Five.

[7] The Build It Back program assists homeowners, landlords, and tenants whose primary homes were damaged by Hurricane Sandy. Funded by the Federal Community Development Block Grant–Disaster Recovery Bill passed by Congress, the goal of the program is to help affected residents return to safe, sustainable housing by addressing unmet housing recovery needs (NYC Build It Back, undated[a]).

erty owner.[8] For ease of exposition, we will refer to these as owner-occupied residences. The other 10 percent are second residences or properties that are entirely rented out by the individuals or businesses that own them. These individuals or business owners presumably have too many assets to justify assistance for flood insurance premiums, and we will restrict our analysis of the economic impact of premium increases and flood affordability programs to owner-occupied residences. Of the 42,700 owner-occupied one- to four-family homes in the study area, 18,700 are in the high-risk zones of the 2007 FIRM (bottom set of rows in Table 2.1).

An important indicator of flood risk is the elevation of the structure relative to the Base Flood Elevation (BFE).[9] These elevation differences are measured from the lowest floor of the structure.[10] BFEs are provided by the FIRM, but only for the high-risk zones. The elevation differences for the one- to four-family structures in the high-risk zones of the 2007 FIRM are shown in Figure 2.1. Just more than 85 percent of the structures are below the BFE at their location, and two-thirds are three or more feet below BFE. These figures indicate that a substantial proportion of the one- to four-family structures in the high-risk zones of the 2007 FIRM are at risk of flooding in the flood that occurs with a 1-percent annual chance. Substantial percentages of both pre-FIRM and post-FIRM structures are at risk: 71 percent of the 16,600 pre-FIRM structures in the high-risk zones of the 2007 FIRM are three or more feet below BFE, as are 55 percent of the 5,600 post-FIRM structures.

Households That Live in the Owner-Occupied One- to Four-Family Structures in the Study Area

We now describe the households that live in the owner-occupied, one- to four-family structures in the study area. When there is more than one household living at the property, we restrict our attention to the household of the property owner.

Household Size, Age, Race, Ethnicity

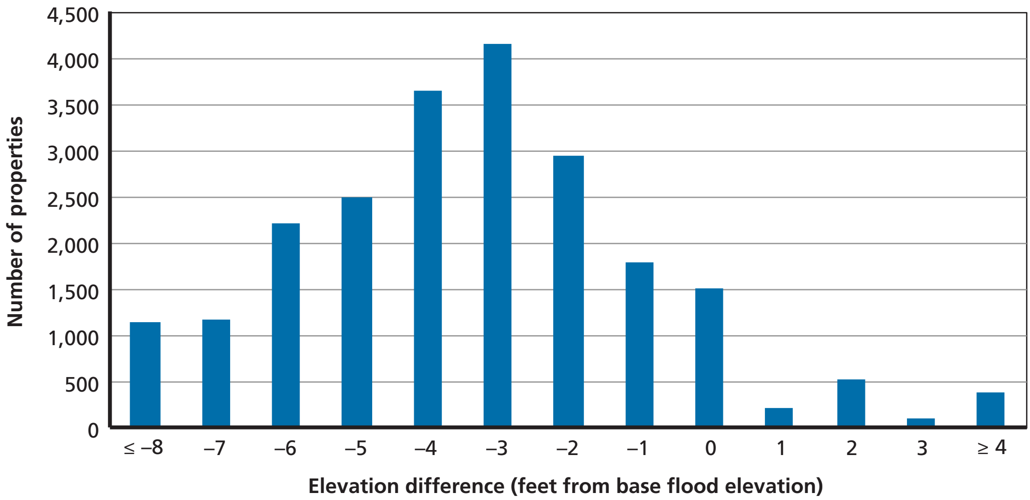
Table 2.2 shows that the household size of owner-occupied properties is quite variable. Nearly 80 percent of households have one to four individuals, with five or more individuals in the remaining 20 percent. The average household size of three is somewhat larger than the average household size of 2.6 for all New York City households reported

[8] Two- to four-family properties for which the owner lives in one of the units (and the unit is the primary residence) are considered owner occupied. In Chapter Four, we will consider how flood insurance premium increases could potentially affect the rental market.

[9] The BFE is the elevation water reaches in a flood that occurs with a 1-percent annual chance.

[10] For structures with basements, structure elevation is measured from the top of the basement floor. For structures with crawlspaces and enclosures, structure elevation is measured from the top of the crawlspace or enclosure floor (which may be a dirt floor). For structures with slabs, the elevation is measured from the top of the slab.

Figure 2.1
Difference Between Structure Elevation and 2007 BFE for Structures in the High-Risk Zones of the 2007 FIRM



SOURCE: Structure elevation is from ECs for the 240 structures in the study sample with complete ECs that are in the high-risk zones of the 2007 FIRM. Data on 2007 BFE are interpolated from the 2007 FIRM. Data are weighted to reflect the 22,200 one- to four-family properties in the high-risk zones of the 2007 FIRM.
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by the American Community Survey. As will be discussed, household size is relevant to interpreting household income.

We also collected the age of the oldest financially responsible individual living in the household. Although eligibility for affordability programs is unlikely to be dependent on the age of the homeowner, the age of those financially responsible for the home can be informative about the population's ability to manage the financial costs associated with significant flood damage. Younger homeowners have had less time to build up significant financial savings. Older homeowners are more likely to be retired and hence reliant on past savings rather than new labor income to cover unexpected financial losses.

The majority of owner-occupied residences in the study area have at least one financially responsible individual who is 45 or older. We estimate that, for 15 percent of the residences, the oldest financially responsible individual is between 25 and 44, and no households reported the oldest financially responsible individual being younger than 25. Almost one-third of households reported that the oldest financially responsible individual is older than 65. These households are more likely to be on fixed incomes.

In addition to household size and age, race and ethnicity of potential beneficiaries are also important factors to consider when designing and implementing a benefits program. Understanding the racial and ethnic composition of the population of

Table 2.2
Household Size, Age, Race, and Ethnicity of One- to Four-Family Households in the Study Area (Owner-Occupied Residences Only)

	Number of Households	Percentage of Households	95% Confidence Interval	
Total owner-occupied residences	42,700	100%	40,800–44,100	—
Household size (persons)				
1	6,100	14%	4,800–7,600	11–18%
2	12,100	28%	10,300–14,000	24–33%
3	6,400	15%	5,100–8,000	12–19%
4	9,000	21%	7,400–10,900	17–25%
5	3,700	9%	2,800–4,900	7–12%
6	2,800	6%	1,800–4,100	4–10%
7	1,400	3%	800–2,600	2–6%
8	1,200	3%	600–2,200	1–5%
Age of oldest financially responsible individual				
< 25	[a]	[a]	[a]	[a]
25–44	6,600	15%	5,200–8,300	12–19%
45–64	22,400	52%	20,300–24,400	48–57%
≥ 65	13,700	32%	11,800–15,700	28–37%
Race or ethnicity[b]				
Asian Indian	500	1%	200–1,200	1–3%
Black or African American[b]	7,100	17%	5,700–8,800	13–21%
Chinese	1,300	3%	700 –2,400	2–6%
Haitian	300	1%	100–800	0.3–2%
Russian	1,000	3%	500–1,900	1–4%
White[b]	21,400	50%	19,300–23,500	45–55%
Prefer not to answer	6,700	16%	5,400–8,400	13–20%
Other[c]	2,900	7%	1,900–4,200	5–10%
Multiple racial or ethnic groups	1,400	3%	800–2,300	2–5%
Hispanic, Latino, or Spanish origin				
Yes	3,200	7%	2,200–4,500	5–11%
No	33,600	79%	31,800–35,100	74–82%
Prefer not to answer	5,900	14%	4,700–7,400	11–17%

Table 2.2—Continued

NOTE: These values are based on a sample of 569 owner-occupied residence households. Categories may not add exactly to total because of rounding to nearest 100. Sample weights are described in Appendix A.

[a] No respondents in owner-occupied residences reported that the oldest financially responsible individual is younger than 25.

[b] Our questionnaire mirrors the structure of the U.S. Census Bureau's American Community Survey in asking Hispanic origin as a separate and distinct question, in accordance with current guidelines from the Office of Management and Budget that individuals of Hispanic origin may be of any race. At the same time, in recognition of research findings that the race-versus-ethnicity distinction is confusing to many respondents, we follow current research efforts by the U.S. Census Bureau in asking race and ethnicity as a combined question.

[c] Individuals who selected "other" for their race or ethnicity were asked to write in their race or ethnicity. Those who selected "other" and wrote in "black" were recoded as "black or African American." Those who selected "other" and wrote in "Irish and German," "Italian," "Italian American," or "Italian descent" were recoded as "white."

potential beneficiaries can help the city understand the extent to which multilanguage services may be required.

The 2010 census data found 44 percent of all New York City residents identified as white, 26 percent identified as black, and 13 percent identified as Asian. Table 2.2 shows that households in the study area's owner-occupied residences appear somewhat more likely to be white than the average New York City resident, with roughly one-half of the owners of owner-occupied residences identifying as white. Because 15 percent of the population in our sample preferred to not provide their race or ethnicity, it is difficult to say for certain whether households in owner-occupied residences are less likely to be black or Asian than the average New York City resident. Of the homeowners of owner-occupied residences in the study area, 17 percent identified as black or African American. The remaining 18 percent identified as Asian Indian, Chinese, Haitian, Russian, multiple racial or ethnic groups, or other. At 7 percent, the proportion that identified as Hispanic, Latino, or of Spanish origin is substantially smaller than the 29 percent of all New York City residents that identified as Hispanic or Latino in the 2010 census.

Household Income

Income is often one of the first variables that come to mind when considering how to define eligibility for a subsidy program. Income is paired with household size to classify households by income category. It is also combined with various expenses to determine the proportion of income spent on housing costs, which is another potential metric used to determine eligibility for an affordability program to reduce housing costs.

Appendix C describes how income is estimated based on the survey responses. We find that median income in our sample is $74,500, which is higher than the median income for all households in New York City ($53,782 in 2016 dollars) (U.S. Census Bureau, undated[a]). It should not be surprising that median income for New York City homeowners is higher than median income for all residents in the city. Because income is strongly correlated with race and ethnicity, it is also not surprising that homeowners are less diverse than all New York City residents on average. However, not all homeowners have high incomes. Table 2.3 shows the distribution of income for households in owner-occupied residences in the study area. We estimate 35 percent have an annual income of less than $60,000.

Because household income is in part driven by the number of wage earners in the household, looking at total household income without considering household size can be deceptive. An annual household income of $74,500 has very different implications for a single individual compared with a household with four people. To address this issue, the U.S. Department of Housing and Urban Development (HUD) calculates area median income (AMI) for regions across the country separately by household size. The following AMI categories are used in HUD analysis and in the design of HUD housing assistance programs:

- Extremely low income: ≤ 30 percent of AMI
- Very low income: > 30 percent and ≤ 50 percent of AMI
- Low income: > 50 percent and ≤ 80 percent of AMI
- Moderate income: > 80 percent and ≤ 120 percent of AMI
- Middle income: > 120 percent and ≤ 165 percent of AMI.

Appendix C provides income cutoffs for these income categories (which vary by household size) in the New York, New York Metro Fair Market Housing Area.

Table 2.3 shows that just less than 20 percent of households in owner-occupied, one- to four-family homes in the study area are extremely low or very low income according to the HUD categories. Approximately 20 percent are low income, and another 20 percent are moderate income.[11] Overall, 39 percent of households have incomes that are 80 percent of AMI or below (see last row of Table 2.3).

The flood insurance affordability programs analyzed in Chapter Six base eligibility in part on household income. However, it may also be desirable to combine income with an asset test to ensure that households that have low incomes but high net worth are not provided subsidies. Appendix C uses U.S. Census data to show the relation between income and net worth for households nationwide. It provides a basis for estimating how much the number of program beneficiaries would decline if an asset test were imposed on top of an income test.

[11] Note that these percentages do not include renters.

Table 2.3
Income of One- to Four-Family Households in Study Area (Owner-Occupied Residences Only)

	Number of Households	Percentage of Households	95% Confidence Interval	
Total owner-occupied residences	42,700	100%	40,800–44,100	—
Household income				
< $30,000	4,200	10%	3,100–5,600	7–13%
$30,000–59,999	10,600	25%	8,900–12,600	21–29%
$60,000–99,999	12,000	28%	10,200–13,900	24–33%
$100,000–149,999	9,000	21%	7,400–10,700	17–25%
≥ $150,000	6,900	16%	5,400–8,600	12–20%
Household income by AMI range				
Extremely low (≤ 30% of AMI)	2,700	6%	1,800–4,000	4–9%
Very low (30–50% of AMI)	4,700	11%	3,600–6,100	9–14%
Low (50–80% of AMI)	9,400	22%	7,800–11,300	18–26%
Moderate (80–120% of AMI)	8,600	20%	7,100–10,400	17–24%
Middle (120–165% of AMI)	7,200	17%	5,800–8,900	14–21%
Higher income (> 165% of AMI)	10,000	23%	8,300–11,900	20–28%
Low income and below (≤ 80% of AMI)	16,800	39%	14,800–18,900	35–44%

NOTE: These values are based on a sample of 569 owner-occupied residences. Categories may not add exactly to total because of rounding to nearest 100. Sample weights as described in Appendix A.

Flood Insurance Take-Up Rates

The NFIP is the predominant provider of flood insurance for one- to four-family structures, and take-up rates for NFIP policies in the study area for 2012 and 2016 were calculated and compared.

To do this, we obtained the NFIP's policy master files (PMFs) for New York City as of December 31, 2012, and June 30, 2016. Policies were then matched by address to the 2,800 sample of properties selected for the study. The resulting take-up rates for 2012 reflect the take-up rates prior to Hurricane Sandy (because most of these one-year policies were in effect prior to Hurricane Sandy). The 2016 take-up rates are reflective of those during the time the survey for this study was conducted.

As shown in the first column of Table 2.4, an estimated 40 percent of one- to four-family structures in the high-risk zones of the 2007 FIRM had flood insurance in 2012, with the 95-percent confidence interval for the estimate running from 37 to

42 percent. This estimate is lower than that for the same area reported in Dixon et al. (2013). In that study, the take-up rate was estimated at 55 percent, with upper and lower bounds for the estimate running from 49 to 60 percent. The gap may partly be explained by the different methods for merging the PMF onto the addresses in New York City databases. In the 2013 study, the addresses in the 2012 PMF were geocoded and mapped onto the nearest property parcel, which may overstate the take-up rate to some extent.[12] In this study, the policies were matched using both geocoded location and address, which we believe provides a more accurate estimate of the take-up rate.

The 2012 take-up rate outside the high-risk zones of the 2007 FIRM but in the study area is 8 percent. This is consistent with the 10 percent found in prior work (Dixon et al., 2013, p. 41).

Take-up rates rose substantially between 2012 and 2016. For properties in the high-risk zones of the 2007 FIRM, take-up rose from 40 to 57 percent. For those outside, but in the high-risk zones of the PFIRM, the estimated take-up rates increased from 8 to 30 percent. The increase undoubtedly reflects a number of factors including (1) heightened awareness of flood risk by both property owners and lenders, (2) requirements that property owners who received federal assistance following Hurricane Sandy purchase flood insurance,[13] and (3) outreach initiated by the mayor's office regarding flood risk and the benefits of purchasing flood insurance.

Properties with federally regulated mortgages in the high-risk zones of the 2007 FIRM are required to purchase flood insurance. Based on the property owner survey, we estimate that 61 percent of one- to four-family properties in high-risk zones of the 2007 FIRM had mortgages in 2016 (95-percent confidence interval is 55–68 percent).[14]

Table 2.4 presents initial estimates of compliance with this mandatory purchase requirement. We find that 73 percent of these had NFIP coverage. The 95-percent confidence interval for this estimate of compliance with the mandatory purchase requirement runs from 65 to 82 percent and is consistent with the 65 percent found for 2012 in prior work (Dixon et al., 2013, p. 16).[15] A final estimate for compliance with the mandatory purchase requirement will be higher than 73 percent because

[12] Dixon et al. (2013, p. 13) audited a random sample of properties to determine the extent to which the NFIP policies were accurately assigned to property parcels. They found a match rate of 88 percent, suggesting that the estimate in that study may overstate the actual take-up rate.

[13] Kousky (2016) finds that the majority of the increase in flood insurance take-up after a hurricane can be explained by the availability of disaster aid grants.

[14] Outside the high-risk zones of the 2007 FIRM, the percentage with mortgages is estimated to be 70 percent (with a 95-percent confidence interval of 64 to 77 percent).

[15] Take-up rates for properties with mortgages cannot be calculated for 2012 because the property owner survey only asked about whether there currently was a mortgage on the property—and the survey was fielded from fall 2015 through summer 2016.

Table 2.4
Flood Insurance Take-Up Rates for One- to Four-Family Properties in the Study Area

	2012		2016	
	Take-Up Rate	95% Confidence Interval	Take-Up Rate	95% Confidence Interval
In study area[a]	23%	21–24%	43%	41–44%
High-risk zones of 2007 FIRM	40%	37–42%	57%	54–60%
Outside high-risk zones of 2007 FIRM	8%	6–9%	30%	27–32%
For properties with mortgages[b]				
High-risk zones of 2007 FIRM	—	—	73%	65–82%
Outside high-risk zones of 2007 FIRM	—	—	31%	24–37%
For properties without mortgages[b]				
High-risk zones of 2007 FIRM	—	—	37%	27–47%
Outside high-risk zones of 2007 FIRM	—	—	32%	21–42%
By household income (% of AMI)[c]				
Extremely and very low (≤ 50% of AMI)	22%	14–29%	36%	28–45%
Low (50–80% of AMI)	21%	13–28%	36%	27–46%
Moderate (80–120% of AMI)	26%	18–35%	46%	36–57%
Middle (120–165% of AMI)	35%	25–46%	54%	43–66%
Higher income (> 165% of AMI)	30%	20–39%	48%	37–58%
By housing burden (PITI ratio)[c]				
< 0.2	29%	23–37%	41%	34–48%
0.2 to 0.4	31%	34–38%	57%	49–65%
> 0.4	19%	11–26%	33%	25–43%

NOTE: These estimates have been weighted to reflect all the properties in the study area.

[a] Based on the study sample of 2,800 properties.

[b] Based on study sample with complete surveys (N = 615).

[c] Based on study sample with complete surveys and for owner-occupied residences only (N = 569). The *PITI ratio* is the ratio of mortgage principal and interest, property taxes, and insurance to household income.

not all mortgages are federally regulated and because policies force-placed by lenders using private-sector insurers are not included here.[16]

Findings for properties without mortgages underscore the effectiveness of the mandatory purchase requirement: the 37-percent take-up rate for properties without mortgages in the high-risk zones of the 2007 FIRM (and thus not subject to the mandatory purchase requirement) is similar to the take-up rates outside the high-risk zones for properties either with or without mortgages (31 and 32 percent, respectively).[17]

The penultimate set of rows in Table 2.4 suggest that take-up rate increases as household income increases, particularly for 2016. The relatively large confidence intervals, however, prevent any firm conclusions. We will return to the relation between take-up rate and housing burden (the last set of rows in Table 2.4) later in this chapter.

Survey respondents were asked whether they have flood insurance on the property. Table 2.5 compares their responses with information in the 2016 PMF. The survey responses agree fairly closely with what is recorded in the PMF. Of those who reported that they had flood insurance, 84 percent indeed have flood coverage according to the PMF. Of those who reported that they did not have flood coverage, 82 percent did not have coverage according to the PMF.[18] The results do not suggest any systematic bias in homeowner perception about whether or not they have flood insurance. Forty-one of 615 survey respondents (7 percent) did not know if they had flood insurance (penultimate column of Table 2.5). For this group, it was much more common not to have flood insurance according to the PMF.

Table 2.5
Comparison of Reported and Actual Flood Insurance Coverage

	Flood Insurance Status Reported by Survey Respondent[a]			
Flood Insurance Status According to 2016 NFIP PMF	**Has Flood Insurance**	**Does Not Have Flood Insurance**	**Does Not Know**	**Total**
Has flood insurance	302 (84%)[b]	38 (18%)	14 (34%)	354 (58%)
Does not have flood insurance	57 (16%)	177 (82%)	27 (66%)	261 (42%)
Total	359 (100%)	215 (100%)	41 (100%)	615 (100%)

[a] Based on study sample with complete surveys (*N* = 615).

[b] Percentage of column total in parentheses.

[16] Dixon et al. (2007) found that including policies forced-placed by lenders would increase take up rates by about 5 percentage points (p. xv). If previous estimates that 10 percent of mortgages are not federally regulated and thus not subject to the mandatory purchase requirement, the compliance rate would increase by approximately another 8 percentage points.

[17] The price of flood insurance is typically lower outside the high-risk areas, which should be considered in a more complete analysis of the effect of the mandatory purchase requirement on take-up.

[18] The 16 and 18 percent of responses that do not agree may be in part because of errors in merging the PMF onto the addresses of survey responses.

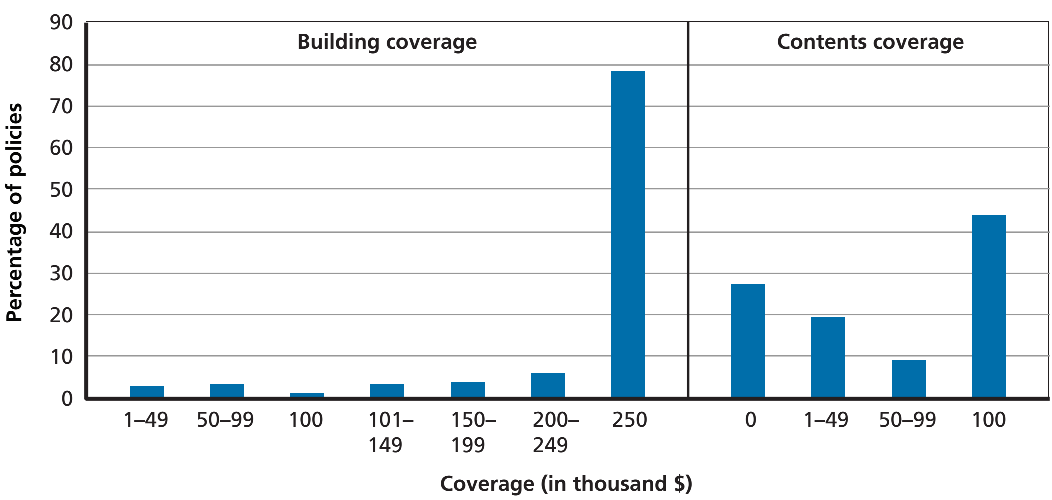
Amount of Flood Insurance Coverage

This section describes the amount of flood insurance coverage purchased through the NFIP. It also examines how the amount of coverage compares with the replacement cost for the structure.

As shown in Figure 2.2, nearly 80 percent of the one- to four-family properties in the study area with building coverage have the maximum $250,000 offered by the NFIP. Slightly more than one-quarter of the properties with building coverage do not carry contents coverage. Approximately 45 percent carry the maximum $100,000 offered by the NFIP.

The relation between building coverage and structure replacement cost is one indicator of the extent to which property owners are protected from flood losses. The NFIP policy application requires applicants to report the replacement value of the insured structure. Unfortunately, this piece of information was not included in the 2016 PMF that was provided to us. It was, however, included in the PMF as of December 31, 2014. The building coverage and replacement cost for properties with flood coverage in 2014 are displayed in Figure 2.3 for properties in the study area. Approximately 45 percent of the insured structures had replacement value of greater than $250,000, illustrating that a substantial fraction of one- to four-family structures are

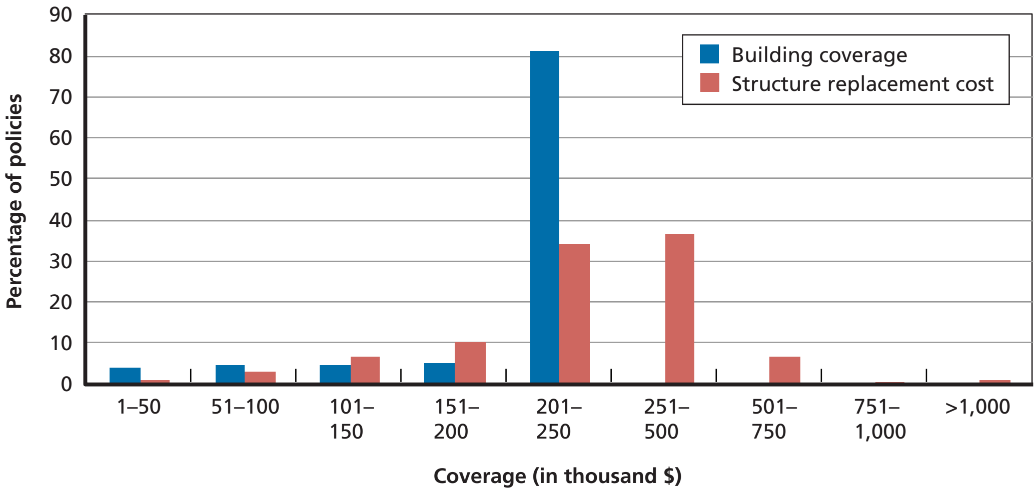
Figure 2.2
Building and Contents Coverage for Policies in Force as of June 2016



NOTE: Data are based on properties in the study sample with a flood insurance policy as of June 2016 (*N* = 1,209). Only policies with building coverage are included.

RAND *RR1776-2.2*

Figure 2.3
Building Coverage and Replacement Cost for Policies in Force as of December 31, 2014



NOTE: Data are based on properties in the study sample with a flood insurance policy as of December 31, 2014 (*N* = 775).
RAND *RR1776-2.3*

unable to obtain full coverage from the NFIP.[19] We also found that, to the extent possible, the vast majority of policyholders were insuring to replacement cost. Eighty-seven percent purchased building coverage that was greater than or equal to replacement cost or equal to the maximum offered by the NFIP. A more detailed examination of relationship among building coverage, replacement cost, and the mortgage balance is presented in Appendix D.

Table 2.6 reports the deductibles selected by policyholders for policies in place as of June 2016. (There are separate deductibles for building and contents coverage.) Very few policyholders selected the new $10,000 deductible offered by the NFIP. The deductibles are typically between $1,000 and $2,000, with a modest share of policyholders selecting a $5,000 deductible.

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[19] Based on interviews with private insurers that RAND conducted for its 2013 flood insurance report (Dixon et al., 2013), residential property owners can obtain excess coverage in the private market, but such coverage is rare. This was attributed to the fact that private insurers are very selective about the properties they will cover in the high-risk zones and some exclude any coverage in high-risk zones altogether. The excess coverage is often more expensive and can be fleeting as insurer risk appetite can change at any time leading to insurers dropping the coverage.

Table 2.6
Deductible Amounts for Flood Insurance Policies in Place as of June 2016 (Percentage of Policies)

Deductible Amount	Building Coverage[a]	Contents Coverage[b]
$1,000	3%	5%
$1,250	57%	71%
$1,500	2%	1%
$2,000	16%	14%
$3,000	1%	1%
$4,000	<0.5%	<0.5%
$5,000	18%	6%
$10,000	2%	1%
All deductible amounts	100%	100%

SOURCE: 2016 PMF.

[a] Based on properties in the study sample with a flood insurance policy as of June 2016 (*N* = 1,209). Only policies with building coverage are included.

[b] Based on properties in the study sample with building and contents coverage as of June 2016 (*N* = 885).

Affordability of Flood Insurance

Flood Insurance Premiums

In this section, we examine the amount paid for NFIP coverage in the study area. Before doing so, we review the rating methods available to structures inside and outside the high-risk zones. As shown in Table 2.7, elevation-based rates are available to both pre-FIRM and post-FIRM structures inside the high-risk zones. Elevation-based rates require information about the elevation of the structure relative to BFE and require the property owner to provide an EC with the NFIP application. Elevation-based rates are typically referred to as post-FIRM rates, but this terminology is somewhat misleading because they are available to both pre-FIRM and post-FIRM structures. Non-elevation-based rates inside the high-risk zones (typically referred to as pre-FIRM rates) are available only to pre-FIRM structures. Preferred risk policies (PRPs) are not available inside the high-risk zones.[20]

Elevation-based rates are not available outside the high-risk zones of the 2007 FIRM because FIRMs do not provide BFEs outside the high-risk zones. Non-elevation-based rates are available to both pre-FIRM and post-FIRM structures. The rates are sometimes referred to as s*tandard X zone rates* and differ from the non-

[20] As will be discussed in Chapter Three, properties that are newly mapped into a high-risk flood zone can pay a PRP rate initially, but that rate will increase over time.

Table 2.7
Rating Methods in 2016 NFIP Policy Master File

Property Location and Rating Method	Pre-FIRM Properties	Post-FIRM Properties
Property in high-risk zones of 2007 FIRM		
Elevation-based rates	X	X
Non-elevation-based rates[a]	X	—
PRP	—	—
Property outside high-risk zones of 2007 FIRM		
Elevation-based rates	—	—
Non-elevation-based rates[b]	X	X
PRP	X	X

[a] Also referred to as the pre-FIRM rate.
[b] Also referred to as the standard X zone rate.

elevation-based rates available inside the high-risk zones. Finally, PRPs are available to both pre-FIRM and post-FIRM structures outside the high-risk zones, but only for structures meeting certain criteria.[21]

The NFIP PMF reports a figure for the flood insurance premium paid by the policyholder, but this figure does not reflect the total amount paid by the policyholder. The total amount paid by the policyholder comprised the following components:

Total premium = *base premium* +
increased cost of compliance (ICC) premium +
deductible adjustment +
reserve fund assessment +
federal policy fee +
HFIAA surcharge.

Specifically, the premium in the PMF does not include the reserve fund assessment, the federal policy fee, or the HFIAA surcharge, and thus is a partial figure for the total premium paid by the policyholder.[22]

[21] A structure is ineligible for a PRP if any of the following conditions are met within a ten-year period regardless of change of ownership: (1) two flood insurance claim payments for separate losses, each more than $1,000; (2) three or more flood insurance claim payments for separate losses, regardless of amount; (3) two federal flood disaster relief payments (including loans and grants) for separate occurrences, each more than $1,000; (4) three federal flood disaster relief payments (including loans and grants) for separate occurrences, regardless of amount; (5) one flood insurance claim payment and one federal flood disaster relief payment (including loans and grants), each for separate losses and each more than $1,000 (FEMA, 2015a, p. PRP-1).

[22] From the NFIP's perspective, the federal policy fee, the reserve fund assessment, and the HFIAA surcharge are fees and not part of the *insurance premium*.

Based on the premium reported in the 2016 PMF, we constructed an estimate of the total premium paid by the one- to four-family homes in the study sample with flood insurance. For the rate schedule in effect as of April 2015,

- the reserve fund assessment was 10 percent of the base plus increased cost of compliance premium for PRPs and 15 percent for most other policies[23]
- the policy fee was $22 for PRPs and $45 for other policies
- the HFIAA charge was $25 for primary residences and $250 for nonprimary residences (FEMA, 2015a, p. RATE-15).

As reported in Table 2.1, the vast majority of homes in the study sample are owner occupied, so we set the HFIAA charge to $25. The resulting estimated total premium is reported in Table 2.8. The premium is broken down by flood zone and rating method and reflects the amount of coverage purchased. The majority of policies in the high-risk zones of the 2007 FIRM are not elevation rated (top boxed cell). The estimated total premium for policies rated in this way averaged $2,600 with the range running from $290 to $9,950. This premium is much higher than the $1,120 average for the elevation-rated structures.[24] A surprising 10 percent of policies are PRPs—surprising because PRPs are not available in high-risk areas. A likely explanation is that the flood zone was incorrectly stated in the policy application. The tabulations in Table 2.8 are based on the flood zone as indicated by the ECs completed for this study, which in some cases differ from those indicated in the policy application.[25]

Policies outside the high-risk zones of the 2007 FIRM are overwhelmingly PRPs (bottom boxed cells). The estimated total premiums on these policies are low—averaging $470 per year. Not all properties outside the high-risk zones qualify for a PRP, and those that do not typically receive the standard X zone rate, which is available to both pre-FIRM and post-FIRM structures outside the high-risk areas. The premiums on these policies are much higher—averaging $1,650. A few policyholders outside the high-risk zones are using elevation-based rates—but these are likely because of errors in the flood zone provided on the PMF given that FIRMs do not provide a BFE outside the high-risk zones.

Housing Burden

Flood insurance adds to the cost of owning a home, and we frame the discussion of flood insurance affordability in terms of the ratio of homeownership costs to household

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[23] The reserve fund assessment was $0 for the Group Flood Insurance Policy.

[24] The main reason for the low average premium is that structure elevation averages –0.2 feet below BFE for this group (median is no difference from BFE).

[25] Table E.4 in Appendix E shows that the flood zone is incorrectly stated as B, C, or X on the flood insurance policy in approximately 10 percent of cases (18 of 172) when the property is actually in a high-risk zone according to the EC completed for this study. This 10 percent matches that 10 percent in the top part of Table 2.8.

Table 2.8
Rating Method in 2016 NFIP Policy Master File and Estimated Total Premium

Property Location and Rating Method	Number of Properties	Percentage of Total	Estimated Total Premium[a] Average	Median	Minimum	Maximum
Property in high-risk zones of 2007 FIRM						
Non-elevation-based rates	402	55%	$2,600	$2,600	$290	$9,950
Elevation-based rates	255	35%	$1,120	$840	$350	$6,060
PRP	71	10%	$480	$500	$290	$500
Other	5	1%	$2,850	$2,940	$2,020	$3,820
Total	733	100%	$1,880	$1,550	$290	$9,950
Property outside high-risk zones of 2007 FIRM						
Non-elevation-based rates	22	5%	$1,650	$1,490	$320	$3,480
Elevation-based rates	2	< 0.5%	$870	$870	$570	$1,170
PRP	452	95%	$470	$500	$190	$500
Other[b]	0	0%	—	—	—	—
Total	476	100%	$530	$500	$190	$3,480

SOURCE: Author analysis of NFIP PMF for New York City as of June 30, 2016.
[a] Assumes that the home is a primary residence.
[b] Includes FEMA special rate and tentative rating methods.

income. Federal agencies have long regarded renter households that spend more than 30 percent of their income on housing as "burdened."[26] Programs such as HUD's housing assistance program provide assistance when rents exceed 30 percent of adjusted household income. An analogous concept for homeowners is the debt-to-income (DTI) ratio used in regulations developed pursuant to Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. As defined in these regulations, debt includes mortgage principal and interest payments, property taxes, and insurance; homeowners association fees; payments on other loans (e.g., car, student, payday); minimum credit card payments; judgments; alimony; child support; and other debt payments. Income is pre-tax and pre-deduction earnings. There are a number of conditions identified in the

[26] Schwartz and Wilson (undated) trace the history of this definition back to the National Housing Act of 1937. The regulations promulgated pursuant to this act originally offered public housing to families with incomes less than five to six times the rent. This rule was quickly changed to limit maximum rent to 20 percent of the family's income. The Housing Act of 1959 gave local authorities power to set maximum rent as a function of income, which resulted in increased rent paid by families living in public housing. The 1969 Brooke Amendment established a maximum rent of 25 percent of family income, and in 1981 Congress further raised this maximum rent to 30 percent.

Consumer Financial Protection Bureau Ability-to-Repay Rule, which a new mortgage must meet to be considered a "qualified mortgage," and one of them is that the DTI should not exceed 0.43 (Bureau of Consumer Financial Protection, 2013).[27]

The Federal Housing Administration (FHA) uses two different ratio limits, the DTI ratio (also known as the back-end ratio) as well as the front-end ratio. The front-end ratio includes the following housing-related debts:

- mortgage principal and interest payments
- escrow deposits for real estate taxes
- fire and hazard insurance (including flood insurance)
- mortgage insurance premium
- homeowners' association dues
- ground rent
- special assessments, and
- payments for any acceptable secondary financing (HUD, 2011a).

Depending on credit score and other circumstances, FHA allows the maximum for the back-end ratio to vary between 0.43 and 0.50 and the front-end ratio to vary from 0.31 to 0.40 (HUD, 2016, p. 325).

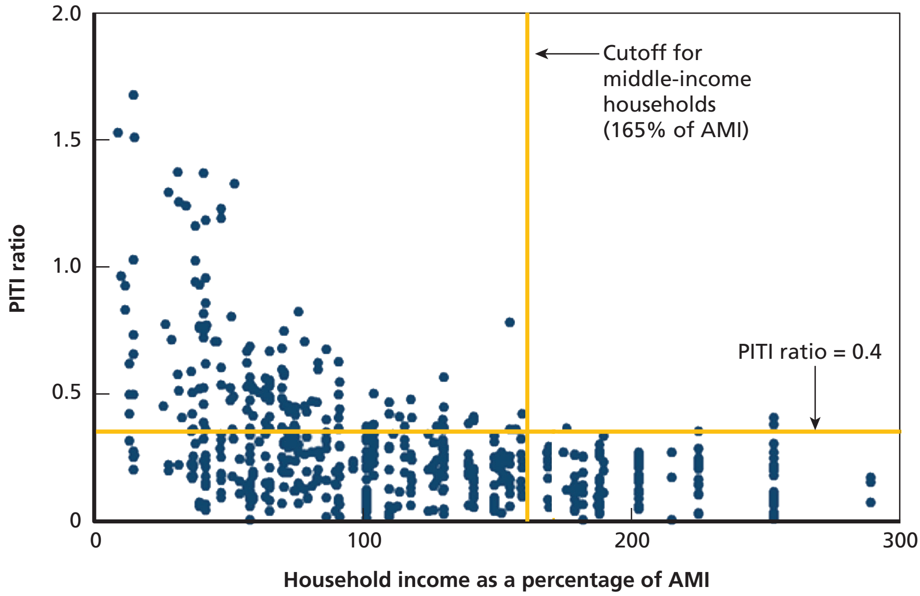
For this study, we were able to assemble information very close to the front-end ratio for the households participating in this study. Monthly mortgage payments on first and second mortgages and payments for fire, hazard, and flood insurance were collected in the property owner survey. Property taxes were obtained from the New York City Department of Finance. Careful efforts were made not to double-count property taxes and insurance payments escrowed in the mortgage. Consistent with common terminology in the lending industry, we refer to these costs collectively as PITI (mortgage principal and interest [PI], property taxes [T], and insurance [I]). We consider households housing burdened if the ratio of PITI to household income (PITI ratio) exceeds 0.4.[28] Because 0.4 is the top end of the range used to determine loan eligibility by FHA, choosing 0.4 as the cutoff for our analysis will provide a conservative estimate of the number of households that are housing burdened.

Figure 2.4 shows the PITI ratios for the households in the study area's owner-occupied residences. The PITI ratio is graphed against household income expressed in terms of AMI. For example, 50 percent on the horizontal axis means that the household's income is 50 percent of AMI for that size household (very low income). As can be seen, the PITI ratio exceeds 0.4 for many households, particularly low-income households. Note that the PITI ratio exceeds 0.4 for very few households with incomes

[27] These regulations were established pursuant to the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. See also HUD, 2011b.

[28] Data on utility costs were also collected in the property owner survey. Appendix D reports findings on utility costs.

Figure 2.4
Relationship Between PITI Ratio and Household Income



NOTE: Survey results for 569 owner-occupied households. Six households that report annual household income of less than $20,000 and have a PITI ratio greater than 2.5 but less than 4.1 are not shown on this chart.
RAND *RR1776-2.4*

greater than the upper threshold for the middle-income range (the middle-income range runs between 120 percent and 165 percent of AMI).

Table 2.9 breaks down households by PITI ratio, income range, and age. As can be seen from the third row of the table, 25 percent (10,700) of the owner-occupied, one- to four-family homes in the study area are housing burdened.[29] A very high 64 percent of extremely low- and very low–income households are housing burdened (see second group of rows in Table 2.9). The proportion that are housing burdened drops as income rises, falling to only 1 percent when household income is more than 165 percent of AMI (see third to last group of rows in Table 2.9). Somewhat surprisingly, the findings are nearly identical when the oldest financially responsible person is 65 or older and for households when the oldest financially responsible person is younger than 65 (last two sets of rows in Table 2.9). Additional information on the amount spent on the components that make up PITI and on the amount spent on utilities is included in Appendix D.

[29] Twenty-five percent is the sum of the 14 percent with the PITI ratio between 40 and 60 and the 11 percent with the PITI ratio more than 60 percent.

Table 2.9
PITI Ratios in the Study Area, Owner-Occupied Residences Only

PITI Ratio	Number of Households	Percentage of Households	95% Confidence Interval: Number of Households	95% Confidence Interval: Percentage of Households
All owner-occupied residences				
0 to 0.3	26,800	63%	24,700–28,800	58–67%
> 0.3 and ≤ 0.4	5,100	12%	4,000–6,600	9–15%
> 0.4 (housing burdened)	10,700	25%	8,900–12,700	21–30%
Extremely low- and very low–income households (income ≤ 50% of AMI)				
0 to 0.3	2,200	30%	1,600–3,100	21–41%
> 0.3 and ≤ 0.4	400	6%	200–900	3–12%
> 0.4 (housing burdened)	4,700	64%	3,900–5,500	53–74%
Low-income households (income 50–80% of AMI)				
0 to 0.3	4,000	43%	3,100–5,000	32–53%
> 0.3 and ≤ 0.4	1,500	16%	1,000–2,300	10–24%
> 0.4 (housing burdened)	3,900	41%	2,900–4,900	31–52%
Moderate- and middle-income households (income 80–165% of AMI)				
0 to 0.3	11,200	70%	9,900–12,200	63–77%
> 0.3 and ≤ 0.4	2,700	17%	1,900–3,800	12–24%
> 0.4 (housing burdened)	2,000	12%	1,200–3,000	8–19%
Higher-income households (income > 165% of AMI)				
0 to 0.3	9,400	94%	8,700–9,700	87–97%
> 0.3 and ≤ 0.4	500	5%	200–1,100	2–11%
> 0.4 (housing burdened)	100	1%	0–700	0–7%
Older households (financially responsible person ≥ 65 years old)				
0 to 0.3	8,400	62%	7,200–9,600	53–70%
> 0.3 and ≤ 0.4	1,500	11%	1,000–2,300	7–17%
> 0.4 (housing burdened)	3,700	27%	2,700–5,000	20–36%
Younger households (financially responsible person < 65 years old)				
0 to 0.3	18,400	63%	16,700–20,000	57–69%
> 0.3 and ≤ 0.4	3,600	13%	2,700–4,900	9–17%
> 0.4 (housing burdened)	7,000	24%	5,600–8,600	19–30%

NOTE: These values are based on a sample of 569 owner-occupied residence households. Categories may not add exactly to total because of rounding to nearest 100. Sample weights are as described in Appendix A.

Figure 2.5
PITI Ratios in the Study Area, Owner-Occupied Residences Only

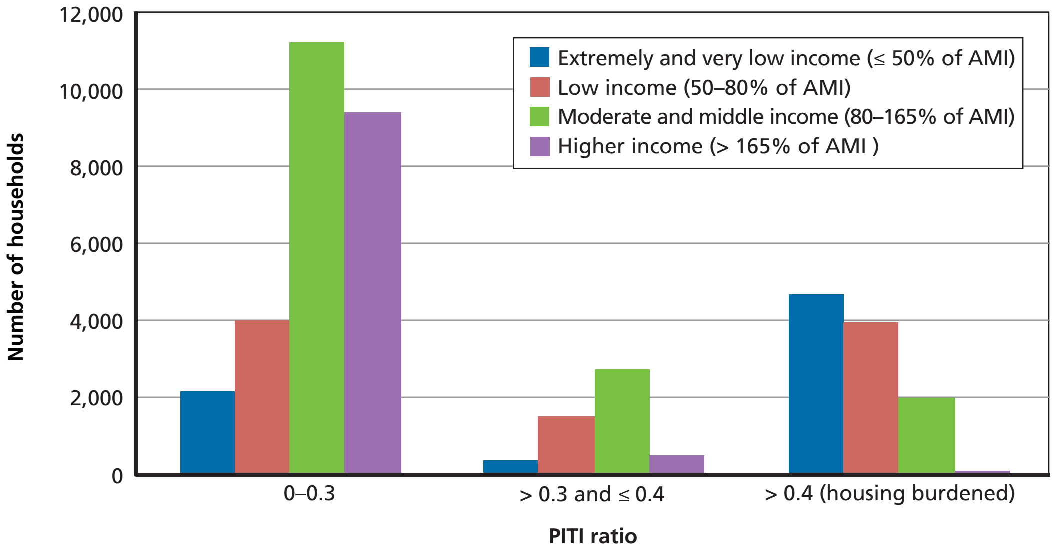


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Figure 2.5 shows the number of homeowners that are housing burdened in the study area. As shown by the right-most group of boxes, an estimated 4,700 extremely low- and very low–income households are housing burdened, as are 3,900 low-income households. Roughly 2,000 moderate- and middle-income households are housing burdened, and very few higher-income households are housing burdened.

An estimated 33 percent of the 10,700 households in the study area that are housing burdened have flood insurance (bottom row of Table 2.4). Thus, for these 3,500 households, one can argue that the flood insurance premium they paid in 2016 was burdensome, or at least that part of the flood insurance program that causes the PITI ratio to exceed 0.4. The remaining 7,200 households with PITI ratios above 0.4 do not have flood insurance, and purchasing flood insurance would only increase their PITI ratio further above 0.4. Consequently, flood insurance is also burdensome for these households using this measure of housing burden. There are some additional households currently without flood insurance whose PITI ratio would increase above 0.4 if they purchased flood insurance. Adding in an estimate for the number of such properties increases the estimate for the number of households in the study area for which flood insurance is burdensome from 10,700 to 11,000 (out of 42,700 owner-occupied one- to four-family properties).[30]

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[30] If the properties without flood insurance paid the average premium for flood insurance that other properties do (approximately $1,880 in the high-risk zones and $530 outside the high-risk zones), then approximately 260

Summary of Key Findings

There are approximately 48,100 one- to four-family properties in the study area. Owner-occupied residences account for about 90 percent of these properties and just less than 40 percent of the households living in them are low income. A considerable number of one- to four-family properties in the study area face substantial flood risk: more than 85 percent of properties in the high-risk areas of the 2007 FIRM are below BFE and two-thirds are 3 feet or more below BFE.

The flood insurance take-up rate is an estimated 43 percent in the study area, substantially higher than in 2012, but even those property owners who have insurance are not fully covered for flood-related losses. Replacement cost is greater than building coverage for about 45 percent of the structures with flood insurance.

Using a definition of housing burden based on the PITI ratio, flood insurance is burdensome for approximately 11,000 (26 percent) of the households in owner-occupied one- to four-family residences in the study area. As expected, flood insurance is most difficult to afford for low-income households. We found that flood insurance is burdensome for 64 percent of extremely and very low–income households and for 41 percent of low-income households. Take-up rates are also lower for low-income households.

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properties currently below the 0.4 threshold would move above the 0.4 threshold. That part of the premium that pushed their PITI ratio over 0.4 would be considered burdensome.

CHAPTER THREE

Flood Insurance Premium Scenarios

Chapter Two examined the flood insurance premiums that are currently paid and the extent to which they are financially burdensome. That analysis was predicated on the FIRM currently in place (the 2007 FIRM), the NFIP rate schedule in effect between July 1, 2015, and June 30, 2016, and the availability of non-elevation-based rates for pre-FIRM structures.

This chapter examines how flood insurance premiums in New York City might change moving forward. The NFIP is gradually increasing pre-FIRM rates so that they are no longer cheaper than elevation-based rates, and we first examine the impact of eliminating the pre-FIRM rates given the 2007 FIRM.

We then turn to how flood premiums might change if a FIRM such as the PFIRM that was issued in June 2013 were adopted. That PFIRM is now being revised, but it provides an initial look at how the flood zones and BFE might change when the 2007 FIRM is updated. We project premiums under the PFIRM given the April 1, 2015, rate schedule. Doing so allows us to characterize the effects of changes in the FIRM, *ceteris paribus*. Although the advantages of pre-FIRM rates may well be largely eliminated by the time a revised map is in place, we calculate how much premiums would change under the PFIRM if the pre-FIRM rates currently allowed in the April 2015 rate schedule were removed.[1] We also examine the effect of grandfathering on flood insurance premiums. Grandfathering allows premiums to be based on the flood zone and BFE of the earlier FIRM in some circumstances, and we analyze how premiums would change should grandfathering not be available.[2] We finally explore the effect 8 inches of sea level rise (SLR) would have on premiums.

We conclude by examining the impact of these premium increases on housing burden in the study area. These premium scenarios will be used to examine the eco-

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1 The NFIP is phasing out pre-FIRM subsidies by gradually increasing non-elevation-based rates in the high-risk areas until they are no longer less expensive than elevation-based rates.

2 The NFIP does not consider grandfathering a subsidy because the lower rates paid by some policyholders are offset by charging higher rates to other policyholders. Although this cross-subsidy does not come from outside the program, it nevertheless is a subsidy for certain policyholders.

nomic consequences of potential premium increases (Chapter Five) and the costs and benefits of various flood insurance affordability programs (Chapter Six).

Approach

A detailed flood insurance premium model was developed to analyze how flood insurance premiums would change under different scenarios. As described in Appendix E, flood insurance premiums were assigned to each structure in the study for which an EC was completed using structure and flood zone characteristics such as

- occupancy (one and two-to-four family)
- structure type (e.g., slab, basement, enclosure, crawlspace, subgrade crawlspace)
- number of floors
- location of M&E
- flood zone
- structure elevation relative to BFE
- residency (whether primary residence of property owner).

When a structure is eligible for more than one type of rate (see Table 2.7 in Chapter Two), the structure is assigned the most favorable rate. For example, pre-FIRM structures in high-risk flood zones are eligible for both elevation-based and non-elevation-based rates, and, as will be shown, the elevation-based rate is often less than the non-elevation-based rate given the 2007 FIRM. The premium model is validated using the premiums reported in the 2012 NFIP PMF. The validation exercise shows that the premium model reproduces the premiums in the 2012 PMF quite closely (see Appendix E).

Premiums are projected for the 485 structures in the study sample with ECs, and the results scaled up to the 48,100 structures using statistical weights. The weighting procedure is explained at the end of Appendix A.

Premiums are generated for the scenarios described in Table 3.1. In all cases, the full premium including all fees is projected. Scenario A characterizes the situation on the eve of Hurricane Sandy with the 2007 FIRM in place before the premium increases required by BW-12 and HFIAA began to be implemented. Scenario B captures the effects of changes in the NFIP rate schedule between 2012 and 2015, holding other factors constant. Scenario C examines the impact of eliminating the pre-FIRM rate, which is what FEMA is gradually in effect doing over time.

Scenarios D through G examine the effect that the PFIRM would have on flood insurance premiums in the study area. Scenario D uses the PFIRM but allows grandfathering and the pre-FIRM rates provided in the 2015 rate schedule. Scenario E shows the impact of eliminating pre-FIRM rates when the PFIRM is in place (this impact

Table 3.1
Premium Scenarios Examined

Scenario	FIRM in Effect	NFIP Rate Schedule	Grand-fathering Available	Pre-FIRM Rates Available	Description
A	2007 FIRM	2012	—	Yes	Situation on the eve of Hurricane Sandy
B	2007 FIRM	2015	—	Yes	Updates NFIP rates to 2015 levels
C	2007 FIRM	2015	—	No	Eliminates pre-FIRM rates
D	PFIRM	2015	Yes	Yes	Updates flood map but allows grandfathering and pre-FIRM rates
E	PFIRM	2015	Yes	No	Eliminates pre-FIRM rates when PFIRM in place, but keeps grandfathering
F	PFIRM	2015	No	Yes	Eliminates grandfathering but keeps pre-FIRM rates
G	PFIRM	2015	No	No	Eliminates both grandfathering and pre-FIRM rates. Moves closer to risk-based rates.
H	PFIRM	2015	No	No	Shows impact of 8-inch SLR

is not necessarily the same as when a less-stringent flood map is in place). Scenario F shows the impact of eliminating grandfathering, and scenario G shows what would happen to rates if two of the major features that cause NFIP rates to diverge from risk-based rates—grandfathering and pre-FIRM rates—are eliminated. The premiums in scenario G are closer to risk-based rates assuming the flood risk portrayed in the PFIRM is accurate. Finally, scenario H provides insight into how SLR would affect flood insurance premiums in the study area. Sea level is expected to rise 8 inches from the levels assumed in the PFIRM by sometime in the 2020s.[3] Eight inches of SLR is assumed to increase the BFE throughout the PFIRM by 8 inches.[4]

The premium scenarios project the levels that premiums will ultimately reach under the conditions specified, but they do not consider the time pattern for moving there. Congress has limited annual flood insurance premium increases to 18 percent per year, so large premium increases would be phased in over multiple years. For example, if premiums triple as they do in some of the scenarios below, it would take approximately seven years for the premiums to reach the new levels at an 18-percent com-

[3] Eight inches is the 75th percentile of estimates by the New York City Panel on Climate Change on the amount of SLR by sometime in the 2020s (see Horton et al., 2015, p. 41).

[4] It may well be that 8 inches of SLR will cause BFE to increase by more than 8 inches in the study area or that the effects will differ across the study area. However, an 8-inch BFE increase throughout the study provides at least an initial sense of the impact of SLR. The range of SLR over which the estimated impact can be linearly extrapolated requires further investigation.

pound annual growth rate. (See Appendix F for more detailed information on allowed premium increases.)

The analysis assumes that all properties eligible for grandfathered rates will use those rates if they are more favorable than other available rates. However, there are various eligibility requirements for grandfathered rates, and property owners may fail to qualify for them. For example, a pre-FIRM property whose flood zone changes from zone A to zone V may keep the zone A rate only if coverage was in place before the FIRM changed. In addition, the rate will convert to the zone V rate if the policy lapses for more than 90 days or twice for periods of more than 30 days. Eligibility criteria for both grandfathered rates and pre-FIRM rates are summarized in Appendix F. The implication of these often-stringent eligibility requirements is that the premium scenarios that allow grandfathering likely paint an overly optimistic picture of the rates that property owners in New York City will actually pay when the FIRM is updated.

An important input into the premium projections is the amount of flood insurance coverage assumed for each structure. Based on the analysis in Chapter Two, the following coverage limits are assumed:

- building coverage: the lesser of replacement cost and $250,000 (the maximum offered by the NFIP)
- contents coverage: $100,000 for structures with $250,000 in building coverage and 40 percent of the amount of building coverage for structures with less than $250,000 in building coverage.

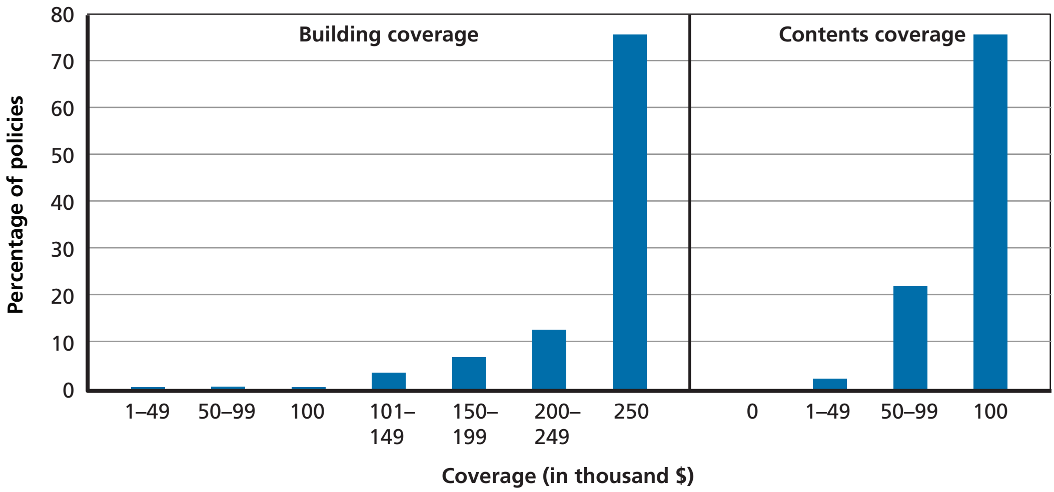
The deductible is assumed to be $2,000 for building coverage and $2,000 for contents coverage (abbreviated as $2,000/$2,000).

There are two main justifications for setting building coverage to the lesser of replacement cost and $250,000. First, as shown in Chapter Two, upward of 85 percent of the policyholders in 2016 had coverage greater than replacement cost or equal to $250,000. Second, from a public-policy perspective, it is desirable for property owners to have the resources available to repair damage after a flood. The NFIP's $250,000 building coverage cap limits the extent to which this objective can be achieved, but setting building coverage to the minimum of replacement cost or $250,000 moves in the right direction.

The deductible assumed reflects the observed deductible chosen by NFIP policyholders in New York City in 2016 (see Table 2.6).

Figure 3.1 shows the coverage limits assumed in the premium projections for the one- to four-family homes in the study area. Similar to Figure 2.2 in Chapter Two, approximately 75 percent of one- to four-family structures have $250,000 in building coverage. All policyholders are assumed to carry contents coverage (in contrast to observed behavior of current NFIP policyholders), with about 75 percent carrying the maximum $100,000 offered. The argument for setting contents coverage at these levels

Figure 3.1
Building and Contents Coverage Assumed in the Premium Scenarios



NOTE: The distributions of building coverage and contents coverage have been statistically reweighted to reflect all 48,100 properties in the study area.
RAND *RR1776-3.1*

is analogous to that for building coverage—from a public policy perspective, it is desirable for property owners to have the resources to recover after a disaster.

Example Premium Calculations

A few examples help better understand how premiums are calculated and the magnitude expected for premiums in the study area using the April 2015 rate schedule. Table 3.2 characterizes a typical structure in the high-risk zone of the 2007 FIRM. The elevation difference chosen for the example is the most common observed in the high-risk areas of the 2007 FIRM (see Figure 2.1 in Chapter Two).

We calculate the elevation-based rate and the non-elevation-based rate (pre-FIRM rate) for this structure. For the elevation-based rate, we begin by calculating the base premium. The base premium is calculated using the rates for the appropriate elevation difference in Table 3.3 (boxed cells). The basic building rate applies to the first $60,000 of building coverage and the additional rate to the remaining $190,000. For contents coverage, the basic rate applies to the first $25,000 of coverage, and the additional rate applies to the remaining $75,000. The resulting base premium comes to $2,500 and is shown in Table 3.4. Including the other premium components increases the total premium to $2,762.

The bottom part of Table 3.4 shows the *non*-elevation-based premium for this structure. The building and contents rates are shown in the last row of Table 3.3, with a resulting base premium of $4,053. The total premium comes to $4,794, which is over $2,000 higher than the elevation-based rate.

Table 3.2
Structure Characteristics for Premium Example

Characteristic	Example Value
Date constructed	Pre-FIRM
Occupancy	Single family
Structure type	Has basement
Number of stories	3 (including basement)
Flood zone	A
Elevation difference	3 feet below BFE
Location of contents	Throughout structure
Location of M&E	In basement
Building coverage	$250,000 with $2,000 deductible
Contents coverage	$100,000 with $2,000 deductible

Premiums Using the 2007 Flood Insurance Rate Map

Figure 3.2 shows the scenarios examined with the 2007 FIRM in place. The first three columns characterize premiums for the 22,200 one- to four-family properties in the high-risk zones of the 2007 FIRM, and the second three columns characterize the premiums for the 25,800 one- to four-family newly mapped properties (those inside the study area but outside the high-risk zones of the 2007 FIRM). The box-and-whisker plots show the fifth percentile (end of bottom whisker), 25th percentile (bottom of box), median (line inside box), 75th percentile (top of box), and 95th percentile (end of top whisker) of the distribution of flood insurance premiums in each scenario. The average premium is reported in the penultimate line of the figure followed by the 95-percent confidence interval for the average. The 95-percent confidence interval reflects the fact that these premium projections are based on a sample of the one- to four-family properties in the study area.[5] The confidence interval would be larger if there were fewer properties in the sample.

The mean and median premiums in scenario A are $4,100 and $3,300, respectively, for proprieties inside the high-risk zones of the 2007 FIRM, given the assumed amount of building and contents coverage and the $2,000/$2,000 deductible. One-quarter of property owners are paying more than $3,800 (the 75th percentile), and premiums exceed $9,800 for 5 percent.

[5] If the study were repeated over and over with the same number but a different set of property owners enrolling in the study each time, the resulting mean premium would be expected to fall within this 95-percent confidence interval 95 percent of the time.

Table 3.3
Rates from the NFIP April 2015 Rate Schedule

	Building Coverage ($ per $100 of coverage)		Contents Coverage ($ per $100 of coverage)	
Elevation Difference in Feet (Structure Elevation–BFE)	Basic (First $60,000 of Coverage)	Additional	Basic (First $25,000 of Coverage)	Additional
Elevation-based rates				
≥ 4	0.24	0.08	0.38	0.12
3	0.27	0.08	0.38	0.12
2	0.32	0.08	0.38	0.12
1	0.46	0.09	0.38	0.12
0	0.68	0.10	0.38	0.12
–1	0.89	0.12	0.38	0.13
–2	2.09	0.18	0.68	0.13
–3	2.87	0.25	0.82	0.13
–4	3.15	0.54	0.85	0.14
–5	3.15	0.85	0.88	0.14
–6	3.15	1.07	0.90	0.17
–7	3.15	1.33	1.29	0.22
–8	4.05	1.34	1.85	0.27
–9	5.10	1.35	2.64	0.32
–10	6.13	1.37	3.69	0.37
–11	7.15	1.39	4.38	0.48
–12	8.18	1.41	4.81	0.59
–13	9.33	1.39	5.23	0.71
Non-elevation-based rates	0.95	1.20	1.12	1.23

SOURCE: Torrent Technologies, Inc.

NOTE: Rates from the April 2015 rate schedule for a one- to four-family structure in an AE zone, with two or more floors, contents located throughout the structure, and M&E in the basement.

Somewhat unexpectedly, changes in the NFIP rate schedule between 2012 and 2015 result in an overall reduction in flood insurance premiums in the high-risk areas of the 2007 FIRM. The average premium in scenario B is lower than in scenario A ($3,500 versus $4,100), and there are fewer property owners paying the highest premiums in scenario A. In contrast to the 2012 NFIP rate schedule, the 2015 schedule

Table 3.4
Premiums for the Example Structure

Premium Component	Building Coverage	Contents Coverage	Total
Elevation-based rate			
Base premium	$2,197	$303	$2,500
Increased cost of compliance premium	—	—	$4
Deductible adjustment[a]	—	—	–$188
Reserve fund assessment[b]	—	—	$376
Federal policy fee	—	—	$45
HFIAA surcharge	—	—	$25
Total			$2,762
Non-elevation-based rate			
Base premium	$2,850	$1,203	$4,053
Increased cost of compliance premium	—	—	$55
Deductible adjustment[c]	—	—	0
Reserve fund assessment[b]	—	—	$616
Federal policy fee	—	—	$45
HFIAA surcharge	—	—	$25
Total			$4,794

[a] –7.5% of base premium.
[b] 15 percent of base and ICC premiums.
[c] There is no deductible adjustment for a $2,000/$2,000 deductible on a non-elevation-based rate.

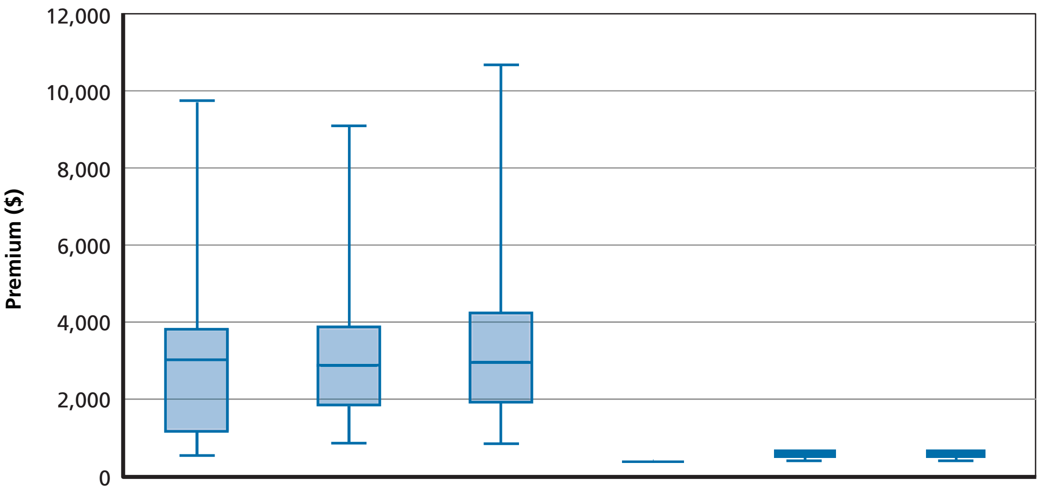
includes a reserve fund assessment and HFIAA surcharge, but increases because of these charges are offset by changes in other parts of the schedule.[6] However, flood insurance premiums remain high for a substantial number of property owners. Twenty-five percent would pay more than $3,900, and 5 percent would pay more than $9,100. These high premiums would undoubtedly discourage some property owners from purchasing the amount of coverage assumed in these scenarios or from purchasing flood insurance at all. They may also create a substantial financial hardship for some households, a topic to which we will return later in this chapter.

Comparing scenarios B and C shows the impact of eliminating pre-FIRM rates with the 2007 FIRM in place. The mean and median premiums go up in scenario C,

[6] NFIP actuaries who reviewed these premiums projections did not find differences between scenarios A and B surprising.

Figure 3.2
Flood Insurance Premium Projections Using the 2007 FIRM for Properties in Study Area

Premium scenario	In High-Risk Zones of 2007 FIRM[a]			Outside High-Risk Zones of 2007 FIRM[b]		
	A	B	C	A	B	C
Rate schedule	2012	2015	2015	2012	2015	2015
FIRM	2007	2007	2007	2007	2007	2007
Pre-FIRM subsidy	Yes	Yes	No	Yes	Yes	No



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5th percentile	$500	$800	$800	$400	$400	$400
25th percentile	$1,200	$1,900	$1,900	$400	$500	$500
Median	$3,300	$3,000	$3,100	$400	$500	$500
75th percentile	$3,800	$3,900	$4,300	$400	$700	$700
95th percentile	$9,800	$9,100	$10,700	$400	$700	$700
Mean	$4,100	$3,500	$4,100	$400	$600	$600
95% confidence interval for mean	$2,600–5,500	$2,800–4,100	$3,300–4,800	$400–410	$550–580	$550–580

NOTE: Premiums include all fees.

[a] 22,200 one- to four-family properties.

[b] 25,900 one- to four-family properties. These properties are outside the high-risk zones of the 2007 FIRM but in the study area, so are inside the high-risk zones of the PFIRM.

but the increases are surprisingly modest. The reason is that the elevation-based rate is already cheaper than the non-elevation-based rate for 76 percent of the pre-FIRM structures in the high-risk zones of the 2007 FIRM.[7]

Although the average and median premium increase only modestly when pre-FIRM rates are eliminated, pre-FIRM rates provide substantial savings for some property owners. Roughly 20 percent of property owners in the high-risk zones will see premiums go up if pre-FIRM rates were eliminated, and 10 percent will see them go up by $1,200 or more.[8]

Outside the high-risk zones of the 2007 FIRM, the premiums are low in all three of the scenarios examined (see rightmost three columns in Figure 3.2). Consistent with the fact that nearly all policyholders outside the high-risk areas of the 2007 FIRM paid PRP rates in 2016 (Table 2.8 in Chapter Two), we assume that property owners outside the high risk zones of the 2007 FIRM continue to pay PRP rates in all three scenarios.

Comparison Between Scenario B Premiums and Premiums Paid by Policyholders in 2016

The premiums projected in scenario B are substantially higher than the premiums paid by policyholders in New York City in 2016—conditions that are similar to those assumed in scenario B (e.g., 2015 rate schedule, 2007 FIRM, and pre-FIRM rates available). The average premium paid in the high-risk areas of the 2007 FIRM is $1,880 (see Table 2.8 in Chapter Two), just more than one-half of the $3,500 average projected in scenario B. Primary reasons for this for gap are:

- The coverage levels observed for policies in force are lower than those assumed in scenario B.
- Structures tend to be at higher elevations according to the PMF than according to the data collected for this study. Specifically, the structure elevation is higher according to the PMF than according to the study ECs in 47 percent of cases when comparisons are possible and lower in only 12 percent of cases (see Table E.5).

Other factors that tend to depress the reported premiums for policies in force relative to those in scenario B are as follows and are discussed in Appendix E:

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7 The types of rates actually paid by policyholders in 2016 do not reflect this. As shown in the top part of Table 2.8 in Chapter Two, substantially more policyholders had non-elevation-based rates in 2016 than elevation-based rates. Policyholders may not be taking advantage of elevation-based rates because of lack of information. Most homeowners may not be aware that they are paying pre-FIRM subsidized rates or that an EC would lower their premiums (an EC typically costs between $800 and $1,000 in the New York City area).

8 Premiums are lower with subsidies for 24 percent of pre-FIRM one- to four-family structures in the high-risk zones and pre-FIRM properties account for 84 percent of all one- to four-family structures in the high-risk zones. Thus, 20 percent (0.24 times 0.84) of property owners will see rates decline if pre-FIRM subsidies are eliminated.

- There is some disagreement over structure type. Properties that have basements according to the study ECs are misclassified as structures with slabs, crawlspaces, or enclosures 20 percent of the time (see Table E.6).
- Post-FIRM structures tend to be mistakenly declared as pre-FIRM on the PMF, although this effect is not large (see Table E.7).
- The estimated total premium in Table 2.8 in Chapter Two assumes that all properties are owner occupied and that the HFIAA charge is $25. However, roughly 10 percent of the one- to four-family homes are not owner occupied, and the HFIAA charge for these properties would be $250.

These differences all contribute to the divergence between the premiums reported in the PMF and those in scenario B.

Premiums Using the Preliminary Flood Insurance Rate Map

This section examines how flood insurance premiums might change if risk increases as shown in the PFIRM. The PFIRM is being revised using better data, but the analysis of premiums under the PFIRM allows us to understand the impact of grandfathering when a new FIRM is released and to revisit the importance of pre-FIRM rates when BFEs increase and high-risk areas expand.

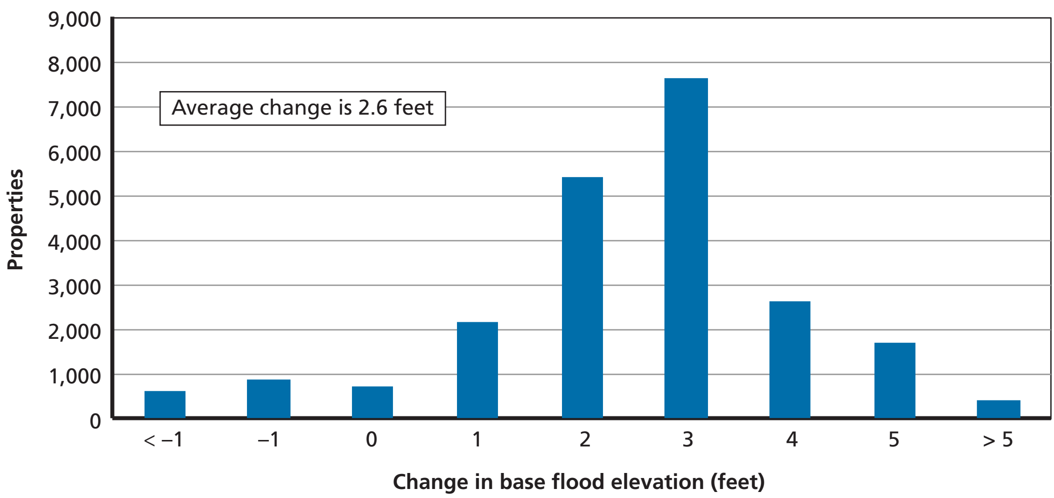
The PFIRM affects flood insurance premiums by increasing the number of structures in high-risk areas and by increasing, for most properties, the property-specific BFE. As shown in Table 3.5, there are 25,900 "newly mapped" properties under the PFIRM—these are properties that are not in high-risk zones according to the 2007 FIRM but are in high-risk zones according to the PFIRM. Figure 3.3 shows the change in BFE for the one- to four-family homes in the high-risk areas of the 2007 FIRM if the PFIRM were adopted. The average increase in BFE is 2.6 feet, with most properties seeing increases of 2 or 3 feet. This higher BFE means that the structure elevation relative to BFE will decrease by a like amount.

The lower structure elevations relative to BFE will cause flood insurance premiums to increase for post-FIRM properties in the high-risk areas of the 2007 FIRM as well as for pre-FIRM properties in these areas for which the elevation-based rate is less than the non-elevation-based rate (the pre-FIRM rate). As an example, consider the example structure considered earlier in this chapter (Table 3.2). The elevation difference was –3 feet under the 2007 FIRM and the base premium was $2,500 (Table 3.4). If the PFIRM were adopted, the elevation difference would

Table 3.5
Flood Zone Changes in the Study Area Under the PFIRM (Number of One- to Four-Family Properties)

	Zone According to the PFIRM		
Zone According to the 2007 FIRM	A	V	Total
A	17,300	3,700	21,000
V	200	1,000	1,200
B, C, and X	25,700	200	25,900
Total	43,200	4,900	48,100

Figure 3.3
Change in BFE Under PFIRM Versus 2007 FIRM for Properties in High-Risk Zones of the 2007 FIRM



NOTES: Based on 1,256 properties in high-risk zones of 2007 FIRM. Weighted to reflect all 22,200 one- to four-family properties in the high-risk zones of the 2007 FIRM.
RAND *RR1776-3.3*

drop to –6 and, using the rates in Table 3.3, the base premium would rise to \$4,275—a 71-percent increase.[9]

Figure 3.4 shows the elevation differences for all one- to four-family structures in the study area (which *is* the high-risk area of the PFIRM) if the PFIRM were adopted. The large number of structures with the lowest-floor 3 feet or more below BFE under-

[9] The base premium for building coverage is (\$3.15 × 60,000 + \$1.07 × 190,000) / 100. The base premium for contents coverage is (\$0.90 × 25,000 + \$0.17 × 75,000) / 100. Even with this large increase, the elevation-based rate remains lower than the non-elevation-based rate for the example structure.

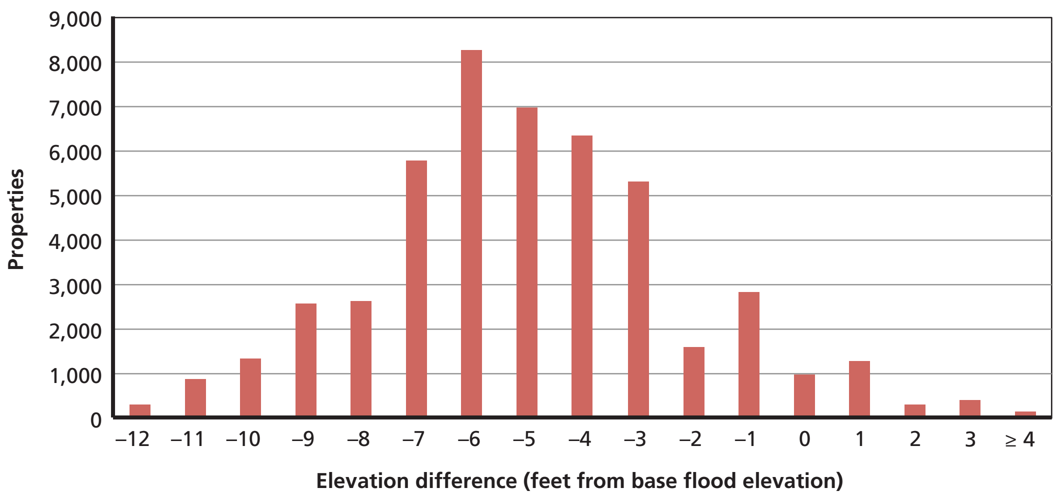
scores the substantial flood risk faced by homeowners in New York City according to the PFIRM. The average elevation difference for one- to four-family structures in the study is area is –5.0 feet.

Premiums for Properties Already in High-Risk Zones

How premiums would change under the increasing risk depicted by the PFIRM depends importantly on whether the property is already in a high-risk area or is newly mapped into a high-risk area. Figures 3.5 and 3.6 present two different views on how premiums change in the high-risk areas. Figure 3.5 summarizes the distribution of premiums in each of the PFIRM scenarios, and Figure 3.6 summarizes the premium differences across the most relevant pairs of scenarios. Scenario B, which is based on the 2007 FIRM, is reproduced in Figure 3.5 for comparison.

If grandfathering is allowed, adoption of the PFIRM has little effect on properties already in the high-risk zones (compare scenarios B and D in Figure 3.5). In fact, some premiums actually fall because grandfathering allows the property owner to choose the more-favorable elevation difference from the two FIRMs, and, for some property owners, the BFE is lower in the PFIRM than it is in the 2007 FIRM (see first column of Figure 3.6). Premiums fall for less than 5 percent of properties, which results in a $400 decline in the average premium.

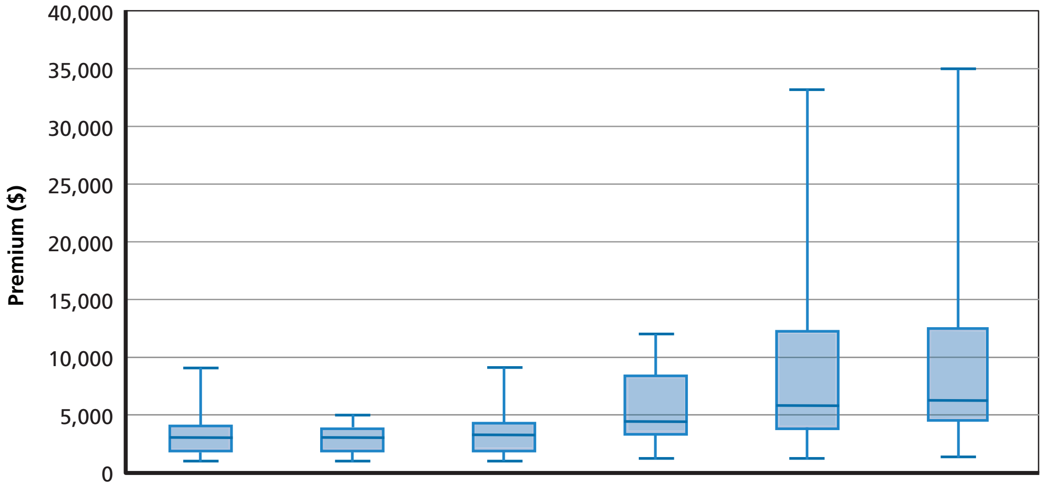
Figure 3.4
Difference Between Structure Elevation and PFIRM BFE in the Study Area



NOTES: Based on 485 properties in the study areas. Weighted to reflect all 48,100 one- to four-family properties in the study area.
RAND *RR1776-3.4*

Figure 3.5
Premium Projections Using the PFIRM for Properties in the High-Risk Zones of the 2007 FIRM

	Scenario					
	B	**D**	**E**	**F**	**G**	**H**
Rate schedule	2015	2015	2015	2015	2015	2015
FIRM	2007	PFIRM	PFIRM	PFIRM	PFIRM	PFIRM + SLR
Grand-fathering	—	Yes	Yes	No	No	No
Pre-FIRM subsidy	Yes	Yes	No	Yes	No	No

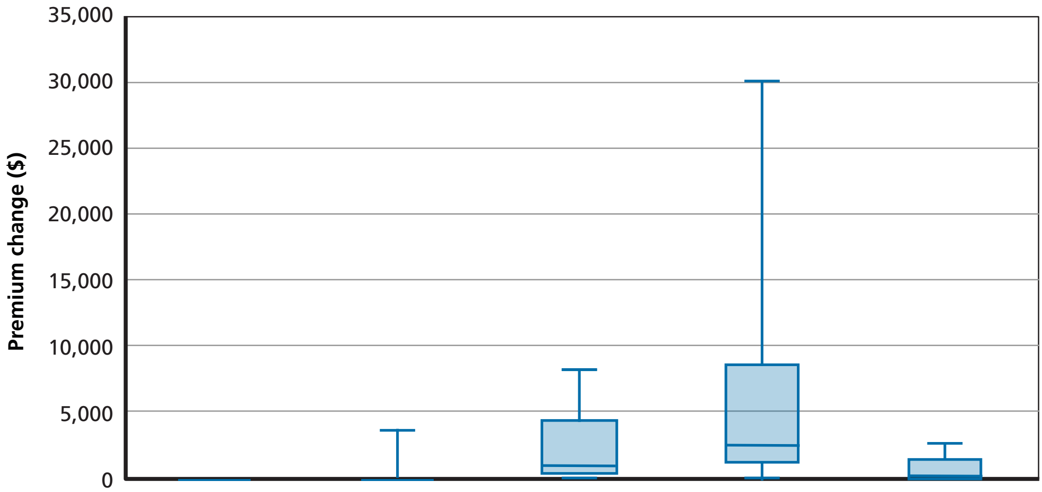


RAND *RR1776-3.5*

	B	D	E	F	G	H
5th percentile	$800	$800	$800	$1,200	$1,200	$1,300
25th percentile	$1,900	$1,700	$1,800	$3,300	$3,900	$4,400
Median	$3,000	$3,000	$3,100	$4,500	$5,600	$6,100
75th percentile	$3,900	$3,800	$4,200	$8,400	$12,300	$12,400
95th percentile	$9,100	$5,000	$9,100	$12,000	$33,200	$35,000
Mean	$3,500	$3,100	$3,500	$5,800	$10,800	$11,500
95% confidence interval for mean	$2,800–4,100	$2,800–3,300	$3,100–3,900	$5,100–6,500	$9,000–12,500	$9,800–13,300

Figure 3.6
Premium Increases for Properties in the High-Risk Zones of the 2007 FIRM

	Scenario Differences				
	D–B	E–D	F–D	G–B	H–G
Change	Adopt PFIRM with pre-FIRM rates and grandfathering	Drop pre-FIRM rates, keep grandfathering	Drop grandfathering, keep pre-FIRM rates	Adopt PFIRM with risk-based rates	Add 8 inches of SLR



RAND *RR1776-3.6*

	D–B	E–D	F–D	G–B	H–G
5th percentile	$0	$0	$0	$0	$0
25th percentile	$0	$0	$300	$1,100	$0
Median	$0	$0	$1,400	$2,300	$600
75th percentile	$0	$0	$4,400	$8,600	$1,400
95th percentile	$0	$3,700	$8,200	$30,200	$2,600
Mean	–$400	$500	$2,700	$7,300	$800

Consistent with the analysis using the 2007 FIRM, eliminating the pre-FIRM rate affects relatively few property owners as long as grandfathering remains in place (compare scenarios D and E in Figure 3.5 and the difference between scenarios E and D in Figure 3.6). Less than 25 percent of property owners experience a premium increase and the average premium across properties increases by $500.

Eliminating grandfathering does have a considerable impact for properties that are already in high-risk zones according to the 2007 FIRM. As can be seen by comparing scenarios F and D in Figure 3.5, the average premiums nearly double from $3,100 to $5,800, and the median premium jumps nearly 50 percent from $3,000 to $4,500. Now, 5 percent of property owners face annual premiums of $12,000 or more.

Without grandfathering, pre-FIRM rates are of considerable benefit. It may well be the case, however, that FEMA has raised pre-FIRM rates enough by the time a map such as the PFIRM is adopted that they are no longer relevant. Average premiums jump from the $5,800 in scenario F to $10,800 in scenario G, and one-quarter of property owners are facing flood insurance premiums in excess of $12,300 in scenario G. Pre-FIRM rates are important with the PFIRM absent grandfathering because elevation-based rates are very high because of the large elevation differences for many properties.

With the elimination of grandfathering and pre-FIRM rates, the premiums in scenario G approximate full-risk rates. The median premium ($5,600) is approximately 85 percent higher than the premium under current conditions (scenario B). The mean premium is more than three times higher, reflecting the very high premiums charged on certain properties. Premiums increase for a high percentage of property owners (see difference between scenarios G and B in Figure 3.6).

Comparison of scenarios G and H reveals the impact of a further increase in risk because of an 8-inch SLR. The mean and median premium increase by 6 and 9 percent, respectively, for this amount of SLR (see Figure 3.5).

Premiums for Newly Mapped Properties

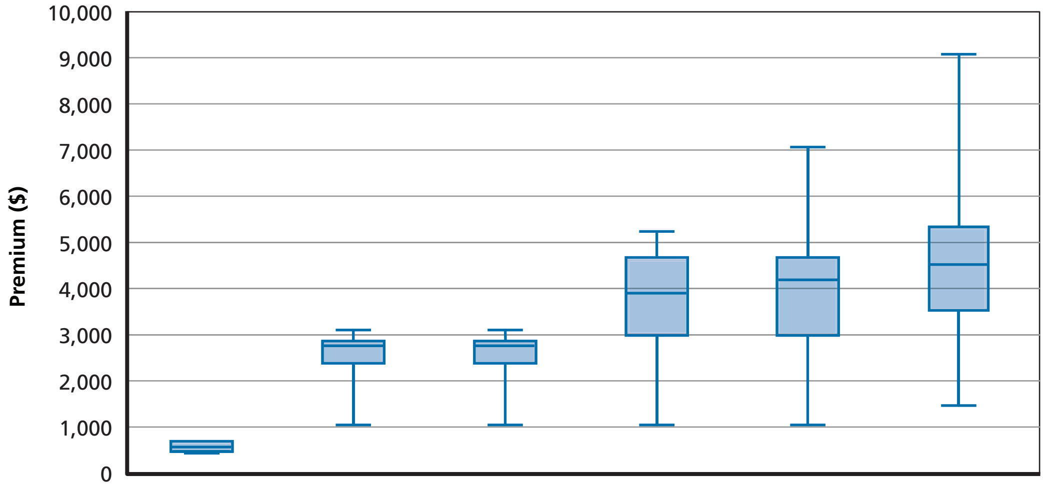
Figures 3.7 and 3.8 repeat the analysis in Figures 3.5 and 3.6, but this time for newly mapped properties—properties that are in the high-risk zones of the PFIRM but not in the high-risk zones of the 2007 FIRM. For this set of properties, adoption of the PFIRM has considerable consequences, even with grandfathering. Average premiums move from $600 in scenario B to $2,500 in scenario D (Figure 3.7), and at least 75 percent of properties see increases of $1,800 or more (first column of Figure 3.8). The reason is that Congress directed FEMA to gradually increase rates from the PRP rate to the standard X-zone rate for newly mapped properties (Public Law 113-89, 2014).[10] The standard X-zone rate will typically be lower than rates the property owner would pay if the property was rated using its actual flood zone (AE or VE), but is much higher than the PRP rate that most properties outside the high-risk zones of the 2007 FIRM are paying. The increase for the newly mapped properties would not happen suddenly given the current direction from Congress. At the maximum allowed 18-percent annual premium increase, it would take approximately nine years for the mean premium to increase from $600 to $2,500. As will soon be seen, premiums would be even higher without grandfathering, and property owners will need to be careful not to let their policies lapse for too long a time to qualify for even these grandfathered rates (see Appendix F for details).

Eliminating pre-FIRM rates when grandfathering is allowed does not make any difference for newly mapped properties (scenario E is the same as scenario D in

[10] The standard X-zone rate is also referred to as the non-elevation-based rate for properties outside the high-risk areas (Table 2.7, Chapter Two).

Figure 3.7
Premium Projections Using the PFIRM for Newly Mapped Properties

	Scenario					
	B	**D**	**E**	**F**	**G**	**H**
Rate schedule	2015	2015	2015	2015	2015	2015
FIRM	2007	PFIRM	PFIRM	PFIRM	PFIRM	PFIRM + SLR
Grand-fathering	—	Yes	Yes	No	No	No
Pre-FIRM subsidy	Yes	Yes	No	Yes	No	No

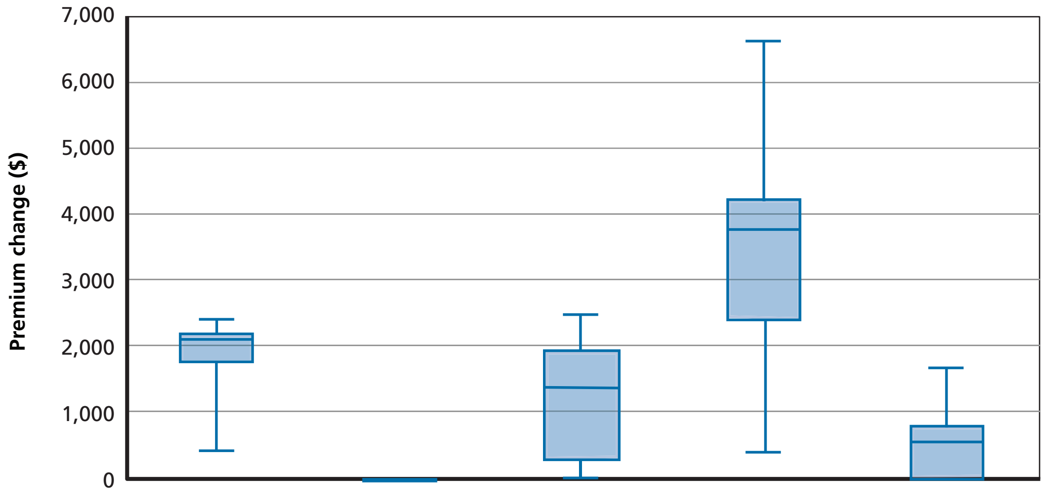


RAND *RR1776-3.7*

	B	D	E	F	G	H
5th percentile	$400	$1,100	$1,100	$1,100	$1,100	$1,500
25th percentile	$500	$2,400	$2,400	$3,000	$3,000	$3,600
Median	$500	$2,700	$2,700	$3,900	$4,200	$4,500
75th percentile	$700	$2,900	$2,900	$4,700	$4,700	$5,300
95th percentile	$700	$3,100	$3,100	$5,200	$7,100	$9,100
Mean	$600	$2,500	$2,500	$4,000	$4,700	$5,300
95% confidence interval for mean	$550–580	$2,400–2,600	$2,400–2,600	$3,600–4,400	$3,900–5,500	$4,400–6,100

Figure 3.8
Premium Increases for Newly Mapped Properties

	Scenario Differences				
	D–B	**E–D**	**F–D**	**G–B**	**H–G**
Change	Adopt PFIRM with pre-FIRM rates and grandfathering	Drop pre-FIRM rates, keep grandfathering	Drop grandfathering, keep pre-FIRM rates	Adopt PFIRM with risk-based rates	Add 8 inches of SLR
5th percentile	$400	$0	$0	$400	$0
25th percentile	$1,800	$0	$300	$2,400	$0
Median	$2,200	$0	$1,300	$3,700	$600
75th percentile	$2,200	$0	$1,900	$4,200	$800
95th percentile	$2,400	$0	$2,500	$6,600	$1,700
Mean	$2,000	$0	$1,500	$4,100	$600



RAND *RR1776-3.8*

Figure 3.7) because the standard X-zone rate is the same for pre- and post-FIRM properties.

However, eliminating grandfathering does again make a considerable difference for newly mapped properties. Absent grandfathering, the newly mapped properties must pay the rates available in high-risk zones, and the mean premium increases from $2,500 in scenario D to $4,000 in scenario F.

Eliminating pre-FIRM rates when grandfathering is not allowed increases premiums on many properties (compare scenario G with scenario F). The end result is that moving to full risk rates for newly mapped properties will result in large premium increases. Median premiums are more than eight times higher than in scenario B (increasing from $500 in scenario B to $4,200 in scenario G), and mean premiums are more than seven times higher. As shown in the penultimate column of Figure 3.8, premiums rise by $2,400 or more for at least 75 percent of properties.

An 8-inch increase in sea level increases the mean and median premium in scenario H by 7 and 13 percent over scenario G, respectively. These percentage increases are similar to those discussed above for the properties already in the high-risk zones.

Housing Burden Under Different Premium Scenarios

Premium increases such as those depicted in this chapter would increase the housing burden of households in the study area. The first set of rows in Table 3.6 repeats estimates of the distribution of the PITI ratio for owner-occupied households in the study

Table 3.6
PITI Ratios in the Study Area Under Premium Scenarios B and G, Owner-Occupied Residences Only

			95% Confidence Interval	
Premium Scenario and PITI Ratio	**Number of Households**	**Percentage of Households**	**Number of Households**	**Percentage of Households**
Actual in 2016				
0 to 0.3	27,900	65%	25,600–30,100	60–71%
> 0.3 and ≤ 0.4	5,500	13%	4,100–7,200	10–17%
> 0.4 (housing burdened)	9,200	22%	7,400–11,400	17–27%
Using premiums from scenario B (2007 FIRM, 2015 rate schedule with pre-FIRM rates)				
0 to 0.3	26,600	62%	24,300–28,900	57–68%
> 0.3 and ≤ 0.4	6,300	15%	4,900–8,100	11–19%
> 0.4 (housing burdened)	9,700	23%	7,800–11,900	18–28%
Using premiums from scenario G (PFIRM, 2015 rate schedule, no grandfathering or pre-FIRM rates)				
0 to 0.3	20,000	47%	17,700–22,400	41–53%
> 0.3 and ≤ 0.4	8,400	20%	6,700–10,400	16–24%
> 0.4 (housing burdened)	14,200	33%	12,000–16,600	28–39%

NOTE: These values are based on a sample of 449 owner-occupied households with ECs. Categories may not add exactly to total because of rounding to nearest 100. Sample weights are described in Appendix A.

area in 2016. These PITI ratios reflect the actual percentage of households that bought flood insurance and the amount paid in 2016.[11] The next two sets of rows show the PITI ratio when the premiums in scenarios B and G are assumed. In both of these scenarios, all properties are assumed to have flood coverage at the same coverage amounts assumed in this chapter. Moving to premium scenario B does not increase the percentage of households that are housing burdened a great deal (the percentage rises from 22 to 23 percent). In contrast, moving to premium scenario G does result in a substantial increase in the percentage of household in owner-occupied structures that are housing burdened. Now, one-third, or 14,200, of households in the study area are housing burdened.

Summary of Key Findings

Table 3.7 summarizes the key findings from the premium scenario analysis. As shown in the first row of the table, we project that the median flood insurance premium would be $3,000 for the 22,200 one- to four-family properties in the high-risk zones of the

Table 3.7
Key Findings from Premium Analysis

	Premium for 22,200 Properties in High-Risk Zones of 2007 FIRM		Premium for 25,900 Newly Mapped Properties	
FIRM in Effect and Premium Scenario	Median	Percentage Change from Scenario B	Median	Percentage Change from Scenario B
2007 FIRM				
B. With pre-FIRM rates	$3,000	—	$500	—
C. Without pre-FIRM rates	$3,100	3%	$500	0%
PFIRM				
E. With grandfathering and without pre-FIRM rates	$3,100	3%	$2,700	440%
G. Without grandfathering or pre-FIRM rates	$5,600	7%	$4,200	740%

NOTE: Based on NFIP 2015 rate schedule.

[11] The estimates for “Actual in 2016” in Table 3.6 are not identical to those in Table 2.9 in Chapter Two because the estimates in Table 3.6 are based on a smaller set of properties than those in Table 2.9. To allow comparison with the results using premium scenarios B and G, the estimates in Table 3.6 are based on owner-occupied properties with ECs (N = 449), while those in Table 2.9 are based on properties with complete surveys (N = 485). The number of owner-occupied properties in the study area projected with the smaller sample is slightly fewer (42,600 versus 42,700). However, the number of housing-burdened households is 14 percent less (9,200 versus 10,700). We use estimates based on the large sample when available.

2007 FIRM under current conditions (2007 FIRM, April 2015 NFIP rate schedule, and the availability of pre-FIRM rates). This estimate assumes that the policies cover structure-replacement cost or $250,000 if replacement cost is greater than $250,000. It also assumes the amount of contents coverage is 40 percent of the amount of building coverage.

Eliminating pre-FIRM rates under current conditions would affect relatively few property owners in high-risk zones of the 2007 FIRM because the pre-FIRM rates (non-elevation-based rates) are already higher than the elevation-based rates for most properties given the types of structures and their elevations relative to 2007 BFE.

Outside the high-risk zones of the 2007 FIRM, the median premium remains at $500, with or without pre-FIRM rates. This assumes that property owners continue to qualify for PRP rates outside the high-risk area. Continued qualification for the PRP rates is not automatic: Another Sandy-type storm could generate a second claim for many households and force them into the much higher standard X-zone rate (with a premium of approximately $2,700).

Moving to the PFIRM has little impact on properties already in the high-risk zones of the 2007 FIRM if grandfathering is allowed. Pre-FIRM rates may well be largely irrelevant by the time a revised FIRM is adopted for New York City, but even without pre-FIRM rates, the median premium with grandfathering is not much higher than under the 2007 FIRM ($3,100 in scenario E and $3,000 in scenario B). It should be remembered, however, that not all homeowners will keep up with the eligibility requirements for grandfathered rates.

The results are very different for newly mapped properties. As shown in the penultimate column of Table 3.7, the median premium for the 25,800 newly mapped properties would gradually increase from $500 to $2,700, even with grandfathering.

The removal of grandfathering would have considerable consequences for all one- to four-family properties in the study area. For those already in the high-risk zones of the 2007 FIRM, the median premium would increase from $3,100 to $5,600. For newly mapped properties, the median would increase from $2,700 to $4,200.

Our analysis also provides an estimate of how much 8 inches of SLR would increase premiums in the study area given the April 2015 NFIP rate schedule. Average premiums would increase on the order of 10 percent from the full-risk rates projected using the PFIRM (the average increase is 6 percent in the high-risk zones of the 2007 FIRM and 13 percent for newly mapped properties).

Finally, we project how the premium increases would affect the number of households in owner-occupied structures that are housing burdened. If premiums rise to those in scenarios G, the percentage of households that are housing burdened would rise from the 25 percent currently observed in the study area to 33 percent.

CHAPTER FOUR

Flood Insurance Affordability in Five Vulnerable Subareas

Chapter Three presented findings for the study area as a whole. In this chapter, we examine how the results vary across five subareas in the study area. These five subareas either are coterminous with or include communities that DCP has identified as particularly vulnerable to flooding and other negative shocks. Figures 4.1 and 4.2 map the locations of the five subareas highlighted in the chapter and listed below:

- Canarsie
- Gerritsen Beach/Sheepshead Bay
- Rockaway Peninsula
- Broad Channel, Howard Beach, Old Howard Beach, and Hamilton Beach (referred to jointly as the Jamaica Bay subarea)
- South Beach/Midland Beach/New Dorp Beach/Oakwood (referred to jointly at the East Shore subarea).

We oversampled in these subareas to get a better representation of vulnerable communities in our study.[1] This chapter begins by providing a brief overview of the housing type and flood risk in each subarea. Much of this information is taken from the assessments conducted over the last two years by DCP as part of its Resilient Neighborhoods initiative (NYC Planning, undated[d]). Later in the chapter, findings on the flood insurance take-up rates and the percentage of households in each subarea that are housing burdened are presented. The flood insurance premiums developed in Chapter Three will then be broken down by subarea and their implications for the proportions of households that are housing burdened will be investigated.

[1] The Rockaway Peninsula includes the Rockaway Park and Rockaway Beach communities which the DCP considers particularly vulnerable to flooding and other negative shocks.

Subarea Risk Profiles

This study focuses on one- to four-family properties. Table 4.1 reports the number of one- to four-family properties in each of these subareas and the estimated number that are owner occupied.

The location of these subareas are identified in the following maps (Figures 4.1 and 4.2). The purple areas denote high-risk flood zones of the current flood maps (2007 FIRM), and the orange areas are the expanded flood zones identified in the more recently proposed flood maps (PFIRM).

Canarsie

Background

After the American Civil War, Canarsie was primarily known for commercial fishing and boat building industries given its waterfront access. The community morphed from a fishing economy to a waterfront recreation economy over the 20th century. Canarsie became a popular waterfront recreation area known for summer bungalows, restaurants, and hotels. In the early to mid-20th century, the wetland areas surrounding Jamaica Bay underwent infill development, paving the way for large-scale residential developments, which led to Canarsie becoming a predominantly residential community (NYC Planning, undated[a]).

Canarsie has approximately 83,000 residents and about 12,000 residential buildings. Many Canarsie residents are first or second generation from the Caribbean region.

Flood Risk Profile

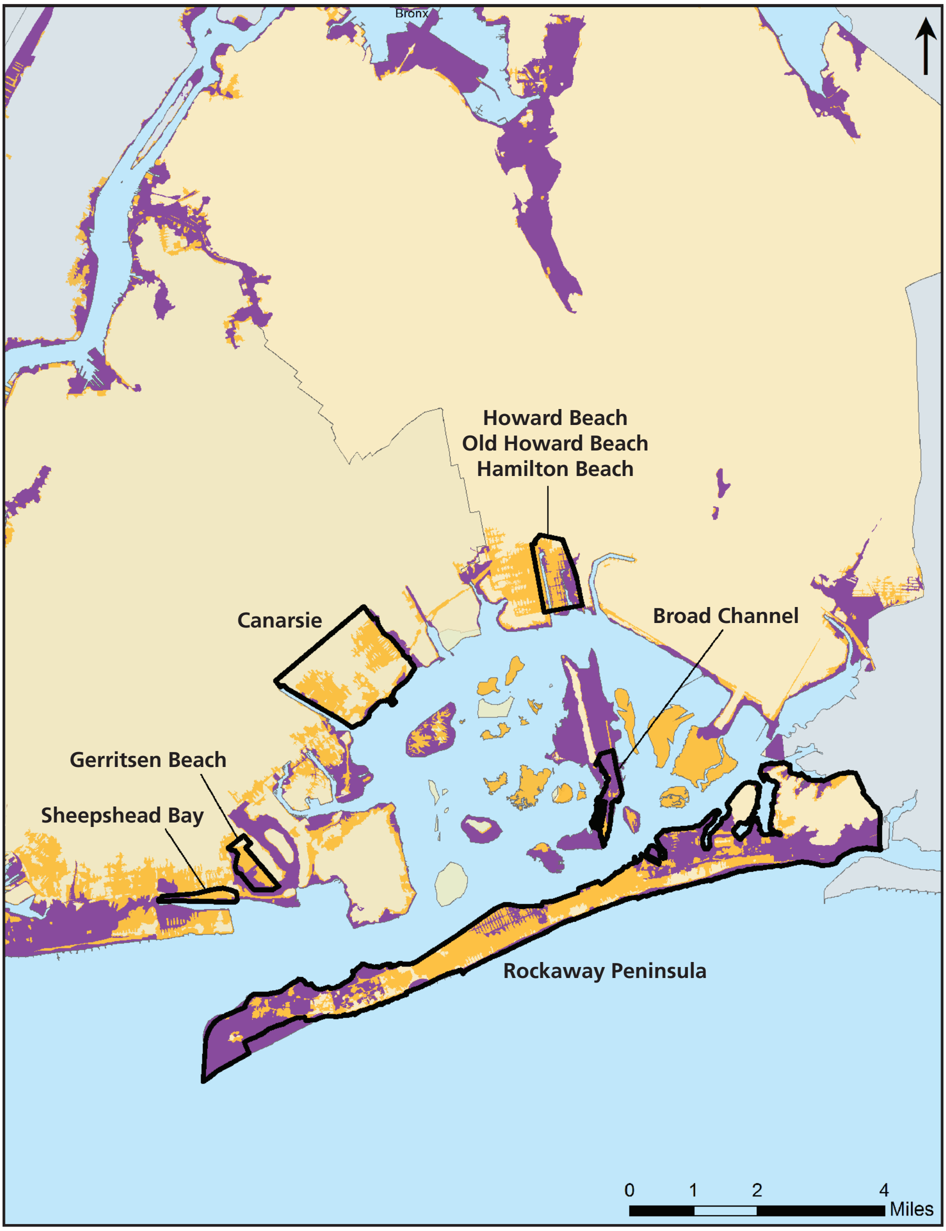
As can been seen in Figure 4.1, only a very small portion of Canarsie is in the high-risk zone of the 2007 FIRM, the area closest to the water. However, during Hurricane Sandy, Canarsie residents experienced extensive flooding that caused significant

Table 4.1
Estimated Number of One- to Four-Family Properties by Study Subarea

Study Subarea	Total	Estimated Number Owner Occupied
Canarsie	4,800	4,500
Gerristen Beach, Sheepshead Bay	1,800	1,800
Jamaica Bay	2,800	2,600
Rockaway Peninsula	11,300	9,700
East Shore	6,300	5,800
Rest of study area	21,100	18,300
Overall study area	48,100	42,700

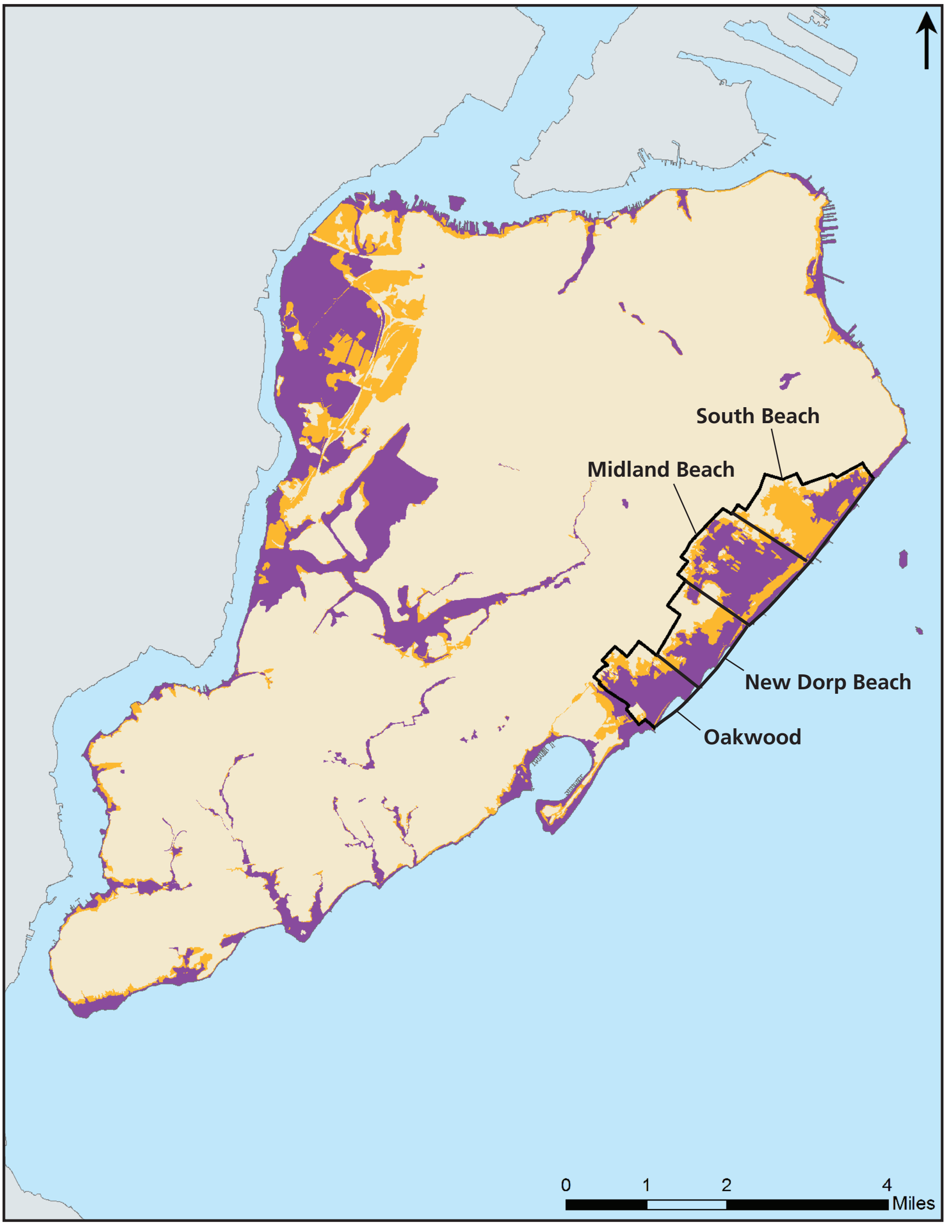
SOURCE: Property address provided by the New York City Department and Finance. Residency status determined in survey.

Figure 4.1
Study Subareas in Brooklyn and Queens



NOTE: Purple areas denote high-risk zones according to the 2007 FIRM and orange areas denote high-risk zones added by the PFIRM.
RAND *RR1776-4.1*

Figure 4.2
Study Subarea on Staten Island



NOTE: Purple areas denote high-risk zones according to the 2007 FIRM and orange areas denote high-risk zones added by the PFIRM.
RAND *RR1776-4.2*

damage to basements and ground floors. Many of the one- to four-family structures in Canarsie have a separate residential unit in the basement (see Figures 4.3 and 4.4).

Building and Typology

Residential areas in Canarsie consist primarily of one- and two-family attached and semidetached buildings. There is also a concentration of detached residential buildings adjacent to Fresh Creek as well as in the center of the neighborhood. The commercial corridors are typically one- to three-story mixed-use rowhouses (NYC Planning, undated[a]). Most residential buildings were built prior to 1970 and predate current zoning and flood-resistant building requirements.

Household Financial Vulnerability

More than 80 percent of owner-occupied residences have mortgages, which is higher than the city as a whole. Canarsie homeowners were negatively impacted by subprime lending practices (in 2006, more than 50 percent of mortgages in Canarsie met the definition of subprime) and experienced a high foreclosure rate (highest in the city). The high incidence of mortgages and low equity leaves homeowners with little to put toward mitigating their flood risk. A complicating factor is that many homeowners with basements rent them out to supplement their mortgage payments, making it unattractive to abandon their basements to gain cheaper flood insurance premiums (NYC Planning, undated[a]).

Figure 4.3
Attached Home in Canarsie with a Residential Unit on the Ground Floor

SOURCE: Image used with permission of the New York City Department of City Planning.

RAND *RR1776-4.3*

Figure 4.4
Typical Row Houses in Canarsie

SOURCE: Image used with permission of the New York City Department of City Planning.
RAND *RR1776-4.4*

Gerritsen Beach and Sheepshead Bay

Background

In the late 19th century, Sheepshead Bay was a waterfront recreation area.[2] By early 20th century, it was populated with summer bungalows. Gerritsen Beach was mostly marshland, but it too was full of summer bungalows by the early 20th century. Over time, these bungalows were winterized and became year-round residences. These two communities are home to approximately 11,000 people and more than 9,000 residential units.

Flood Risk Profile

Hurricane Sandy caused significant inundation of surge waters across Gerritsen Beach, resulting in widespread flooding of basements and ground floors and moderate to severe structural damage. A number of bulkheads that serve as storm protection are in poor shape, and the waterfront areas could require infrastructure improvements to protect them from future storms. The entire Gerritsen Beach neighborhood is low lying, making it more vulnerable to flooding (NYC Planning, undated[c]). Future SLR will increase the neighborhood's vulnerability to future daily tidal flooding (NYC Planning, undated[c]).

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2 The area indicated in Figure 4.1 for Sheepshead Bay is a smaller geography than this neighbor profile represents. The smaller geography was originally selected by DCP for its unique building and land use conditions, but then the area was expanded to include a larger neighborhood context (Alan Zaretsky, personal communication, Department of City Planning, March 7, 2017).

Sheepshead Bay also experienced significant inundation during Hurricane Sandy. Homes south of the Belt Parkway experienced extensive damage from floodwaters. Especially vulnerable are the bungalow courts that experience regular flooding (pictured in next section). Many of these bungalows were abandoned after Hurricane Sandy (NYC Planning, undated[f]).

Building and Typology

Gerritsen Beach boasts mainly single-family detached homes with some semidetached and two- and three-story buildings. Ninety-five percent of the building stock was built before 1983 and before current zoning and flood-resistant building requirements (NYC Planning, undated[c]). Many of the homes are at or below grade, and many have basements (see Figure 4.5), characteristics that make them more vulnerable to flooding. The majority of the lots are small, shallow, and of a nonstandard size (see Figure 4.6). The lots' "narrow street frontage and shallow front yards mean homes often don't meet minimum yard requirements, and there is not enough space to provide stairs to elevated buildings and incorporate streetscape amenities like porches and plantings" (NYC Planning, undated[c]).

In Sheepshead Bay, 95 percent of the building stock was built before 1983. The area north of the Belt Parkway represents a mix of two- and three-story homes, some sunken bungalows (see Figure 4.7), and some multifamily buildings. The other parts of Sheepshead Bay comprise detached (see Figure 4.8) and semidetached one- and two-family homes, and there are numerous multifamily buildings. Elevating or retrofitting

Figure 4.5
First Floor Below Street Level in Gerritsen Beach

SOURCE: Image used with permission of the New York City Department of City Planning.

RAND *RR1776-4.5*

Figure 4.6
Narrow Streets and Small Shallow Lots in Gerritsen Beach

SOURCE: Image used with permission of the New York City Department of City Planning.
RAND *RR1776-4.6*

Figure 4.7
Bungalows in Below-Grade Courts in Sheepshead Bay

SOURCE: Image used with permission of the New York City Department of City Planning.
RAND *RR1776-4.7*

Figure 4.8
Typical Detached Bungalow in Sheepshead Bay

SOURCE: Image used with permission of the New York City Department of City Planning.
RAND *RR1776-4.8*

attached or multifamily buildings is challenging (NYC Planning, undated[f]). Bringing homes, even detached homes, into compliance with current floodplain management standards would be challenging, as it would mean filling in cellars or basements (NYC Planning, undated[f]). Another constraint with attached homes is that most are at the maximum height limit and overbuilt, meaning they are already at the maximum allowable floor area. If lower floors have to be vacated or filled in to come into compliance, those homeowners are not able to add a new story to replace the lost square footage (NYC Planning, undated[f]).

Household Financial Vulnerability

The majority of residents of Gerritsen Beach have lived there for generations (NYC Planning, undated[c]). Gerritsen Beach has a high rate of owner-occupied houses, about 80 percent, but those homeowners have lower average incomes than the rest of Brooklyn or the city.

Sheepshead Bay is a middle-income community that, despite the ongoing flood risks, has a strong property market and new development is underway (NYC Planning, undated[f]). About 55 percent of owner-occupied housing units have a mortgage, which is lower than in other parts of New York City and is reflective of multiple generations having lived in the home and long since paid off the mortgage (NYC Planning, undated[c]).

Jamaica Bay Subarea

Background

These communities are in the Jamaica Bay area of Queens and have a population of about 10,000 people and about 4,000 housing units. In the late 19th century, the residential buildings in these communities tended to be fishing shacks or summer homes. These did not become year-round communities until the early 20th century with the introduction of the Long Island Railway and construction of the Cross Bay Boulevard. These communities were expanded by dredging and filling in marshland (NYC Planning, 2016).

Flood Risk Profile

These communities have long experienced flooding during storm events and even regular tidal flooding. These communities experienced significant inundation during Hurricane Sandy, with 75 percent of homes in Old Howard Beach and Hamilton Beach and 97 percent of homes in Broad Channel reporting flood damage (NYC Planning, 2016). These neighborhoods are also vulnerable to future SLR. Certain streets are impassable during the more regular tidal flooding events (see Figure 4.9). There are some infrastructure projects underway to protect these neighborhoods from storm surge, such as erecting dunes or berms. Protection against future daily tidal flooding will be more difficult, as much of the coastline is owned by multiple homeowners, making comprehensive coastal protection difficult (NYC Planning, 2016).

Figure 4.9
Flooded Street in Broad Channel During a Super Moon High Tide

SOURCE: Image used with permission of the New York City Department of City Planning.

RAND *RR1776-4.9*

Building and Typology

Low-density residential, mostly one- and two-family residences (see Figure 4.10), characterizes the area. More than 90 percent of residences were built before 1983 and predate current zoning and flood-resistant building requirements. The lot sizes in Old Howard Beach meet the zoning requirements for detached houses, making it easier to retrofit those homes. Hamilton Beach and Broad Channel have some substandard lot sizes so current zoning requirements for side yards may make retrofitting more difficult. Hamilton Beach has seen an increase in the number of semidetached homes, causing challenges for elevating because of the shared wall (see Figure 4.11).

Household Financial Vulnerability

These are middle-income communities with a higher than average homeownership rate. About 75 percent of homes are owner occupied. According to the Department of City Planning, almost 60 percent of homeowners have a mortgage in Old Howard Beach and Hamilton Beach, compared with 88 percent for Queens overall. An estimated 82 percent of homeowners have a mortgage in Broad Channel, which is closer to the borough average. This may mean that homeowners in Broad Channel may have more limited home equity with which to finance flood mitigation or retrofits (NYC Planning, 2016).

Figure 4.10
Detached House in Old Howard Beach

SOURCE: Image used with permission of the New York City Department of City Planning.

RAND *RR1776-4.10*

Figure 4.11
Semidetached Homes in Hamilton Beach

SOURCE: Image used with permission of the New York City Department of City Planning.
RAND *RR1776-4.11*

Rockaway Peninsula

Background

The Rockaways is a barrier island bounded by the Atlantic Ocean to the south and Jamaica Bay to the north. It is home to about 112,000 residents. In mid- to late 19th century, the Rockaways was primarily a waterfront resort area. The construction of the Cross Bay Bridge, the Marine Parkway Bridge, and improvements to railway services between the 1920s and 1940s made the Rockaways more accessible and contributed to the development of the Rockaways as a working-class neighborhood ("Rockaway . . . 'Place of Waters Bright,'" undated).

Flood Risk Profile

The Rockaway peninsula is exposed to flood risks from coastal wave action on the Atlantic side, and water inundation from the low-lying bayside. During Hurricane Sandy, coastal wave action and then the subsequent retreating water led to significant coastal erosion of the beaches on the Rockaway peninsula (City of New York, 2013). Floodwaters also overtopped shorelines and bulkheads along the bay. This water flooded many areas of the peninsula, damaging hundreds of homes and leading to the break out of fires as the salt water interacted with electrical equipment. The flooded streets made it difficult for fire trucks and emergency responders to get through and resulted in fires burning unabated. This destroyed 175 homes and businesses (City of New York, 2013).

Building and Typology

Low-density residential buildings and multifamily buildings (see Figure 4.12) characterize the area, which also includes many publicly subsidized high-rise buildings and several commercial corridors. Housing types include small bungalows, attached row houses, attached and detached one- and two-family homes, and midrise multifamily buildings. The majority of the building stock was built prior to 1983 and flood-resistant construction requirements. It is common for many of the buildings to have characteristics that make them especially vulnerable to flooding, such as being built at grade and having basements and sloping driveways (NYC Planning, undated[e]). Flood mitigation or retrofits may not be cost-effective in many cases.

Household Financial Vulnerability

As the Rockaway Peninsula was being developed in the mid-20th century, developers from both the public and private sectors "began constructing nursing homes, public housing developments and affordable housing projects under the Mitchell-Lama program" (NYC Planning, undated[e]). As a result, the peninsula has high numbers of disadvantaged populations. Taken along with the majority working-class neighborhood, these homeowners may not have much in the way of disposable income to put toward flood mitigation of their homes.

Figure 4.12
Bungalows in the Foreground and High-Rise Buildings in the Background on the Rockaway Peninsula

SOURCE: Image used with permission of the New York City Department of City Planning.

RAND *RR1776-4.12*

East Shore Subarea

Background

The East Shore of the Staten Island study area consisted primarily of fresh and tidal wetlands prior to its development in the early to mid-19th century. It was a popular beach destination in the summer months, and communities of beach bungalows popped up in the early part of the century. By the mid-19th century, development of the railroad and bridges connecting Staten Island to the mainland brought even more residential development. The result is low-density residential housing with a limited number of multifamily buildings as well as commercial properties located more inland. The East Shore has approximately 40,000 residents and about 13,000 residential housing units (NYC Planning, undated[b]).

Flood Risk Profile

The East Shore is a low-lying coastal area that contains open spaces, parks, and other natural areas. Heavy rainstorms lead to flooding events on a fairly regular basis. Hurricane Sandy brought widespread coastal inundation on the East Shore. Floodwater traveled as far as one mile inland, causing damage to homes and businesses in its path.

Building and Typology

Many of the beach bungalows built early in the 19th century have been retrofitted to provide year-round housing. The bungalows remain a predominant style of single-family detached housing on the East Shore (see Figure 4.13). Additionally, newer semi-attached buildings were built prior to 1983 and the first FIRM. These homes were constructed prior to the introduction of flood-resistant construction standards. Many of those homes were built at grade, which makes them very vulnerable to flooding. DCP reports that many of these homes were in some degree of disrepair prior to Hurricane Sandy (NYC Planning, undated[b]). The historical nature of many of the bungalow lots means that they are narrow, and retrofitting the housing units to make them less vulnerable to flooding is a challenge.

Household Financial Vulnerability

East Shore residents generally have higher household incomes relative to the city as a whole ($73,000 on East Shore versus $53,000 citywide, according to U.S. Census data). However, the costs associated with storm damage (repairs, retrofitting, relocation, elevation) have exceeded the funding received from insurance payouts and federal support (NYC Planning, undated[b]). More than 70 percent of the households in New Dorp Beach and Midland Beach experienced damage from Sandy based on data from FEMA's Individual Assistance program. DCP reports that many homeowners used savings, credit, or took out loans to supplement the insurance payments or federal assistance to cover repair costs or temporary housing costs (NYC Planning, undated[b]).

Figure 4.13
Typical Bungalow on the East Shore

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Take-Up Rates and Housing Burden

Flood insurance take-up rates vary considerably across the five study subareas. Table 4.2 reports estimates of the take-up rate in 2012 and 2016 for one- to four-family properties based on data collected for this study. At 18 percent, the 2016 take-up rate is substantially lower in Canarsie than in the other four subareas as well as that in the remaining parts of the study area. This is undoubtedly due largely to the fact that very little of Canarsie is in the high-risk areas of the FIRM currently in effect (the 2007 FIRM). The lower household incomes in Canarsie also likely play a role in the low take-up rate. Estimated take-up rates in the Jamaica Bay subarea and the Rockaway Peninsula are higher than in other areas, with nearly 60 percent of one- to four-family structures insured. Take-up rates rose considerably between before Hurricane Sandy hit in 2012 and 2016 in all study subareas.

Canarsie again stands out in terms of income and housing burden. An estimated 54 percent of households in owner-occupied one- to four-family homes in Canarsie are low income, very low income, or extremely low income (first column of Table 4.3). More than 50 percent of the households in Canarsie are housing burdened based on data collected in 2016 on income and housing costs (third column of Table 4.3).

Households in Canarsie also tend to be younger than in other parts of the study area (penultimate column of Table 4.3), although the differences are not as great as for the other variables examined.

To provide a better sense of how housing burden varies across the study area, Figure 4.14 plots the location of each of the 569 households completing the survey. Those with a PITI ratio of more than 0.4 are colored red. It should be noted that this map does not reflect the differing weights that each household is given in the analy-

Table 4.2
Flood Insurance Take-Up Rates for One- to Four-Family Properties in the Study Subarea (Percentage)

	2012		2016	
Study Subarea	Take-Up Rate	95% Confidence Interval	Take-Up Rate	95% Confidence Interval
Canarsie	3%	1–5%	18%	14–22%
Gerritsen Bay/Sheepshead Bay	24%	19–29%	45%	39–51%
Jamaica Bay	12%	9–16%	58%	53–64%
Rockaway Peninsula	27%	23–30%	58%	54–62%
East Shore	40%	26–45%	47%	43–52%
Rest of study area	20%	17–23%	36%	32–39%
Overall study area	23%	21–24%	43%	41–44%

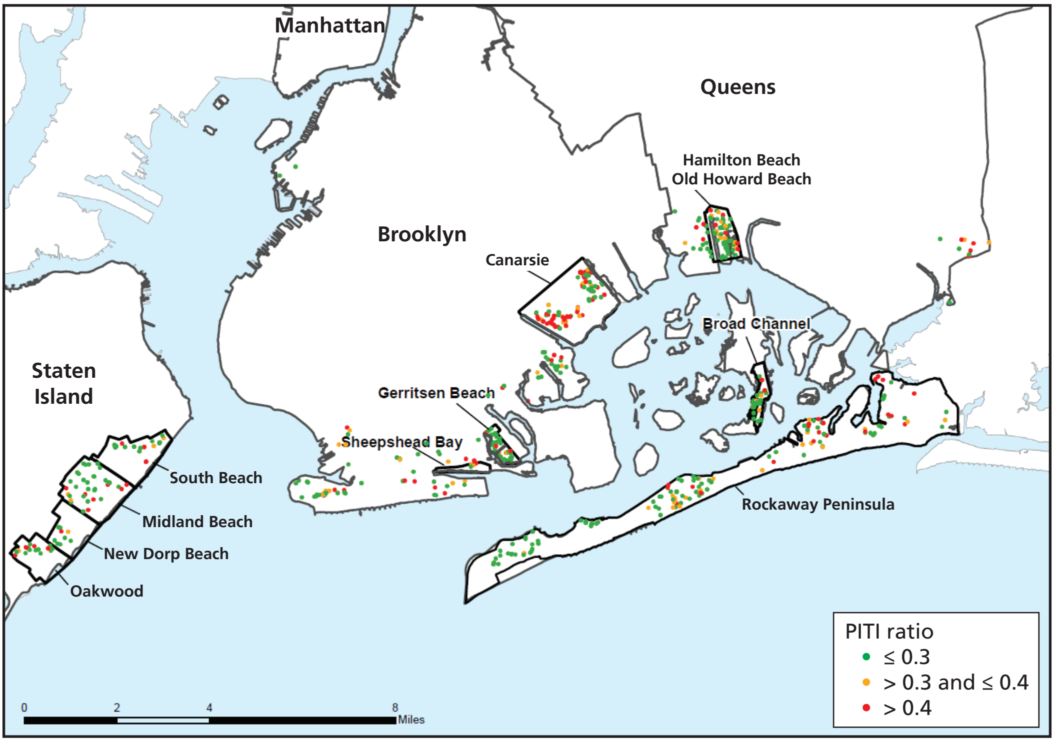
NOTE: Data based on the study sample of 2,800 properties. These estimates have been weighted to reflect all the properties in the study area.

Table 4.3
Household Characteristics by Study Subarea (Owner-Occupied Residences Only)

	Percentage Low Income and Below (≤80% AMI)		Percentage Housing Burdened (PITI Ratio >0.40)		Percentage Older (Financially Responsible Person ≥65 Years Old)	
Study Subarea	Estimated Percentage	95% Confidence Interval	Estimated Percentage	95% Confidence Interval	Estimated Percentage	95% Confidence Interval
Canarsie	54%	43–66%	55%	43–66%	22%	14–33%
Gerritsen Beach/ Sheepshead Bay	41%	26–57%	15%	7–30%	33%	21–48%
Jamaica Bay	44%	33–57%	11%	6–21%	31%	21–43%
Rockaway Peninsula	33%	25–43%	19%	13–28%	33%	25–42%
East Shore	44%	33–56%	23%	15–35%	29%	19–41%
Rest of study area	36%	28–46%	26%	18–35%	35%	27–44%
Overall study area	39%	35–44%	25%	21–30%	32%	28–37%

NOTE: These values are based on a sample of 569 owner-occupied residences. Categories may not add exactly to total because of rounding to nearest 100. Sample weights as described in Appendix A.

Figure 4.14
PITI Ratio for Households Participating in the Study as of 2016



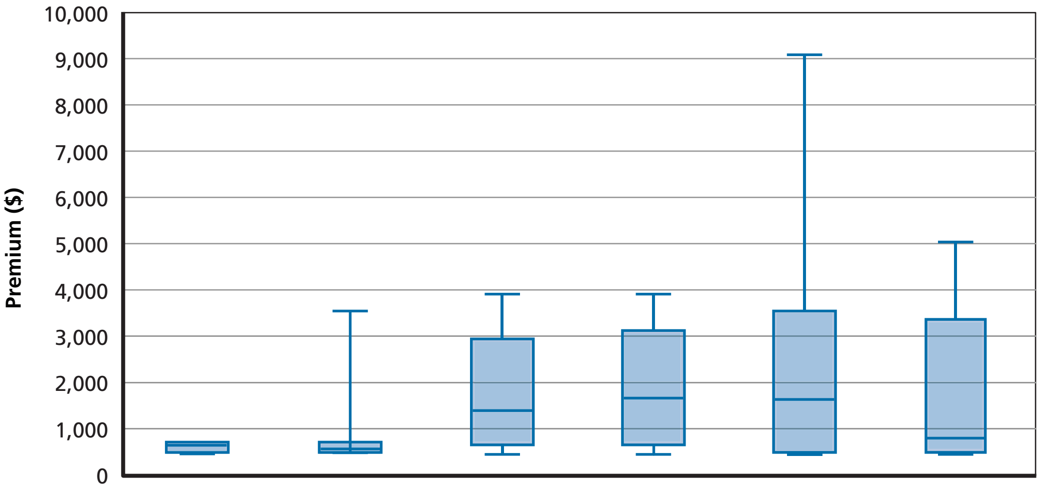
RAND *RR1776-4.14*

sis. As expected, a large share of the dots are red in Canarsie. Also noteworthy is the incidence of housing burden in the Rockaway Peninsula: Households that are housing burdened are located in the middle and eastern parts of the peninsula, not the western end, where the Breezy Point cooperative is located.

Premium Scenarios by Study Subarea

We break out premiums by study subarea for two of the premium scenarios examined in Chapter Three—scenarios B and G. Recall that scenario B uses the 2007 FIRM, the 2015 NFIP rate schedule, and allows for the pre-FIRM rates in that rate schedule. Scenario G used the PFIRM, the 2015 rate schedule, and does not allow for either pre-FIRM rates or grandfathering. Each of these scenarios assumes that all one- to four-family properties in the study area have flood insurance at the coverage levels assumed in Chapter Three.

Figure 4.15
Premium Scenario B Projections by Study Subarea (2007 FIRM, 2015 NFIP Price Schedule, with Pre-FIRM Rates)



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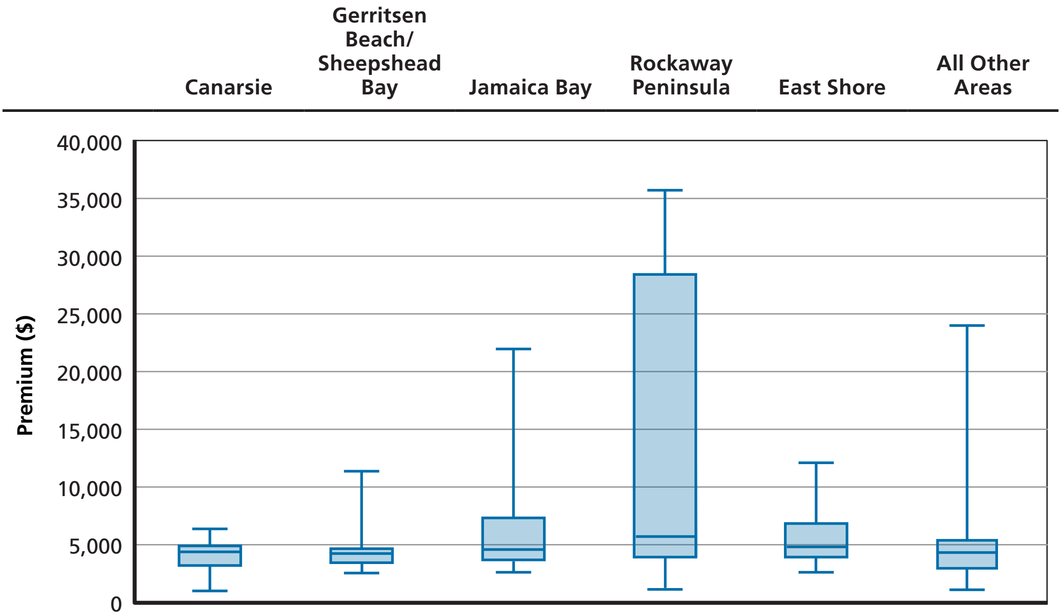
	Canarsie	Gerritsen Beach/ Sheepshead Bay	Jamaica Bay	Rockaway Peninsula	East Shore	All Other Areas
5th percentile	$400	$400	$500	$400	$400	$400
25th percentile	$500	$500	$700	$700	$500	$500
Median	$700	$500	$1,300	$1,700	$1,700	$700
75th percentile	$700	$700	$3,000	$3,100	$3,500	$3,400
95th percentile	$700	$3,600	$3,900	$3,900	$9,100	$5,000
Mean	$600	$1,000	$2,100	$1,900	$2,500	$2,300
95% confidence interval for mean	$560–630	$720–1,300	$1,400–3,100	$1,600–2,200	$2,100–3,700	$1,800–3,800

Figure 4.15 reports the distribution of premiums in scenario B. Premiums are low in Canarsie, reflecting the fact that nearly all property owners pay the PRP rate because nearly all of Canarsie is outside the high-risk areas of the 2007 FIRM. Similarly, premiums for most properties in Gerritsen Beach/Sheepshead Bay are low because a large part of these communities are also outside the high-risk areas of the 2007 FIRM. Mean premiums in the other areas range from $1,900 to $2,500, with some particularly large

Figure 4.16
Premium Scenario G Projections by Study Subarea (PFIRM, 2015 NFIP Price Schedule, Without Pre-FIRM Rates or Grandfathering)



RAND *RR1776-4.16*

	Canarsie	Gerritsen Beach/ Sheepshead Bay	Jamaica Bay	Rockaway Peninsula	East Shore	All Other Areas
5th percentile	$1,100	$2,600	$2,800	$1,100	$2,800	$1,100
25th percentile	$3,200	$3,600	$3,800	$4,000	$4,000	$3,000
Median	$4,400	$4,200	$4,400	$5,600	$4,700	$4,200
75th percentile	$4,900	$4,800	$7,400	$28,500	$6,900	$5,600
95th percentile	$6,400	$11,500	$22,100	$35,600	$12,300	$24,200
Mean	$4,000	$4,800	$5,900	$14,100	$5,900	$6,100
95% confidence interval for mean	$3,600–4,500	$3,900–5,700	$4,300–7,600	$11,200–16,900	$5,100–6,700	$4,600–7,600

premiums on the East Shore. At least 5 percent of property owners on the East Shore would pay $9,100 or more for the levels of coverage assumed in this analysis.

Figure 4.16 reports the full-risk rates with the PFIRM in place (scenario G) by study subarea. Notice first that the mean and median premiums are considerably higher than in scenario B for all subareas. Second, a substantial number of property owners are paying very high premiums in all of the subareas: at least 25 percent of property owners are paying $4,800 or more in each subarea (the 75th percentile is

$4,800 or greater in all five subareas as well as in the rest of the study area). Premiums are particularly high in the Rockaway Peninsula. At least 50 percent are paying $5,600 or more, at least 25 percent are paying $28,500 or more, and at least 5 percent are paying $35,600 or more per year. These high premiums are due in part to the fact that approximately one-third of homes in the Rockaway Peninsula are in V zones according to the PFIRM.

These premium increases will increase the percentage of households in each subarea that are housing burdened. Moving to premium scenario B does not increase the percentage of households that are housing burdened from that observed in 2016 a great deal in any of the subareas examined (Table 4.4). In contrast, moving to premium scenario G does result in moderate to large increases in all subareas. Currently, housing-burdened households occupy more than 50 percent of the owner-occupied residences in Canarsie. Reflecting the large premium increases in the Rockaway Peninsula, the increase in the percentage of households that are housing burdened is particularly large—increasing from 16 percent under current conditions to 39 percent should premiums rise to those in premium scenario G.

Figures 4.17 and 4.18 plot the premium in scenarios B and G for each of the 485 households completing the survey and EC. As can be seen, the western tip of the Rockaway Peninsula is hit particularly hard by premium increases.

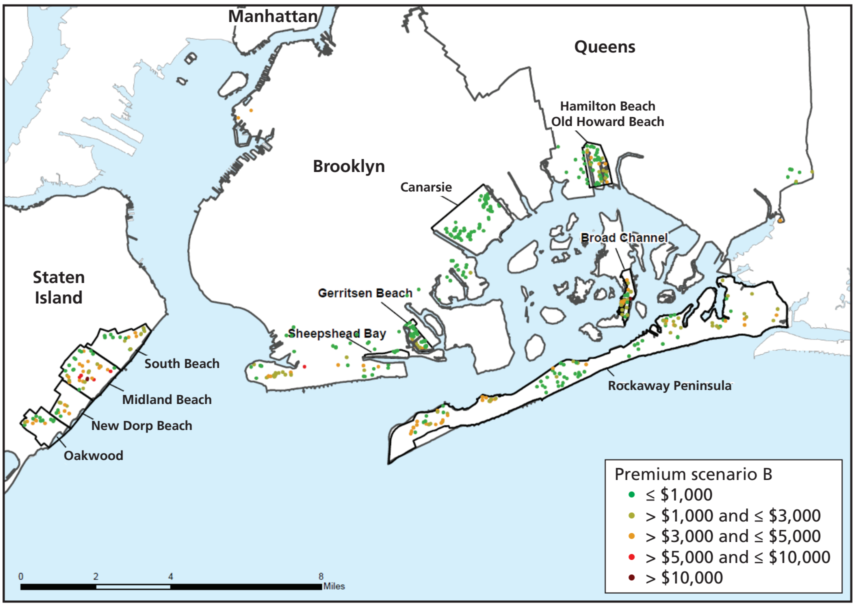
Table 4.4
Percentage of Households That Are Housing Burdened Under Premium Scenarios B and G by Study Subarea (Owner-Occupied Residences Only)

	Actual in 2016		With Premium Scenario B		With Premium Scenario G	
Study Subarea	Estimated Percentage[a]	95% Confidence Interval	Estimated Percentage	95% Confidence Interval	Estimated Percentage	95% Confidence Interval
Canarsie	44%	31–58%	46%	32–60%	54%	40–68%
Gerritsen Beach/ Sheepshead Bay	18%	8–36%	18%	8–36%	25%	13–43%
Jamaica Bay	8%	3–16%	9%	4–18%	21%	11–35%
Rockaway Peninsula	16%	9–26%	17%	10–27%	39%	29–50%
East Shore	26%	16–39%	29%	18–42%	31%	21–45%
Rest of study area	21%	13–30%	21%	13–31%	29%	20–39%
Overall study area	22%	17–27%	23%	18–28%	33%	28–39%

NOTE: These values are based on a sample of 449 owner-occupied households with ECs. Categories may not add exactly to total because of rounding to nearest 100. Sample weights are described in Appendix A.

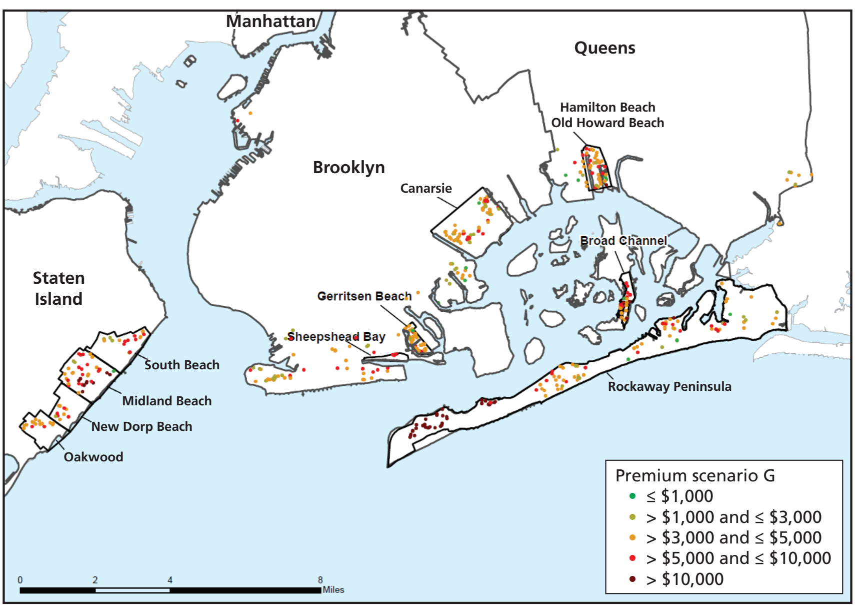
[a] The estimates for "Actual in 2016" are not identical to those in Table 2.9 in Chapter Two because the two sets of estimates are based on different sets of properties. The estimates in Table 2.9 are based on all owner-occupied properties with complete surveys. To allow comparisons with the results using premium scenarios B and G, the estimates in this table are based owner-occupied properties with ECs.

Figure 4.17
Flood Insurance Premium in Premium Scenario B



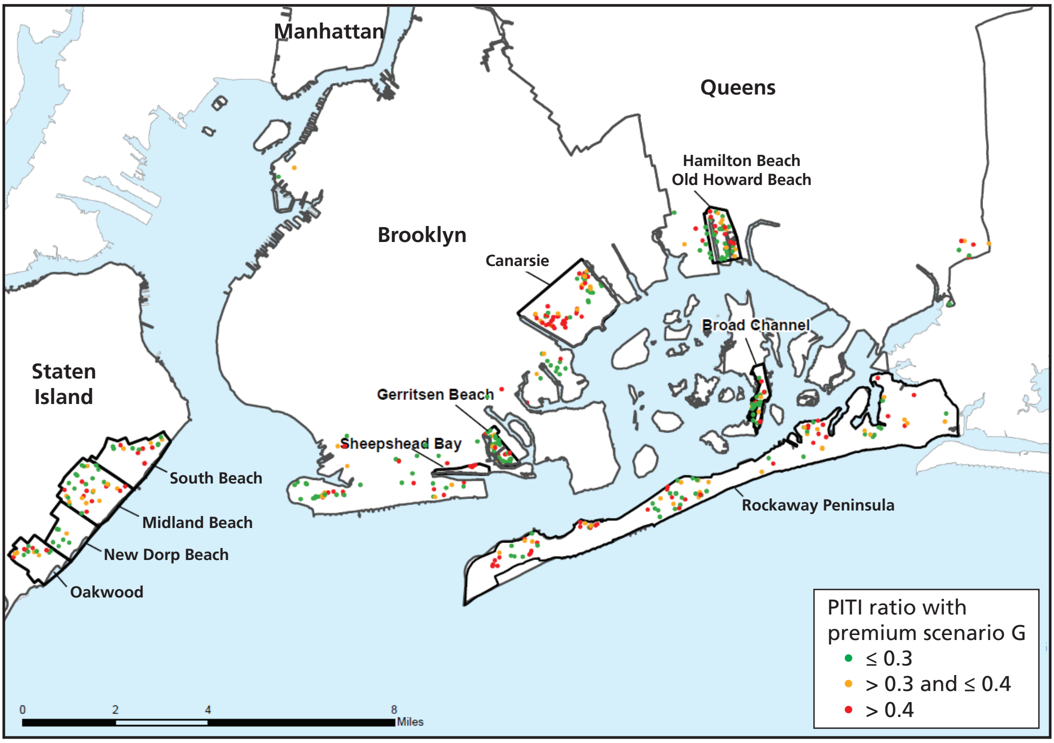
RAND *RR1776-4.17*

Figure 4.18
Flood Insurance Premium in Premium Scenario G



RAND *RR1776-4.18*

Figure 4.19
PITI Ratio Assuming Premium Scenario G



RAND *RR1776-4.19*

Figure 4.19 plots the PITI ratios when premiums are set to those in scenario G. The number of housing-burdened households on the Rockaways has increased considerably compared with Figure 4.14.

Summary of Findings

Of the five subareas examined, flood insurance premiums are particularly burdensome for households in Canarsie. A substantially higher proportion of households in Canarsie are currently housing burdened than in the other subareas examined and a substantially higher proportion are low, very low, or extremely low income.

All subareas will be hit hard if flood insurance premiums increase from those available today (premium scenario B) to those under a PFIRM when neither pre-FIRM rates nor grandfathering is allowed (premium scenario G). The Rockaways are particularly exposed in this respect, with the largest premium increases in the study area. Premiums in scenario G are $25,800 or more for at least 25 percent of one- to four-family properties in the Rockaways, and the west end of the Rockaways is particularly hard hit.

The premium increases in scenario G cause a substantial increase in the percentage of households that are housing burdened in all subareas. The percentage that is housing burdened in Canarsie increases from the already high level in scenario B, and the Rockaways will start to look like Canarsie currently does in terms of the percentage of households that are housing burdened.

CHAPTER FIVE

Effects of Flood Insurance Premium Increases on Households and Neighborhoods

Introduction

Having flood insurance provides households with a source of financial support to remain financially solvent during a flooding disaster that might otherwise leave their property underwater both physically and financially. Being exposed to large financial risk also means insurance can be expensive. And, as shown in the previous chapter, increasing flood risk and the removal of grandfathering can result in large increases in flood insurance premiums for many households. Some households have or will have limited financial ability to pay these increasing premiums, resulting in severe impacts on their well-being and, if these higher premiums result in lower flood insurance take-up rates, on the community's ability to recover.

Changes in flood insurance prices will increase the cost of housing for almost all affected households. As discussed in Chapter One, FEMA is now updating the flood insurance maps for New York City, so there is uncertainty about exactly what future prices will look like and exactly who might be affected. However, as discussed in Chapter Three, the PFIRM may provide an initial view of how flood risk in New York City differs from that depicted in the effective FIRM. Understanding the ways households and neighborhoods would be affected by shifting from the effective FIRM to the PFIRM can provide insight into how households and neighborhoods will be affected by whatever change ultimately occurs.

Another source of uncertainty is that the magnitude of price changes will also depend on the extent to which pre-FIRM rates and grandfathering remain or are removed. Chapter Three presented eight different scenarios for flood insurance premiums. Scenario B is most representative of the present situation, as it reflects flood insurance prices under the 2015 rate schedule and the effective FIRM. Hence, scenario B is largely used as the baseline case in this chapter.

Although scenario B is most similar to the present situation, recall from Chapter Three that the average premiums in scenario B are higher than premiums paid by current policyholders. The reasons for this difference were discussed in Chapter Three, but recall that a primary reason is that higher coverage levels are assumed in scenario B than actually occur in practice. We assume these higher coverage levels because it is desirable for property owners to have the resources available to recover after a flood (subject to the policy limits offered by the NFIP).

This chapter focuses on the implications of shifting from scenario B to scenario G. Recall from Figures 3.5 and 3.7 in Chapter Three that median premium increases from $3,000 to $5,600 for properties in the high-risk zones of the effective FIRM, and from $500 to $4,200 for properties outside the high-risk zones of the effective FIRM but in the high-risk zones of the PFIRM. Scenario G shows what would happen to rates if pricing moved closer to risk-based rates by eliminating grandfathering and pre-FIRM rates. The premiums in scenario G assume the flood risk shown in the PFIRM. The shift from scenario B to scenario G is particularly interesting because it represents the impacts associated with moving from the current pricing scenario to a scenario of risk-based pricing. Because coverage rates are held constant, the impacts associated with moving from scenario B to scenario G are driven by (1) the shift from the effective FIRM to the PFIRM and (2) the elimination of grandfathering and pre-FIRM rates.

This chapter examines the impact of changes in flood insurance premiums on property values, property tax revenue, defaults, renters, and insurance take-up rates.

Effect of Flood Insurance Premium Increase on Property Values

This analysis begins by looking at the impact of changes in flood insurance premiums on property values, which include both the value of the structure and the value of the land. As a baseline, Table 5.1 shows the distribution of the 2016 market value of properties in the study area as recorded by the New York City Department of Finance Appraisal system (recall that the study area is in the high-risk zones of the PFIRM). Many factors beyond floodplain location and flood insurance prices go into determining property values; for example, the 2008 subprime mortgage crisis had an enormous effect on housing prices. Overall, the market value of homes in the study area is slightly lower than in New York City as a whole. Our survey finds the median 2016 market value of homes in the study area is $407,000. In 2013, as housing prices recovered from the subprime mortgage crisis, the American Housing Survey found the median value of homes in New York City to be $415,000.[1] By 2014, the New York City Housing and Vacancy Survey found the median value of homes had risen to $489,000 (U.S. Census Bureau, undated[a]).[2]

The property values presented in Table 5.1 incorporate the current cost of flood insurance. The market value of a property reflects the price a new homeowner would be willing to pay, taking into consideration any requirement or desire to purchase

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1 Inflation-adjusted to 2016 dollars and rounded to the nearest $1,000.

2 Inflation-adjusted to 2016 dollars and rounded to the nearest $1,000.

Table 5.1
Market Value of One- to Four-Family Properties in the Study Area, Owner-Occupied Residences Only

	Property Value (2016 $)
All areas	
5th percentile	$235,000
25th percentile	$307,000
50th percentile	$407,000
75th percentile	$516,000
95th percentile	$850,000
Median home price by study subarea	
Canarsie	$390,000
Southern Brooklyn Waterfront	$361,000
Jamaica Bay	$400,000
Rockaway Peninsula	$402,000
East Shore, Staten Island	$325,000
Rest of study area	$469,000

NOTE: Based on 2016 assessed fair market value, rounded to nearest $1,000.

flood insurance over the subsequent years. We are assuming that a new homeowner, if purchasing flood insurance, would pay the premium described in scenario B. Current home values reflect the "scenario B" prices to the extent that a new homeowner, if purchasing flood insurance, would choose the level of coverage described in Chapter Three and face a premium based on the particular location and characteristics of the structure. Current home values also reflect any expectation the average homebuyer has about future changes in the cost of the home, including future changes in flood insurance rates.

There have been several academic studies looking at the extent to which flood insurance prices are incorporated into property values. Bin, Kruse, and Landry (2008) use a hedonic pricing model to examine home sales in Carteret County, North Carolina. They find "[p]rice differentials for flood risk and the capitalized value of flood insurance premiums are roughly equivalent" (p. 63). MacDonald et al. (1990) examine the price of homes sold in Monroe, Louisiana, between January 1988 and July 1988. They similarly find the homes in high-risk flood zones sold at a lower price compared with similar homes outside of high-risk flood zones, and that the magnitude of this price reduction was roughly comparable to the present value of flood insurance premiums. Based on this literature, we assume that the present value of the cost of flood insurance is fully incorporated into the value of the property. Although the cost of flood insurance reduces property value when considered in isolation, other aspects of properties in high-risk flood zones may increase their value. Atreya and Czajkowski (2015) find that properties in Galveston County, Texas, that are closer to the coast command significantly higher prices, and that the rate at which this price premium decays as distance to the coast increases varies depending on flood risk.

To examine the change in the value of a property, we need to estimate the change in the present value of all the flood insurance payments that would be paid on that property. To calculate this change in present value, it is important to consider how long the household will purchase insurance. As presented in Chapter Two and Dixon et al. (2013), we know that homeowners who are not required to purchase flood insurance are less likely to purchase flood insurance. We also know that so long as a homeowner is paying off a federally backed mortgage, that homeowner would face a mandatory purchase requirement if the home is in a high-risk flood zone. Although this requirement is not perfectly enforced, homeowners with mortgages are considerably more likely to purchase flood insurance.

We assume that new homeowners will only purchase flood insurance during the duration of the mortgage, which we assume is 30 years. Under this assumption, an increase in flood insurance prices reduces the value of a home by the present value of 30 years of flood insurance payments.[3] Table 5.2 presents the range of declines in property value of homes in the study area associated with moving to risk-based rates with the PFIRM (scenario G). Results are divided between homes in the high-risk zones of the effective FIRM and homes that are not in the high-risk zones of the effective FIRM but are in the high-risk zones of the PFIRM. Under scenario G, declines in home value are large but extremely variable from one property to another. The median decline in property value is $40,000 for properties in the high-risk zone of the effective FIRM. The median changes are considerably larger ($64,000) for properties in the study area but outside the high-risk zones of the effective FIRM. Appendix G provides further details about how these changes in property value were calculated.

At least 5 percent of the properties in the high-risk zones of the effective FIRM see no decline in value.[4] On the other extreme, the decline in value of some property in the current high-risk zone is so large that the property is almost worthless. This

3 The average mortgage is prepaid in fewer than 30 years, but the value of the property is based on its resale value and not how long the current owner plans to live there or purchase insurance. So long as the property is sold to another owner with a new 30-year mortgage, the new owner still expects to pay 30 years of flood insurance (or expects to sell it to yet another owner who will pay 30 years of insurance). This holds regardless of the mortgage interest rate; the assumption is that the average home buyer on the market will either (1) sell the property before paying off the mortgage or (2) expect, at the time of purchase, to take 30 years to pay off the mortgage. If the average buyer expects, at the time of purchase, to hold a mortgage for fewer than 30 years and still remain in the house, then the buyer would be willing to pay a higher price for the home. Similarly, if the average buyer expects, at the time of purchase, to be able to stop buying insurance before the buyer's mortgage is fully paid because of lax enforcement or other factors, then he or she would be willing to pay a higher price for the home.

4 A very small number of properties even increase in value after their flood insurance rates decrease.

Table 5.2
Decline in Property Value Because of Change in Flood Insurance Premium from Scenario B to Scenario G, Owner-Occupied Residences Only (2016 Dollars)

	Properties in the High-Risk Areas of the 2007 FIRM	Newly Mapped Properties
All areas		
5th percentile	$0	$8,000
25th percentile	$20,000	$44,000
50th percentile	$40,000	$64,000
75th percentile	$149,000	$73,000
95th percentile	$527,000	$98,000
Mean	$137,000	$62,000
Median change by study subarea		
Canarsie	—	$64,000
Gerritsen Beach/Sheepshead Bay	$23,000	$64,000
Jamaica Bay	$38,000	$64,000
Rockaway Peninsula	$149,000	$64,000
East Shore	$37,000	$65,000
All other areas	$27,000	$53,000

NOTES: Sample limited to one- to four-family properties in the PFIRM with complete ECs. There are no homes from Canarsie in our sample with an EC that are inside the high-risk zones of the effective FIRM. Maximum decline in value is bounded at the 2016 home value. Dollar values are rounded to nearest $1,000. 95-percent confidence intervals for the estimates of the mean change, from left to right, are ($138,000–$225,000), ($93,000–$152,000), ($82,000–$102,000), and ($55,000–$68,000). 95-percent confidence intervals for the number of homes reduced to a value of $0 are (–196–730) and (–33–101). No properties outside of the high-risk areas of the effective FIRM have their value reduced to $0. Percentiles do not have confidence intervals.

is because the cost of insurance becomes so high for those properties that the present value of the increase exceeds the value of the home. The decline in property value affects both the value of the structure and the land itself because the location has become less desirable for any structure requiring flood insurance. The land may retain some residual value for being sold to the city as park space, for example, but there is unlikely to be much interest from homeowners in paying the costs associated with maintaining a home on that property. Although not all changes in property value are that extreme, most affected homeowners are likely to see significant drops in the value of their home. Changing to risk-based pricing in the PFIRM represents a significant financial loss to most homeowners in the study area.

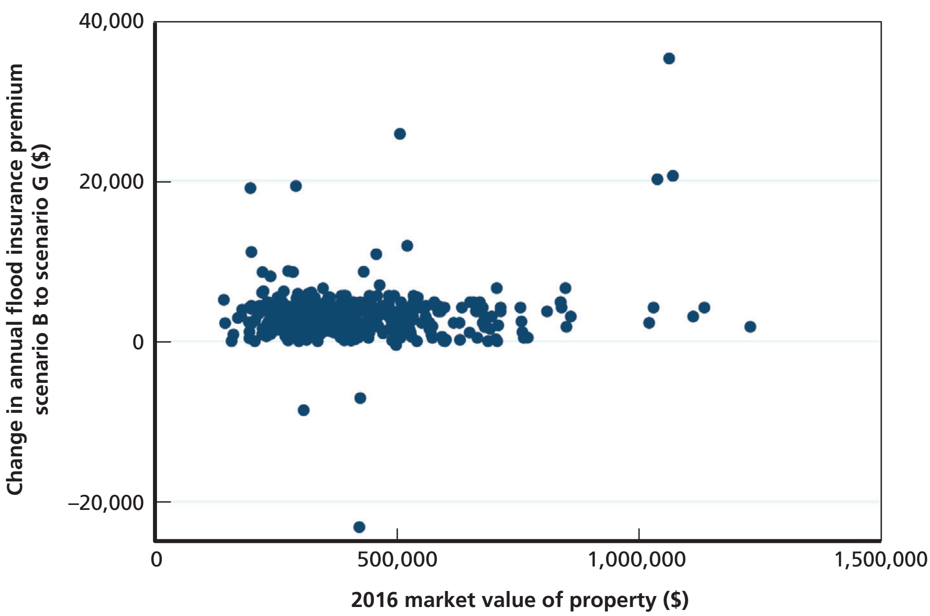
Figure 5.1 shows that the increase in flood insurance premiums is not strongly correlated with property value. Both high- and low-value homes see a large increase in their flood insurance premiums, and hence large declines in the value of their home.

Effect of Flood Insurance Premium Increase on Property Tax Revenue

Such large changes in property value have several further implications. One is that declines in property value directly map to declines in property tax revenue. Property tax rates in New York City are quite high, and the base rate for most one-to-four family homes was 19.6 percent in 2016. However, residences benefit from a significant number of exclusions, such that the vast majority of homes are taxed on less than 10 percent of the value of their property.

Table 5.3 estimates that the total 2016 property tax revenues from one- to four-family households in the study area was $173 million. Under the assumptions previously described concerning how property values incorporate flood insurance prices, a shift to scenario G would result in a decline in property tax revenue of roughly $22 million.

Figure 5.1
Total Change in Spending on Flood Insurance by One- to Four-Family Households in High-Risk Zones of the Preliminary Flood Insurance Rate Map



NOTE: Four outliers with a 2016 market value of over $1.5 million are not shown.
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Table 5.3
Impact of Flood Insurance Rate Changes on Property Tax Revenue (2016 Dollars)

	Property Tax Revenue ($ per Year)	95% Confidence Interval ($ per Year)
2016 property tax revenue	$173 million	$153 million–$192 million
Scenario G property tax revenue	$151 million	$133 million–$169 million

NOTES: Sample limited to households with complete ECs (N = 485). Excludes property tax revenue from co-ops. Assumes all households are occupied, unless home value is $0.

Effect of Flood Insurance Premium Increase on Probability of Default

Increases in flood insurance premiums are also likely to increase the number of mortgage defaults in affected communities. There are two main theories about what factors cause homeowners to default on their mortgage. The first theory, known as the equity theory of default, views the household as essentially buying ownership of the property from the mortgage lender. If the value of the home drops, the household no longer benefits from spending the same amount of money to purchase a now less-valuable home from the lender. Because the value of the home has dropped, selling the home also does not raise sufficient revenue to pay back the lender. In this situation, default becomes a logical financial decision for the household. For example, Campbell and Cocco (2015) find that default rates increase when there are large declines in housing prices.

The second theory, known as the ability-to-pay theory of default, says that as long as individuals can afford the monthly payments, they will avoid default. Order and Zorn (2000) find that while defaults are somewhat higher in low-income areas, this simply reflects that low-income households have more limited ability to access other sources of funding if their resources become constrained. As such, the ability-to-pay literature has found that once such variables as credit score are considered, income has relatively little additional predictive power in forecasting default rates. For example, Quercia, Pennington-Cross, and Tian (2012) find that differences in default rates across different income levels largely disappear after controlling for differences in group characteristics. In emphasizing that the ability-to-pay theory is about liquidity and not income, Gyourko and Tracy (2014) note that "[e]mpirical models of mortgage default typically find that the influence of unemployment is negligible compared with other well known risk factors such as high borrower leverage or low borrower FICO scores" (p. 87). These results suggest it would be inappropriate to assume that households that face a sudden increase in monthly flood insurance payments would necessarily default at the same rate as households with lower income or a higher percentage of income spent on PITI.

Because we do not have access to the credit history of the households in our study but we do have information about the current loan-to-value ratio of the property, we focus on the equity theory of default. If the value of the house falls without any change in the mortgage, the loan-to-value ratio increases and household becomes more likely to default. Appendix G describes how we calculate the probability of default based on the current loan-to-value ratio, following results from Wong, Fong, and Sze (2004) and Gyourko and Tracy (2014).

In January 2016, the mortgage default rate in New York City was 1.0 percent (Barraza, 2016), or just over 300 mortgage defaults per year among owner-occupied residences in the study area. Table 5.4 shows over 150 additional defaults are expected because of the decline in property values. Appendix G provides further details regarding how these default rates were calculated. The majority of defaults come from households in the high-risk zones of the effective FIRM, although areas in the high-risk zones of the PFIRM but outside the high-risk zones of the effective FIRM are also at risk of default. Default rates also vary significantly across the separate subareas. The Rockaway Peninsula is at particular risk of large numbers of defaults.

Effect of Flood Insurance Premium Increase on Probability of Insurance Take-Up Rates

As reported in Table 2.4 in Chapter Two, 43 percent of the homes in our study area have flood insurance. Take-up rates are higher (73 percent) for homes in the current high-risk flood zone with mortgages because these properties face the mandatory purchase requirement. Take-up rates for homes without mortgages and homes outside the current high-risk flood zone are approximately 30 percent. Even absent premium increases, the take-up rate among this latter group is likely to drop over time for two reasons. First, take-up rates will likely fall as memory of Hurricane Sandy fades.[5] Second, several sources of federal aid available to residents affected by Hurricane Sandy required recipients to purchase at least three years of flood insurance. Take-up rates will likely fall once this three-year requirement is satisfied.

Previous work has shown that the demand for flood insurance in high-risk zones is only moderately sensitive to price. Specifically, the estimates of the elasticity of demand for flood insurance, measured as the percentage change in demand for flood insurance divided by the percentage increase in price, range from –0.06 to –0.26.[6] The –0.16 midpoint of this range implies that a 10-percent increase in price would result in only a 1.6-percent decrease in demand for flood insurance. Demand for flood insurance being relatively inelastic is unsurprising because most properties in high-risk zones are subject to the mandatory purchase requirement. The elasticity of demand is likely

5 See Dixon et al., 2006, p. 44, and Gallagher, 2014, for evidence that take-up rates increase following a disaster and then fall as time since last major flood event passes.

6 Browne and Hoyt, 2000, put the elasticity at –0.11; Kriesel and Landry, 2004, at –0.26; and Dixon et al., 2006, at –0.06.

Table 5.4
Estimated Number of Additional Defaults by Current Owners of One- to Four-Family Households in Study Subarea, Owner-Occupied Residences Only

	Number of Additional Defaults	95% Confidence Interval
All areas	156	–12 to 325
Inside high-risk zones of the effective FIRM	128	–40 to 296
Rest of study area	28	12 to 45
By study subarea		
Canarsie	11	–1 to 23
Southern Brooklyn Waterfront	1	0 to 3
Jamaica Bay	10	–2 to 22
Rockaway Peninsula	107	–61 to 276
East Shore, Staten Island	10	0 to 19
All other areas	17	–3 to 36

NOTE: Sample limited to households with complete ECs.

greater for homes not subject to the mandatory purchase requirement than homes that are, but previous work has not found much of an empirical difference.[7] These inelastic estimates are also based on much smaller changes in price than those considered here. If the probability that a $5,000 increase in insurance costs causes a household to drop its insurance is more than ten times larger than the probability that a $500 increase in insurance costs causes a household to drop its insurance, then these elasticities would underestimate the number of homes that would drop flood insurance in this setting.

Overall, insurance coverage among homes in the study area with mortgages but outside the high-risk zones of the effective FIRM is likely to increase from approximately 30 percent to 70 percent as the flood zones and premiums move from those in scenario B to those in scenario G. That is, these households will now be subject to the mandatory purchase requirement. The large increase in premiums may put some downward pressure on compliance with the mandatory purchase requirement, but how much is uncertain. For homes not subject to the mandatory purchase requirement, the large increases in premiums may cause a decline in take-up rate, particularly for homes outside the high-risk zones of the effective FIRM. Even with low elasticity estimates, the 740-percent increase in the median premium ($500 to $4,200) outside the high-risk areas of the current FIRM would result in a large decline in the take-up

[7] Dixon et al., 2006, p. 46, found that the elasticity is only slightly more negative for homes where the likelihood of a mortgage is low (–0.08 versus –0.06).

rate.[8] As we are not aware of any prior empirical work examining such a large change in the price of flood insurance, it is difficult to say with certainty how large the decline in take-up will be.

Summary of Findings

We examined the impacts of shifting from pricing scenario B, where insurance is purchased at current prices at assumed levels of coverage, to scenario G, where insurance is purchased at risk-based prices under the PFIRM at the same coverage levels. The magnitude of the price increases is described in Chapter Three. This chapter examined the implications of those price changes to individual households and the broader community.

Our results suggest that the increase in flood insurance prices will cause significant decreases in property values. Table 5.2 shows that households in the study area but outside the high-risk zones of the effective FIRM will see the value of their property decrease by roughly $10,000 to $100,000. Within the high-risk zones of the effective FIRM, most properties will decrease in value, although the impact ranges from declines of $20,000 or less to the property value falling by many hundreds of thousands of dollars. In the most extreme cases, the present value of the cost of flood insurance exceeds the current value of the property. Property values are determined by a host of factors (mortgage rates for example), and the declines estimated here should be interpreted as changes from what property values would have been otherwise. For example, other factors may cause property values to rise, more than offsetting the downward pressure because of increasing flood premiums. However, had premiums not increased, property values would have been higher by the amounts estimated here.

This drop in property value has a wide variety of further implications. Property tax revenue is likely to decrease by $22 million. We estimate the mortgage default rate will increase by 50 percent to 1.5 percent of homes with mortgages per year. Most of these defaults will be in the high-risk areas of the current FIRM. Some study areas, such as the Rockaway Peninsula, could be particularly hard hit by increased default rates. Take-up of insurance is likely to increase considerably for homes with mortgages outside of the high-risk areas of the current FIRM, as they would become subject to the mandatory purchase requirement. However, the large increase in premiums may decrease take-up rates for homes not subject to the mandatory purchase requirement both in and outside the current high-risk areas.

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[8] A 740-percent price increase with an elasticity of –0.11 would result in an 81-percent drop in the take-up rate.

CHAPTER SIX

Flood Insurance Affordability Program Options

The preceding chapters have examined the affordability of flood insurance for households living in one- to four-family residences, how flood insurance premiums would change under different scenarios, and the economic consequences of these changes. In this chapter, we examine various approaches for assisting low- and moderate-income households to pay for these premiums.

Approach

Five different designs for a flood insurance affordability program are considered (see Table 6.1). These designs were motivated by affordability programs in other settings as well as approaches discussed in the literature (U.S. Government Accountability Office, 2015 and 2016; National Academies of Sciences, Engineering, and Medicine, 2015 and 2016; Dixon et al., 2013, p. 67; Kousky and Kunreuther, 2013). They were also refined based on discussion during two workshops hosted by the National Academies of Sciences, Engineering, and Medicine on behalf of the Federal Insurance and Mitigation Administration (FIMA).[1] The first three programs subsidize flood insurance premiums in different ways. The fourth makes flood insurance premiums more affordable by funding or subsidizing structure-specific mitigation measures, and the fifth combines mitigation assistance with a premium subsidy.[2]

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[1] The workshops were held in fall 2016 and were part of FIMA's efforts to develop options for a national flood insurance affordability framework.

[2] One way that communities can reduce flood insurance premiums for policyholders is to participate in the Community Rating System (CRS), which FEMA started in 1990. The goal of the program is to reduce flood damage to insurable property, encourage communities to adopt a more comprehensive and coordinated approach to floodplain management, and strengthen and support the role that flood insurance can play in this regard. Based on community activities, flood insurance policyholders in special flood-hazard areas can benefit from insurance premium discounts in 5-percent increments. New York City is not currently a member of the CRS, but is investigating whether it would make sense to join.

The first step to evaluating CRS eligibility entails a FEMA Community Assistance Visit (CAV); FEMA initiated a CAV in New York City in 2015, and it is currently in process. FEMA provided the city with a report detailing high-level findings and recommendations in early 2016. In response to that report, the city provided an

Table 6.1
Flood Insurance Affordability Program Designs

Design	Name	Description	Similar Designs
1	Income-based subsidy	Substantial premium subsidy for very low–income households with more modest subsidies for low-, moderate-, and middle-income households	New York State Home Energy Assistance Program
2	Subsidy based on housing burden	Subsidies for low-, moderate-, and middle-income households that spend more than a certain percentage of their income on housing costs	HUD Section 8 Voucher Program
3	Deductible subsidy	Reimbursement of a portion of the deductible for a high-deductible flood insurance policy	None
4	Mitigation loans and grants	Grants for the lowest-income households and low-interest loans for other low-, moderate-, and middle-income households to modify the structure to reduce flood risk	SBA Disaster Mitigation Loan Program
5	Mitigation loans and grants combined with income-based subsidy	Income-based subsidy program that requires households to implement cost-effective mitigation measures	Program proposed by Kousky and Kunreuther (2013)

NOTE: SBA = Small Business Administration.

These programs aim to reduce the cost of flood insurance for households that find purchasing flood insurance burdensome. They are similar to pre-FIRM rates and grandfathering in that they attempt to reduce the cost of flood insurance for certain households. But in contrast to pre-FIRM rates and grandfathering, the affordability programs developed here include means tests to target households that find purchasing flood insurance burdensome.

We take the following approach in analyzing these affordability designs.

1. **Residency status.** We restrict eligibility to owner-occupied properties that are primary residences (for ease of exposition, we refer to these as owner-occupied residences). Recall from Table 2.1 in Chapter Two that owner-occupied residences account for approximately 90 percent of the one- to four-family properties in the study area. The other 10 percent are second residences or properties that are rented out by the individuals or businesses that own them. These

outline of a planned flood risk reduction compliance unit in fall 2016. The city is currently awaiting a response from FEMA on next steps. The city recognizes the benefits of the CRS and will look into it further once the CAV process is complete.

We do not examine the potential for incorporating CRS participation into a flood insurance affordability strategy in this report. That topic warrants further study.

individuals or businesses presumably have too many assets to justify assistance for flood insurance premiums.

2. **Coverage levels.** The outcomes for each design are modeled assuming the building and contents coverage limits used in the premium projections in Chapter Three. Recall that building coverage is set to replacement cost or to \$250,000 if replacement cost is greater than \$250,000. Contents coverage is \$100,000 when building coverage is \$250,000 and 40 percent of building coverage when building coverage is less than \$250,000. These coverage limits are higher than those observed in practice, but it seems sensible to develop an affordability program that allows households to hold the coverage they would need to rebound from a loss (subject to NFIP coverage limits).
3. **Participation rate.** The cost and number of enrollees for each design are initially projected assuming that all eligible households participate. Doing so provides an estimate of the maximum cost of design. The costs and number of beneficiaries are then projected for lower participation rates.
4. **Premium scenario.** Each design is first modeled using premium scenario B—the one that most closely reflects current conditions (2007 FIRM and 2015 rate schedule with pre-FIRM rates). To understand what program costs might look like with risk-based rates and a more stringent FIRM, we also model several designs using premium scenario G (PFIRM, 2015 rate schedule without pre-FIRM rates, and no grandfathering). To illustrate the impact of grandfathering, these designs are also modeled using premium scenario E (PFIRM, 2015 rate schedule without pre-FIRM rates, but with grandfathering).
5. **Design parameters.** Each design is modeled under a set of base-case design parameters for eligibility and benefit levels. In several cases, versions are then modeled that are (1) targeted more broadly on lower income household and (2) available more broadly.

The objective of the affordability program is to reduce flood insurance costs for households that find them burdensome. Households with a PITI ratio more than 0.4 are considered housing-cost burdened (or "housing burdened" for short), and, as we discussed in Chapter Two, we consider flood insurance that pushes the PITI ratio above 0.4 to be burdensome. Table 6.2 shows the number of households that are housing burdened when flood insurance premiums are set to those in premium scenario B.[3] The target of the affordability program is thus the 9,700 households that would find these premiums unaffordable—81 percent of whom are in the low-, very low–, or extremely low-income categories.

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[3] See discussion around Table 3.6 regarding how the estimate of the number of housing-burdened households (9,700) reported in Table 6.2 compares with the number of housing-burdened households estimated in Chapter Two (Table 2.9).

Table 6.2
Number of One- to Four-Family Households in Owner-Occupied Properties by Housing Burden

	All Households in Study Area[a]	Housing Burden with Premium Scenario B	
		Housing Burdened	Not Housing Burdened
Extremely and very low income (≤ 50% of AMI)	6,800 (16%)[b]	4,500 (46%)	2,300 (7%)
Low income (51 to 80% of AMI)	8,600 (20%)	3,400 (35%)	5,200 (16%)
Moderate income (81–120% of AMI)	9,100 (21%)	1,200 (12%)	7,900 (24%)
Middle income (121–165% of AMI)	7,200 (17%)	600 (6%)	6,600 (20%)
Higher income (> 165% of AMI)	10,900 (26%)	0	10,900 (33%)
Total	42,600 (100%)	9,700 (100%)	32,900 (100%)

[a] Based on study sample with ECs (N = 449).
[b] Percentage of column total in parentheses.

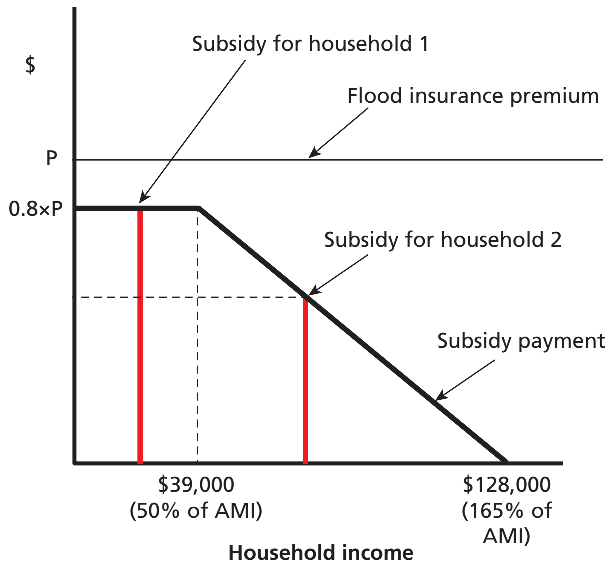
We now describe and analyze each of the designs. Costs and number of beneficiaries are projected given the current characteristics of households in the study areas. Outcomes may change over time as new households move into the study area or as unemployment and other economic conditions change.

Design 1: Income-Based Subsidy

Under this design, a premium subsidy is provided based on household income. The design is motivated by programs such as New York State's Home Energy Assistance Program, in which households with income of less than approximately 50 percent of AMI receive an annual benefit of $575 if their primary heating fuel is oil, kerosene, or propane. Somewhat higher benefits are available for households below a lower AMI threshold (New York State Office of Temporary and Disability Assistance, undated).

Figure 6.1 illustrates the design modeled here. As illustrated by household 1 in the figure, very low–income households (those with income less than or equal to 50 percent of AMI) receive a premium subsidy equal to 80 percent of the flood insurance premium. The subsidy is partial so that households continue to have some incentive to pay attention to flood risk and participate in mitigation programs. The benefit then diminishes as household income increases, falling to zero when household income

Figure 6.1
Structure for Income-Based Subsidy



NOTE: P = flood insurance premium.

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reaches HUD's upper cutoff for moderate-income households (165 percent of AMI).[4] Household 2 in Figure 6.1 has income of more than 50 percent of AMI and receives a lower subsidy than household 1.[5]

This design has a number of advantages and disadvantages. As just mentioned, the subsidy is partial so that households have some skin in the game, and they also bear some of the risk of increasing flood insurance premiums. Incorporating the gradual

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[4] Other New York City housing assistance programs such as the New Housing Opportunities Program, Mixed-Income Program, Taxable 80/20, and Coop Housing Program provide benefits to households with incomes of up to 165 percent of AMI (New York City Housing Development Corporation, undated). A variant of this design would be to provide a subsidy when the flood insurance premium exceeds a specified percentage of income with the percentage increasing as household income increases. That is the approach used for the subsidies provided in the health care exchanges (see Norris, 2017). It is also consistent with the approach used by the Federal Insurance Office to define affordability for automobile insurance. (The Federal Insurance Office presumes auto liability insurance to be affordable within a particular ZIP Code if the ratio of the average annual written personal automobile liability premium divided by median household income in the ZIP Code is less than or equal to 2 percent [see Federal Insurance Office, 2017, p. 9].) Such a variant of design 1 would result in a downward-sloping subsidy payment curve that, with the appropriate parameter settings, could be made to look similar to the shape in Figure 5.1 in Chapter Five.

[5] It may be desirable to restrict the program to households with assets below a certain level. Doing so would restrict benefits to low-income, high-net-worth households. Data on the correlation between household income and net worth are provided in Appendix C. They can be used to provide a rough sense of how various asset tests would reduce eligibility.

decline in benefits avoids a sudden change in benefits from 80 percent of the premium to zero and the associated incentive to reduce income to just below the threshold. It also opens the program to low- and moderate-income households that may find it difficult to afford their flood insurance premium albeit at reduced benefit levels. In addition, this design requires information only on household income and their flood insurance premium, as opposed to the more information-intensive requirements of other designs considered. As far as disadvantages are concerned, this design could provide benefits to households that are not housing burdened and who could, in principle, afford the full flood insurance premium. In addition, there is no obvious basis for choosing the shape of the subsidy schedule in Figure 6.1 (i.e., the maximum percentage subsidy and the rate at which it should decline).

The first column of Table 6.3 reports the number of beneficiaries, costs, and impacts of the income-based flood insurance affordability program depicted in Figure 6.1. Assuming 100-percent program participation, all 31,700 households in the study area with income less than 165 percent of AMI would receive benefits from the program. When flood insurance premiums without the program are equal to those in premium scenario B, households receive $33 million in premium subsidies annually. The average flood insurance premium paid by program participants falls from $1,900 without the program to $900 with the program. The average PITI ratio also declines somewhat.

The two rightmost columns of Table 6.3 report outcomes for households that are housing burdened without the program and those that are not. All of the 9,700 housing-burdened households identified in Table 6.2 receive benefits, with large declines

Table 6.3
Design 1: Income-Based Subsidy—Program Outcomes with Full Participation

Outcomes for Beneficiaries	All Households	Housing Burden Without the Program: Housing Burdened	Housing Burden Without the Program: Not Housing Burdened
Number of beneficiaries	31,700 (28,800–34,600)[a]	9,700 (8,400–11,100)	22,000 (19,600–24,400)
Annual premium subsidy	$33 million (27–37)	$14 million (9–19)	$19 million (15–23)
Average premium without program	$1,900	$2,100	$1,900
Average premium with program	$900	$650	$1,000
Average PITI ratio without program	0.42	0.87	0.22
Average PITI ratio with program	0.38	0.80	0.20

NOTE: This program is run with premium scenario B and assumes maximum percentage of premium subsidized is 80 percent, the income limit for the maximum subsidy is 50 percent of AMI, and the program eligibility cutoff is 120 percent of AMI.

[a] 95-percent confidence intervals in parentheses.

in the average payment for flood insurance. The average PITI ratio for these households declines from 0.87 to 0.80, but remains high.[6] As shown in the last column of Table 6.3, this design provides benefits to many households that are not housing burdened and thus could afford the flood insurance premium without the program. More than one-half of the program benefits ($19 million out of $33 million) are paid to this group. The PITI ratio for this group falls from an already-low 0.22 without the program to 0.20 with the program. We will decrease the program-eligibility cutoff from 165 percent of AMI to 120 percent of AMI to address this shortly.

The analysis has so far assumed a 100-percent program participation rate. It should be expected (and hoped) that such a program would increase take-up from the levels observed in 2016, but by how much remains uncertain. To better understand how program outcomes would vary with take-up, we estimate outcomes under four different participation rate assumptions:

- 2016 flood insurance take-up rates (36 percent for households with incomes 80 percent of AMI or less and 50 percent for households with higher incomes)
- 50-percent participation
- 75-percent participation
- 100-percent participation.

The results are shown in Table 6.4. If only those who currently purchase flood insurance participate in the program, program cost drops to $13 million. It then increases as the participation rate rises.

Table 6.4
Design 1: Enrollment and Program Cost Under Different Program Participation Assumptions

Participation Rate	Number of Beneficiaries	Annual Program Cost
2016 flood insurance take-up rates (36% and 50%)[a]	13,700	$13 million
50%	15,900	$17 million
75%	23,800	$25 million
100%	31,700	$33 million

NOTE: Table assumes maximum percentage of premium subsidized is 80 percent, the income limit for the maximum subsidy is 50 percent of AMI, and the program eligibility cutoff is 165 percent of AMI.

[a] In line with the take-up rates in Table 2.4 in Chapter Two, the participation rate is assumed to be 36 percent for households with incomes less than 80 percent of AMI and 50 percent for households with higher incomes.

[6] The distribution of PITI ratios has a heavy right tail, so the mean is considerably above the median for the housing-burdened households. In this case, median ratio is approximately 0.2 lower than the mean. For the households that are not hosing burdened, the mean and medians are close.

Table 6.5 shows how program costs change under different premium scenarios. Program costs rise to $120 million per year if the PFIRM is adopted and NFIP premiums increase to full-risk rates (premium scenario G). Grandfathering has considerable impacts on the cost of the program. Program costs are $52 million with grandfathering (premium scenario E), less than one-half of the costs without grandfathering. Note also that, as expected, the number of households that are housing burdened without the program increases when full-risk rates are used (from 9,700 to 14,200). For scenarios B and E the program causes little change in the percentage of households that are housing burdened in the study area (e.g., as shown in the table the percentage declines from 23 percent without the program to 22 percent with the program when premium scenario B is used). However, with the PFIRM in place and no grandfathering or pre-FIRM rates, the program does produce a sizable decline in the percentage of households that are housing burdened.

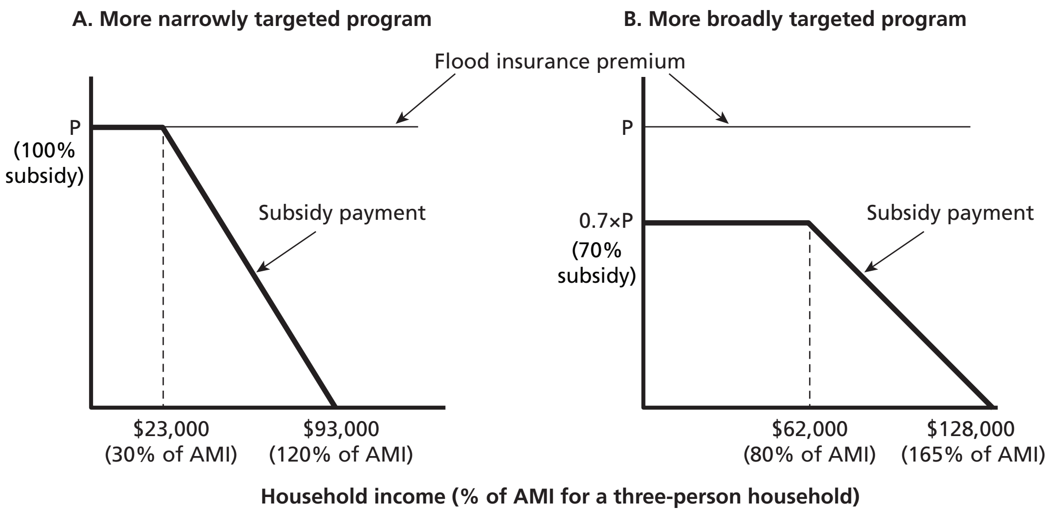
To illustrate the sensitivity of program outcomes to the design parameters, we model two additional versions of the income-based design. The first is more narrowly targeted on lower-income households. As shown in panel A of Figure 6.2, the maximum benefit is now the full flood insurance premium, but the maximum benefit is only available to households earning less than 30 percent of AMI, and the program

Table 6.5
Design 1: Enrollment and Program Cost Under Different Flood Insurance Premium Assumptions

	Premium Scenario		
Premium Scenario	**Scenario B (2007 FIRM with Pre-FIRM Rates)**	**Scenario E (PFIRM, with Grandfathering and No Pre-FIRM Rates)**	**Scenario G (PFIRM, with No Grandfathering and No Pre-FIRM Rates)**
Beneficiaries	31,700	31,700	31,700
Beneficiaries housing burdened without the program	9,700	10,200	14,200
Beneficiaries not housing burdened without the program	22,000	21,600	17,500
Percentage of households in study area that are housing burdened			
Without the program	23%	24%	33%
With the program	22%	22%	24%
Annual program cost	$33 million	$52 million	$120 million

NOTE: Table assumes maximum percentage of premium subsidized is 80 percent, the income limit for the maximum subsidy is 50 percent of AMI, and the program eligibility cutoff is 165 percent of AMI.

Figure 6.2
Alternative Versions of the Income-Based Subsidy Design



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is now only open to households earning less than 120 percent of AMI. The second version is a more broadly targeted program that reduces the maximum benefit but increases the number of households eligible for the maximum benefit.[7]

As can be seen in Table 6.6, the more narrowly targeted program is less expensive than the base-case program ($27 million versus $33 million), even though the lowest-income households receive a subsidy for the full flood insurance premium. The more broadly targeted program is only slightly more expensive than the base-case program. The bottom sections of the table report program outcomes first for households that are housing burdened without the program (the target households) and then for those that are not. The more narrowly targeted program shifts resources toward households that are housing burdened. As can be seen, the number of beneficiaries who are not housing burdened declines by 6,600 in the more narrowly targeted version (from 22,000 to 15,400), while the number of beneficiaries who are housing burdened declines by 600 (from 9,700 to 9,100). Even though the cost of the more narrowly targeted program is 18-percent lower than in the base case, the outcomes for the housing-burdened households are comparable with those in the base case.

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[7] Benefits start to decline at 80 percent of AMI which is the cutoff for eligibility used in many of HUD's housing assistance programs (see U.S. Government Accountability Office, 2005, p. 13).

Table 6.6
Design 1: Sensitivity to Design Parameters

Program Parameter or Outcome	More Narrowly Targeted Program	Base Case	More Broadly Targeted Program
Program parameter			
Maximum percentage of premium subsidized	100% premium	80% premium	70% premium
Income limit for maximum subsidy	30% of AMI	50% of AMI	80% of AMI
Program eligibility cutoff	120% of AMI	165% of AMI	165% of AMI
Program outcomes			
Number of beneficiaries	24,500 (21,700–27,300)[a]	31,700 (28,800–34,600)[a]	31,700 (28,800–34,600)
Annual premium subsidy	$27 million (20–34)	$33 million (27–37)	$34 million (27–40)
Outcomes for households that are housing burdened without the program			
Number of beneficiaries	9,100	9,700	9,700
Annual premium subsidy	$14 million	$14 million	$13 million
Average premium without program	$2,100	$2,100	$2,100
Average premium with program	$560	$650	$720
Average PITI ratio without program	0.89	0.87	0.87
Average PITI ratio with program	0.81	0.80	0.81
Outcomes for households that are not housing burdened without the program			
Number of beneficiaries	15,400	22,000	22,000
Annual premium subsidy	$13 million	$19 million	$21 million
Average premium without program	$1,900	$1,900	$1,900
Average premium with program	$1,100	$1,000	$940
Average PITI ratio without program	0.21	0.22	0.22
Average PITI ratio with program	0.19	0.20	0.20

NOTE: The program is run with premium scenario B. Assumes 2015 rate schedule with pre-FIRM rates and 2007 FIRM.

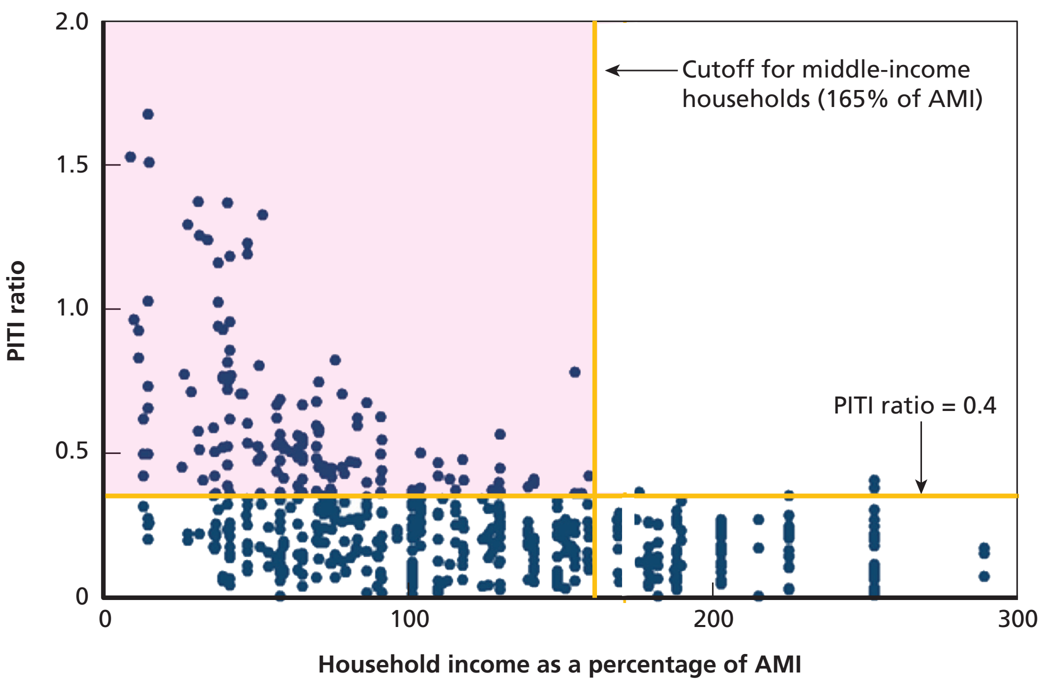
[a] 95-percent confidence intervals in parentheses.

Design 2: Subsidy Based on Housing Burden

In the second design, the premium subsidy is based directly on housing burden. The program is motivated by HUD's Section 8 housing choice vouchers for renters. That program expects renters to pay 30 percent of household income toward rent and then fills in the gap between the household contribution and a measure of market rent in the area.[8] In the design considered here, property owners are expected to pay 40 percent of their income toward homeownership costs, and the program covers the part of the flood insurance that pushes homeownership costs above that threshold. The 0.4 cutoff is chosen so that households are unable to intentionally take on additional debt to qualify for a flood insurance subsidy.

Figures 6.3 and 6.4 describe how this design works. As indicated by the shaded area in Figure 6.3, households with income less than 165 percent of AMI and PITI ratio greater than 0.4 are eligible for benefits. Because of the shape of the relationship between PITI ratio and income, the 0.4 cutoff focuses the program on lower-income

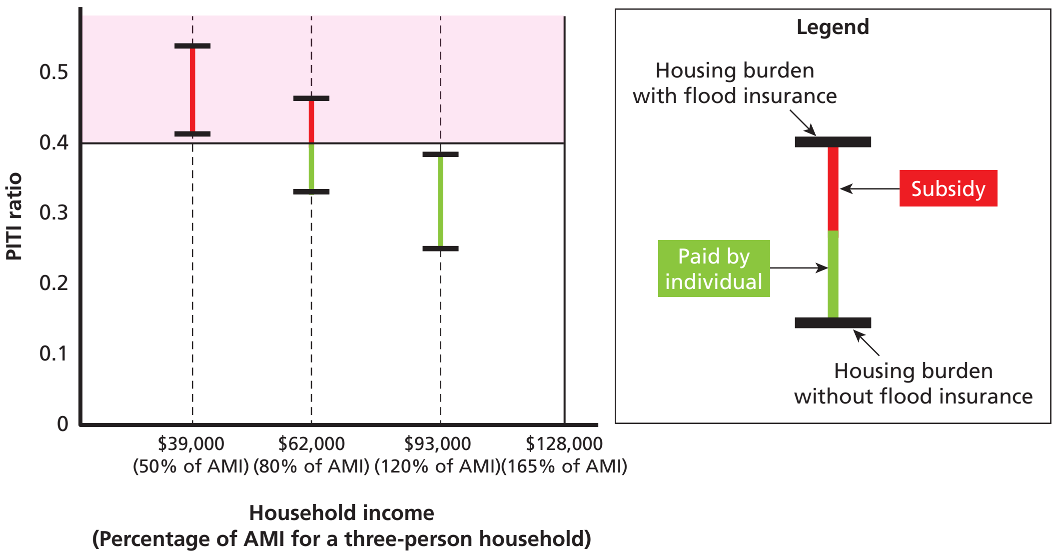
Figure 6.3
Homeowners Eligible for Housing Burden–Based Subsidy Program



NOTE: The *PITI ratio* is the ratio of mortgage principal and interest, property taxes, and insurance to household income.
RAND *RR1776-6.3*

8 U.S. Government Accountability Office, 2005.

Figure 6.4
Subsidy Structure for Housing Burden–Based Subsidy Program



RAND *RR1776-6.4*

households. Figure 6.4 shows the PITI ratio for three hypothetical households, first when the flood insurance premium is included and second when it is excluded. The PITI ratio for the household with income at 50 percent of AMI exceeds 0.4 whether or not flood insurance is included. This household will thus receive a subsidy for the entire flood insurance premium. The second household will receive a subsidy for only the part of the premium that causes the PITI ratio to exceed 0.4. The household with income at 120 percent of AMI will not receive any subsidy because its PITI ratio is less than 0.4 even when the flood insurance premium is included. Flood insurance is considered affordable for that household.

This design is attractive because households receive a subsidy only when flood insurance is not affordable, and the measure of affordability is based on practices in the lending market. Also, because not many households have a PITI ratio higher than 0.4 when income is more than 165 percent of AMI, there is not much incentive for households to reduce income below this threshold. On the downside, this design requires more information on household finances than the income-based subsidy in design 1 requires. In addition to income, information on mortgage payment, property taxes, and insurance payments must be collected and verified. However, this is the same information that a household typically provides when applying for a loan. A second drawback is that this design tends to reward less financially conservative households. A household that, for example, took on the maximum amount of debt when times were good would be more likely to benefit from the program than households that did not borrow up to the maximum debt available.

Table 6.7
Design 2: Housing Burden–Based Subsidy—Program Outcomes with Full Participation

		Housing Burden Without the Program	
Outcomes for Beneficiaries	**All Households**	**Housing Burdened**	**Not Housing Burdened**
Number of beneficiaries	9,700 (7,500–12,900)[a]	9,700 (7,500–12,900)[a]	0
Annual premium subsidy	$19 million (11–26)	$19 million (11–26)	0
Average premium without program	$2,100	$2,100	0
Average premium with program	$150	$150	0
Average PITI ratio without program	0.87	0.87	0
Average PITI ratio with program	0.79	0.79	0

NOTE: The program is run with premium scenario B and assumes the PITI ratio threshold is 0.4 and the program eligibility cutoff is 165 percent of AMI.

[a] 95-percent confidence intervals in parentheses.

Table 6.7 reports the costs, enrollment, and impacts of the housing burden–based flood insurance affordability program depicted in Figures 6.3 and 6.4. At 9,700, the number of beneficiaries is substantially fewer than the 31,700 receiving benefits for design 1 (compared with Table 6.3). Only housing-burdened households receive benefits in design 2, and program cost is about 40 percent less than for design 1. Households that qualify for the program typically receive a subsidy for the entire flood insurance premium with the result that the average premium drops from $2,100 to $150.

Table 6.8 shows how the number of beneficiaries and program cost varies with program participation.

Table 6.8
Design 2: Enrollment and Program Cost Under Different Program Participation Assumptions

Participation Rate	Number of Beneficiaries	Annual Program Cost
2016 flood insurance take-up rates (36% and 50%)[a]	3,700	$7 million
50%	4,900	$9 million
75%	7,300	$14 million
100%	9,700	$19 million

NOTE: The program is run with premium scenario B and assumes the PITI ratio threshold is 0.4 and the program eligibility cutoff is 165 percent of AMI.

[a] In line with the take-up rates in Table 2.4 in Chapter Two, the participation rate is assumed to be 36 percent for households with incomes less than 80 percent of AMI and 50 percent for households with higher incomes.

Table 6.9
Design 2: Enrollment and Program Cost Under Different Flood Insurance Premium Assumptions

	Premium Scenario		
Premium Scenario	Scenario B (2007 FIRM with Pre-FIRM Rates)	Scenario E (PFIRM, with Grandfathering and No Pre-FIRM Rates)	Scenario G (PFIRM, with No Grandfathering and No Pre-FIRM Rates)
Beneficiaries	9,700	10,200	14,200
Beneficiaries housing burdened without the program	9,700	10,200	14,200
Beneficiaries not housing burdened without the program	0	0	0
Percentage of households in study area that are housing burdened			
Without the program	23%	24%	33%
With the program	23%	24%	33%
Annual program cost	$19 million	$32 million	$93 million

NOTE: Assumes the PITI ratio threshold is 0.4 and the program eligibility cutoff is 165 percent of AMI.

Table 6.9 shows how the premium scenario affects the number of beneficiaries and program cost. Higher flood insurance premiums increase a household's PITI ratio, and, as expected, the number of beneficiaries is higher when the program is run using premium scenarios based on the PFIRM. As is the case for the income-based subsidy design, program costs are substantially higher when premiums based on the PFIRM are used, and grandfathering makes a big difference. Note also that, because of the way benefits are calculated, the program does not reduce the percentage of households in the study area that are housing burdened (see second and third-to-last lines in Table 6.9). Of course, the program does reduce the PITI ratio for households that are housing burdened from what they would be without the program (not shown in table).

Table 6.10 shows the outcomes for a more narrowly targeted program and a more broadly targeted program. In the more narrowly targeted program, the PITI ratio threshold is increased to 0.5 and program eligibility is restricted to households with incomes less than 120 percent of AMI. Doing so squeezes the red-shaded area in Figure 6.3 from both directions and focuses the program on households with the highest PITI ratios. The more broadly targeted program reduces the PITI threshold to 0.3 and leaves the program eligibility cutoff at 165 percent of AMI. The number of beneficiaries and costs drop moderately in the more narrowly targeted version but are substantially higher in the more broadly targeted version. In contrast to the base case

Table 6.10
Design 2: Sensitivity to Design Parameters

Program Parameter or Outcome	More Narrowly Targeted Program	Base Case	More Broadly Targeted Program
Program parameter			
PITI cutoff	0.50	0.40	0.30
Program eligibility cutoff	120% of AMI	165% of AMI	165% of AMI
Program outcomes			
Number of beneficiaries	6,900 (5,000–8,900)[a]	9,700 (7,500–11,900)	15,500 (13,000–18,000)
Annual premium subsidy	$14 million (7–21)	$19 million (11–26)	$26 million (18–34)
Outcomes for households that are housing burdened without the program			
Number of beneficiaries	6,900	9,700	9,700
Annual premium subsidy	$14 million	$19 million	$20 million
Average premium without program	$2,000	$2,100	$2,100
Average premium with program	$110	$150	$30
Average PITI ratio without program	1.02	0.87	0.87
Average PITI ratio with program	0.93	0.79	0.78
Outcomes for households that are not housing burdened without the program			
Number of beneficiaries	0	0	5,800
Annual premium subsidy	0	0	$5.9 million
Average premium without program	0	0	$1,400
Average premium with program	0	0	$360
Average PITI ratio without program	0	0	0.35
Average PITI ratio with program	0	0	0.33

NOTE: Run with premium scenario B.

[a] 95-percent confidence intervals in parentheses.

and the more narrowly targeted version, the more broadly targeted version provides benefits to a substantial number of households (5,800) that are not considered housing burdened without the program.

Design 3: Deductible Subsidy

Design 3 is an income-based subsidy like design 1, but instead of paying a subsidy each year when the premium is due, program benefits are only paid when a loss occurs. Under this design, property owners buy flood insurance policies with a high deductible (and lower cost compared with policies with typical deductibles) and are then reimbursed for part of the deductible when a loss occurs.

As discussed in Chapter Two, deductibles on flood insurance typically range from $1,000 to $2,000 and are applied separately to buildings and contents coverage. If instead of buying a policy with a $2,000/$2,000 deductible, the property owner bought a policy with a $10,000/$10,000 deductible, the premium would be 20 to 25 percent lower.[9] Figure 6.5 shows the benefit structure when there is a loss. When there is a loss, property owners with incomes less than 80 percent of AMI would be reimbursed for that part of the deductible exceeding $2,000 separately for building and contents coverage. The maximum benefit would thus be $16,000, and the design is structured so that the benefit declines gradually as household income increases.[10]

An advantage of this design is that instead of making subsidy payments when premiums are due each year, subsidy payments are made only when a loss occurs. As far as disadvantages are concerned, the entity funding the program would have to make payments at a time when it could be financially stressed by other aspects of the loss. For example, if New York City were funding the program, it might be facing high response costs and outlays for damaged infrastructure at the same time it would need to make the deductible reimbursements. If the federal government were funding the program, however, this may not be as important a concern because of the financial resources available to the federal government.[11]

The expected annual program cost is estimated indirectly by comparing the premium charged for the $2,000/$2,000 and $10,000/$10,000 policies. NFIP actuaries consulted during this study indicated that the deductible factors are based on actuarial data and that differences in the factors provide a first estimate of the difference

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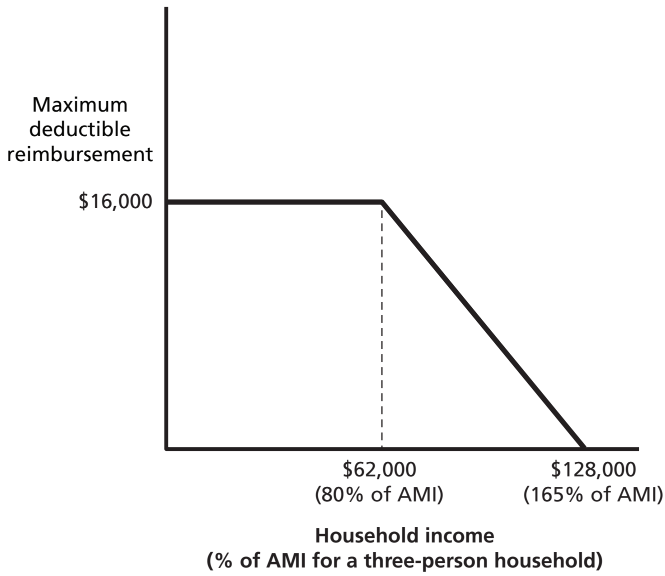
9 The deductible factor for a policy with a $2,000/$2,000 deductible is 0.90 for an elevation-based rate and 0.975 for a non-elevation-based rate (for the 2015 NFIP rate schedule). The deductible factors for a $10,000/$10,000 deductible are 0.60 and 0.65, respectively. As discussed in Chapter Two, the deductible factor is applied to the base + ICC premium. Thus, for a $10,000/$10,000 deductible policy, this part of the premium should be 30 percent lower for elevation-rate properties ((1 – 0.60) – (1 – 0.9)) and 32.5-percent lower for non-elevation-rated properties ((1 –0.65) – (1 – 0.975)). The percentage reduction in the total premium will be lower once the policy fee, reserve fund assessment, and HFIAA surcharge are included.

10 The design could also be structured so that the household pays for a policy with a $10,000/$10,000 premium but the claim is paid as though it had a $2,000/$2,000 deductible. There would then be no need for a separate payment to reimburse the household for the deductible.

11 Federal disaster assistance is sometimes available to cover the insurance deductible. Disaster assistance to cover a higher $10,000 deductible and federal reimbursement for the deductible are two different approaches for covering the same financial loss.

Figure 6.5
Subsidy Structure for Deductible Subsidy



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in expected payouts. The expected annual outlay for the program is thus determined by taking the difference between the premium costs for a $2,000/$2,000 deductible and the $10,000/$10,000 deductible for the eligible households in the study and proportionally reducing them to reflect the gradual phasing out of benefits for households with incomes more than 80 percent of AMI (as shown in Figure 6.5).[12]

As shown in Table 6.11, all 31,700 households in the study area with incomes less than 165 percent of AMI are eligible for the program, and the expected annual cost of the deductible reimbursement is $12 million when the program is run with premium scenario B. Premiums for housing-burdened households drop by $300 on average, far less than the reductions for designs 1 and 2. As with design 1, more benefits go to households that are not housing burdened, absent the program, than to those that are.

The effect of program participation on the number of beneficiaries and the expected annual program cost is shown in Table 6.12. The costs associated with this design are not fixed annual costs as is the case for the previous two design options, which focus on assistance with annual flood insurance premiums. Deductible reimbursements would only occur in the event of flood losses. There could be years where no flooding events take place or years where multiple flooding events take place.

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[12] Because of this relationship between expected outlays and the difference in premiums, the annual cost of a program in which the government paid the difference between the low- and high-deductible policy for eligible households each year would be equal to the expected annual cost of the deductible reimbursements.

Table 6.11
Design 3: Deductible Subsidy—Program Outcomes with Full Participation

		Housing Burden Without the Program	
Outcomes for Beneficiaries	**All Households**	**Housing Burdened**	**Not Housing Burdened**
Number of beneficiaries	31,700 (28,800–34,600)[a]	9,700 (8,400–11,100)	22,000 (19,700–24,400)
Expected annual cost of deductible reimbursements	$12 million (9–15)	$4.7 million (2.6–6.7)	$7.4 million (5.7–9.1)
Average premium without program	$1,900	$2,100	$1,900
Average premium with program	$1,600	$1,600	$1,500
Average PITI ratio without program	0.42	0.87	0.22
Average PITI ratio with program	0.41	0.85	0.21

NOTE: Run with premium scenario B. Assumes policyholders purchase policies with $10,000 deductible for building coverage and contents coverage and are reimbursed for deductible payments over $2,000/$2,000. The program eligibility cutoff is 165 percent of AMI.

[a] 95-percent confidence intervals in parentheses.

Table 6.12
Design 3: Enrollment and Program Cost Under Different Program Participation Assumptions

Participation Rate	Number of Beneficiaries	Expected Annual Cost of Deductible Reimbursements
2016 flood insurance take-up rates (36% and 50%)[a]	13,700	$5 million
50%	15,900	$6 million
75%	23,800	$9 million
100%	31,700	$12 million

NOTE: Run with premium scenario B. Assumes policyholders purchase policies with $10,000 deductible for building coverage and contents coverage and are reimbursed for deductible payments over $2,000/$2,000. The program eligibility cutoff is 165 percent of AMI.

[a] In line with the take-up rates in Table 2.4 in Chapter Two, the participation rate is assumed to be 36 percent for households with incomes less than 80 percent of AMI and 50 percent for households with higher incomes.

The consequences of higher premium levels are shown in Table 6.13. Program cost is nearly five times higher with the risk-based rates and PFIRM in premium scenario G. Whether grandfathering is allowed again makes a big difference in program budget. The program produces modest declines in the percentage of households in the study area that are housing burdened.

Table 6.13
Design 3: Enrollment and Program Cost Under Different Flood Insurance Premium Assumptions

	Premium Scenario		
Premium Scenario	Scenario B (2007 FIRM with Pre-FIRM Rates)	Scenario E (PFIRM, with Grandfathering and No Pre-FIRM Rates)	Scenario G (PFIRM, with No Grandfathering and No Pre-FIRM Rates)
Beneficiaries	31,700	31,700	31,700
Beneficiaries housing burdened without the program	9,700	10,200	14,200
Beneficiaries not housing burdened without the program	22,000	21,500	17,500
Percentage of households in study area that are housing burdened			
Without the program	23%	24%	33%
With the program	22%	23%	30%
Annual program cost	$12 million	$22 million	$53 million

NOTE: Assumes policyholders purchase policies with $10,000 deductible for building coverage and contents coverage and are reimbursed for deductible payments over $2,000/$2,000. The program eligibility cutoff is 165 percent of AMI.

Design 4: Mitigation Grants and Low-Interest Loans

The previous designs have provided financial assistance for flood insurance premiums but have not made any effort to modify the structure to reduce risk. This design makes flood insurance more affordable by modifying structures in ways that reduce the NFIP premium (see U.S. Government Accountability Office, 2016, p. 19, for further discussion of using mitigation to reduce flood insurance costs). Grants are provided to low-income households (households with incomes less than or equal to 80 percent of AMI), and low-interest loans are provided to moderate- and middle-income households (incomes between 80 percent of AMI and 165 percent of AMI) to finance the mitigation measures.[13] To ensure that a mitigation measure pays off over time, we require the present value of the premium reductions to exceed the cost of the mitigation measure. We refer to such mitigation measures as cost-effective.[14]

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13 When implemented, grants would most likely be paid to the contractor doing the work on the structure, not the property owner. Also, note that community-level mitigation measures such as levees are beyond the scope this study.

14 More formally, the mitigation measure passes a cost-benefit test. *Cost-effective* is often used to indicate the least expensive way to achieve a particular goal, but for ease of exposition, we use *cost-effective* to indicate that the specified mitigation at a particular structure passes a cost-benefit test.

We consider four different structure-level mitigation measures: flood vents, elevation of M&E, basement infill, and structure elevation. We restrict our attention to these four mitigation measures because (1) they result in premium reductions according to the 2015 NFIP schedule, and (2) we are able to estimate the premium reduction using the flood insurance premium model developed for this project (the premium model is described in Appendix C).[15]

A mitigation-based approach is attractive because, rather than funding subsidy payments year after year, mitigation reduces risk and the need for subsidies in the first place. Mitigation also means that households experience fewer and less-severe flood losses and the associated inconveniences and uncompensated losses. The approach is also attractive because it tailors the type of assistance to the resources of the household. Grants are offered to low-income households because these households may find it difficult to qualify for a low-interest loan—even if the premium savings more than offset the loan payment. A disadvantage of this approach is that many mitigation measures may not be feasible or cost-effective for a particular structure given the NFIP rate schedule. Additionally, even if the mitigation measure is cost-effective, it may still not be attractive from the property owner's perspective. For example, basement infill may mean the loss of rental income from a basement unit or the loss of a valued use by the property owner. Another downside of this approach is its administrative complexity. A system would have to be created to evaluate which, if any, mitigation measures are appropriate for a particular structure and to make payments to the contractors doing the work.[16]

In the remainder of this section, the approach for modeling the mitigation grant and loan program is described, followed by an overview of the mitigation measures considered and projections of homeowner benefits and program costs for each measure.

Approach

We first determine the number of properties for which the mitigation measure is feasible and whether the household is eligible for the program. For example, basement infill is only feasible for structures with basements, and households are only eligible for a grant or low-interest loan if their income falls below a specified cutoff.

To be eligible for funding, the mitigation measure must be cost-effective. The mitigation measure is assumed to take two years to complete and to have a 75-year life. The premium reductions because of the mitigation are discounted to the present using a 4-percent discount rate. Those properties for which the present value of premium reductions exceeds the cost of the mitigation measure are then eligible for the program.

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[15] Another potential approach to reduce risk (and flood insurance premiums) would be to return the property to open space. Analysis of such an option is beyond the scope of the study, but warrants investigation.

[16] A program modeled after federally funded disaster recovery programs, such as Build It Back, might provide a mechanism for doing this.

The overall cost of the program to the government is the cost of the amount provided in grants and the cost of the low-interest loans. The cost of the loans is not the total amount loaned, but rather the cost of the loans after repayments have been made. This cost is due to the below-market interest rates and loan default. The subsidy rate for the low-interest loans provided by the SBA provides a basis for estimating the cost of the low-interest loan program analyzed here. The subsidy rate for the SBA's disaster assistance program varied between 10.1 percent and 18.7 percent between fiscal years 2011 and 2015 (SBA, undated[a], undated[b], undated[c]). We use the midpoint of this range and estimate the cost of the mitigation and grant program using

$$\text{program cost} = \text{total amount in grants} + 0.14 \times \text{total amount loaned}.$$

The program costs include neither the cost of administering the program nor the cost of temporary housing that may be needed during construction. The benefits of mitigation are also incomplete. The reduction in annual premiums because of the program is considered, but lower-deductible payments and uncompensated losses because of fewer or less severe losses are not. Also, using the present value of premium reductions only captures the benefits of mitigation to the extent that premiums are based on full-risk rates.

As for the previous program designs examined, we calculate the PITI ratio for households that participate in the program with and without the program. For households receiving loans, we include the annual loan repayment in the PITI ratio calculation. Loan-repayment costs are calculated assuming a 30-year fixed loan with a 4-percent interest rate. The amount borrowed is the estimated cost of the mitigation measure (further discussed in this section).

We examine the impacts of structure mitigation under two different premium scenarios: scenarios B and G. Pre-FIRM rates and grandfathering have been removed from scenario G, so scenario G is presumably close to full-risk rates, assuming the flood risk reflected in the PFIRM. Conversely, the premiums in scenario B do not likely reflect actual risk due mainly to the outdated FIRM on which they are based. Although scenario B will not capture the full benefits of mitigation, it is still relevant to addressing the extent to which mitigation can improve the affordability of flood insurance given the current rate structure and the current flood maps.

Mitigation Options and Their Costs

Each of the four mitigation measures is described: from less expensive to more expensive.

Flood Vents

As shown in Table 6.14, installing flood vents is feasible on structures with crawlspaces and enclosures. Appropriately sized flood vents allow water to flow under the first floor of living space of the structure and equalize hydrostatic pressure on the structure during flood events. Once installed, the structure is rated as though it has no base-

Table 6.14
Circumstances Under Which Mitigation Can Result in Premium Reductions

	Mitigation Measure			
Structure Type	**Flood Vents**	**Raising M&E**	**Basement Infill**	**Structure Elevation**
Basement	—	If M&E in basement	All	If no party walls
Slab	—	—	—	If no party walls
Crawlspace	All	If M&E below BFE and next floor	—	If no party walls
Enclosure	All	If M&E below BFE and next floor	—	If no party walls

Table 6.15
Cost of Mitigation Measures

Mitigation Measure	Mitigation Cost per Structure	Cost Used in Program Simulations
Flood vents	\$6,000–10,000[a]	\$8,000
Raise M&E	\$6,000–10,000[b]	\$7,000
Basement infill	\$31,000–116,000[c]	\$70,000
Structure elevation	\$120,000–260,000[d]	\$170,000

[a] FEMA, 2015b, p. 12.

[b] Author analysis of New York City Build It Back database. The range reported here is the 5th and 95th percentiles of the 8,859 observations with cost estimates. The mean is \$6,900.

[c] Data from FEMA.

[d] Author analysis of New York City Build It Back database. The range reported here is the 5th and 95th percentiles of the 3,753 observations with cost estimates. The mean is \$169,000.

ment, enclosure, or crawlspace (i.e., as a slab), and the elevation is determined using the floor above the crawlspace or enclosure. Retrofitting a residential structure with flood vents typically costs between \$6,000 and \$9,000, and we assume a cost of \$8,000 in the program simulations (see Table 6.15).

Raising Machinery and Equipment

M&E includes such items as the furnace, boiler, water heater, and the air conditioning unit, and NFIP rates for building coverage depend in many cases on the location of these items.[17] Premiums for structures with slab foundations do not depend on the location of M&E, so this mitigation measure is not cost-effective for this type of structure. For structures with basements, lower premiums are available if the M&E is raised out of the basement. For enclosures and crawlspaces, lower premiums are available if the M&E are raised above the floor over the crawlspace or enclosure. Raising M&E is estimated to cost between \$6,000 and \$10,000, with an average cost of \$7,000. A

[17] The electric panel is not considered M&E.

potential downside of this mitigation measure is the possible loss of currently used space where the M&E is placed.

Basement Infill

Homeowners can reduce their flood insurance premiums by infilling the basement, which involves filling in the basement to the lowest adjacent grade, raising M&E as necessary, and installing flood vents. Once these measures are taken, the structure can be rated as though it is a crawlspace or enclosure with the crawlspace or enclosure height equal to the distance between the lowest adjacent grade and the next floor. The cost of basement infill depends importantly on the type of construction material used for the basement and on whether the basement contains living space. Cost estimates run from $31,000 to $116,000, and we use $70,000 in our program simulations. An obvious downside of this mitigation measure is the loss in utility and potential rental income that basements generate for homeowners.

Structure Elevation

The last and most expensive mitigation measure considered is elevating the structure. As indicated in Table 6.14, we assume all different structure types can be elevated but that it is not feasible if the structure has party walls.[18] Recall from Chapter Two that 46 percent of the one- to four-family homes in the study area have party walls (Table 2.1). When a structure is elevated, we assume that structures with basements, crawlspaces, or enclosures become structures without basements, enclosures, or crawlspaces and are rated based on the elevation of the elevated floor. Consistent with New York City building codes, structures are raised 2 feet above the BFE as indicated by the PFIRM at that location. When a structure is elevated, the basement is filled in and M&E is raised as appropriate.

The cost of elevating a structure is not overly sensitive to the number of feet that the structure is elevated and, based on data from New York City's Build It Back program, is between $120,000 and $260,000 per structure. In our analysis, we set the cost of elevating a structure to the mean of the Build It Back estimates: $170,000.

Program Outcomes

Findings for mitigation grant and loan programs are presented in Table 6.16. This table reports results assuming full participation in the program and that flood insurance premiums are based on the 2015 rate schedule, the 2007 FIRM, and allowing pre-FIRM rates. As can be seen from the first row of the table, some type of mitigation is feasible, and the household passes the income test (income less than 165 percent of AMI) for a substantial share of the 42,600 owner-occupied properties in the study area. However, mitigation is not cost-effective at a large number of these properties. The second row of the table (labeled "Beneficiaries") shows the number of structures for which the miti-

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[18] A *party wall* is all walls shared by structures on two adjacent property parcels.

Table 6.16
Design 4: Mitigation Grants and Low-Interest Loans—Program Outcomes with Full Participation Using Premium Scenario B (2015 Rate Schedule, 2007 FIRM, Pre-FIRM Rates)

	Mitigation Measure			
Outcome	Install Flood Vents	Raise M&E	Fill-In Basement	Elevate Structure
Number of structures for which mitigation measure is feasible and household is eligible	2,600 (1,500–3.600)	7,200 (5,300–9,100)	21,100 (18,300–23,900)	15,700 (13,100–18,100)
Number of structures for which mitigation measure is cost-effective and household is eligible for the program	220 (50–400)	5,200 (4,100–6,300)	3,200 (2,300–4,100)	190 (n/a)
Government cost of grants and low-interest loans	$1.5 million (0–3.1)	$28 million (17–39)	$100 million (46–150)	$31 million (n/a)
Number of grants	190	2,400	1,100	190
Amount granted	$2 million	$24 million	$80 million	$31 million
Number of loans	30	2,800	2,000	0
Amount loaned	$0.2 million	$28 million	$140 million	$0
Outcomes for households that are housing burdened without the program				
Number of grants	30	900	730	190
Amount granted	$0.2 million	$9 million	$51 million	$31 million
Number of loans	0	30	30	0
Amount loaned	$0	$0.3 million	$2 million	$0
Average premium without program	$2,900	$4,000	$4,400	$10,500
Average premium with program	$1,400	$3,300	$820	$600
Average PITI ratio without program	1.60	0.88	0.94	4.40
Average PITI ratio with program	1.43	0.84	0.68	3.41
Percentage of households in study area that are housing burdened				
Without the program	23%	23%	23%	23%
With the program	23%	23%	23%	22%

gation measure is feasible and cost-effective and the household passes the income test. For example, structure elevation is cost-effective at only 190 of the 15,700 structures for which elevation is feasible and the household meets the income test. Assuming 100-percent participation, these households would then enroll in the program. Raising M&E would be the most commonly funded mitigation measure in the program.

The government cost of the grants and low-interest loans provided through the program vary widely by mitigation measure. Costs range from $2 million for installing flood vents at 220 properties to $100 million for filling in the basements of 3,200 structures. The mix between grants and loans depends on the distribution of household income for each structure type. For example, it turns out that grants are provided for all 190 structures that are elevated, which means that income of all these households is less than 80 percent of AMI.

The relatively high-income eligibility cutoff currently specified for this program means that only a fraction of those receiving assistance are housing burdened. For example, of the 3,100 households that would qualify for funding for basement infill, only 760 are housing burdened (see bottom set of rows in Table 6.16). Thus, only a small percentage of the 9,700 households that are housing burdened would benefit from a mitigation grant and low-interest loan program.

Although the number of housing-burdened households that are eligible for the program is small, premium reductions for those who do participate can be substantial. The average annual premium drops from $10,500 to $600 for structure elevation and from $4,400 to $820 for basement infill. The premium reductions are lower but still substantial for installing flood vents and raising M&E. These premium reductions reduce the PITI ratios for the households participating in the program that are housing burdened, but there is hardly any difference in the overall percentage of households in the study area that are housing burdened (given the rate schedule that underlies premium scenario B).

A final point to underscore regarding the projections in Table 6.16 is that they presume all eligible structures participate in the program. Installing flood vents or raising M&E will typically not fundamentally alter how the structure is used, and property owners may be receptive to implementing them. However, there may be little enthusiasm for basement infill and structure elevation, particularly among those households that might receive a premium subsidy anyway.

Table 6.17 repeats the analysis assuming flood insurance premiums increase to full risk rates with the PFIRM in place. Now, mitigation is cost-effective for many more structures, and program costs increase substantially. For example, funding for elevation would be available to 5,000 structures instead of the 190 using 2015 rates and the 2007 FIRM. The associated government cost would increase nearly ten times, rising from $31 million to $370 million. The program would now potentially benefit a far larger number of housing-burdened households. For example, grants to raise M&E would be available to 6,100 households (4,400 grants and 1,700 low-interest loans), which is just under one-half of the 14,200 households that are housing burdened without the program, assuming flood insurance premiums increase to full risk rates with the PFIRM in place. In contrast to the findings for premium scenario B, the mitigation grant and loan program can make a difference in the percentage of households in the

Table 6.17
Design 4: Mitigation Grants and Low-Interest Loans—Program Outcomes with Full Participation Using Premium Scenario G (2015 Rate Schedule with No Grandfathering, No Pre-FIRM Rates, and PFIRM)

	Mitigation Measure			
Outcome	**Install Flood Vents**	**Raise M&E**	**Fill-In Basement**	**Elevate Structure**
Number of structures for which mitigation measure feasible and household eligible	2,600 (1,600–3,600)	17,400 (14,800–20,000)	21,100 (18,300–23,900)	16,000 (13,400–18,500)
Number of structures for which mitigation measure is cost-effective and household is eligible for the program	320 (220–420)	15,300 (13,600–16,900)	11,500 (10,100–12,800)	5,000 (4,000–6,000)
Government cost of grants and low-interest loans	$2 million (1–3)	$87 million (71–100)	$480 million (380–580)	$370 million (260–490)
Number of grants	260	7,600	6,100	1,900
Amount granted	$2 million	$76 million	$420 million	$300 million
Number of loans	60	7,700	5,400	3,100
Amount loaned	$0.5 million	$77 million	$380 million	$500 million
Outcomes for grant and loan recipients who are housing burdened				
Number of grants	70	4,400	3,400	1,400
Amount granted	$0.5 million	$44 million	$240 million	$220 million
Number of loans	0	1,700	1,300	2,100
Amount loaned	$0	$17 million	$94 million	$330 million
Average premium without program	$9,100	$4,600	$5,000	$26,500
Average premium with program	$5,300	$3,900	$1,200	$4,400
Average PITI ratio without program	1.32	0.82	0.83	1.11
Average PITI ratio with program	1.07	0.80	0.72	0.56
Percentage of households in study area that are housing burdened				
Without the program	33%	33%	33%	33%
With the program	33%	32%	32%	26%

study area that are housing burdened. For structure elevation, the percentage housing burdened now drops from 33 percent to 26 percent (last rows of Table 6.17).

Design 5: Income-Based Subsidy with Mitigation Grants and Loans

The final design combines the income-based premium subsidy from design 1 with a mitigation grant or loan from design 5. To receive the premium subsidy, the household would be required to implement cost-effective mitigation measures.[19] Households with incomes below 50 percent of AMI would then receive a subsidy equal to 80 percent of the reduced premium, with the subsidy decreasing as household income increases to 165 percent of AMI.[20] The advantage of this approach is that it can, in principle, reduce the cost to the government of the affordability program. Mitigation would reduce the amount of annual subsidy payments, and the present value of these reductions over time could more than offset the cost of the grants or low-interest loans.

An illustration of the circumstances under which government cost for design 5 is lower than for design 1 is provided in Table 6.18. The annual premium subsidy for design 1, assuming full risk rate and the flood risk indicated by the PFIRM, is $120 million (see last row of Table 6.5) and is reproduced in the first row of Table 6.18. The second row shows the present value of the subsidy when there is no mitigation. The subsidy continues only as long as a low-, moderate-, or middle-income household lives at the property, and calculations are done assuming such a household lives at the property for five, ten, 15, and 25 years (columns of Table 6.18). A 4-percent discount rate is used, and the cost of design 1 to the government without mitigation is shown in the second row.

Rows three through six build up the costs for design 5 when structure elevation is required. Row 3 shows the government cost of elevating the 5,000 structures for which structure elevation is cost-effective (see last column of Table 6.17). Row four shows the annual cost of design 1 when the 5,000 structures are elevated. Elevation is assumed to take two years, so the cost of the subsidy in design 5 is $120 million for the first two years and $66 million per year for the remaining years (out to five, ten, 15, or 20 years depending on the scenario). The annual subsidies are discounted to the present in row five. The government cost of the structure elevation is then added to generate row six.

Finally, row seven reports the difference in costs between the two designs. The results show that government cost for design 5 will be lower than for design 1 under particular circumstances. Government cost is lower if the subsidy is provided to the households participating in the mitigation program for slightly more than ten years. If

[19] If no mitigation measure were cost-effective, the household would receive the subsidy provided by design 1.

[20] Households would also receive the same percentage subsidy on the premitigation premium until the mitigation measure was completed.

Table 6.18
Difference in Cost Between Design 5 and Design 1 When Cost-Effective Structure Elevation Is Required

	Years Subsidy Remains in Place			
	5	10	15	20
Cost of design 1 with no mitigation				
Annual premium subsidy with no mitigation (design 1)	$120 M	$120 M	$120 M	$120 M
Present value of premium subsidy in (1)	$560 M	$1,010 M	$1,390 M	$1,700 M
Cost of design 5				
Government cost of the structure elevation grant and loan program	$370 M	$370 M	$370 M	$370 M
Annual premium subsidy with mitigation (design 1 after cost-effective structure elevation)	$66 M	$66 M	$66 M	$66 M
Present value of premium subsidy	$410 M	$660 M	$870 M	$1,040 M
Total cost of design 5; (3) + (5)	$780 M	$1,030 M	$1,240 M	$1,410 M
Difference in government costs				
Difference in cost between design 5 and design 1; (6)–(2)	$230 M	$20 M	–$150 M	–$290 M

NOTE: M = million.

the structure is occupied by a low-income household for ten years or fewer, the government cost for design 5 will be higher.

Summary of Findings

This chapter has examined different approaches for providing assistance to households that have difficulty paying flood insurance premiums. Five designs were developed and their performance modeled. Table 6.19 pulls together key outcomes for each design, and a number of observations are in order. The figures in the table are drawn from the base case for each design assuming premium scenario B (the 2015 NFIP rate schedule with pre-FIRM rates allowed and the 2007 FIRM).

The first three designs provide financial assistance to all 9,700 households in the study area from which, based on the definition used in this study, flood insurance is unaffordable. The housing burden–based design (design 2), however, is attractive because it focuses benefits only on those households that are housing burdened without the program. The result is that larger benefits are delivered to the target population with this design even though the program cost is substantially less than in the

Table 6.19
Summary of Outcomes for Flood Insurance Affordability Designs Under Premium Scenario B

	Beneficiaries			Average Flood Insurance Premium for Beneficiaries for Whom Flood Insurance Is Unaffordable Without Program			
Design	Flood Insurance Unaffordable	Flood Insurance Affordable	Benefit Cost with Full Participation[a]	Without Program	With Program	Pros	Cons
1. Income-based subsidy	9,700	22,000	$33 million per year	$2,100	$650	Least data required on household	Benefits not well targeted
2. Housing burdened–based subsidy	9,700	0	$19 million per year	$2,100	$150	Benefits well targeted; large premium reductions	More data required from households; rewards less financially conservative households
3. Deductible subsidy	9,700	22,000	$12 million per year	$2,100	$1,600	Only pays out benefits when a loss occurs	Benefits not well targeted; modest benefit level
4. Mitigation grants and loans							
Flood vents	30	190	$2 million	$2,900	$1,400	Benefits of reduced flood risk exceed mitigation cost; large premium reduction	Few targeted households receive benefits; administratively complex
Raise M&E	930	4,300	$28 million	$4,000	$3,300	Benefits of reduced flood risk exceed mitigation cost	Few targeted households receive benefits; modest premium reduction administratively complex

Table 6.19—Continued

	Beneficiaries			Average Flood Insurance Premium for Beneficiaries for Whom Flood Insurance Is Unaffordable Without Program			
Design	**Flood Insurance Unaffordable**	**Flood Insurance Affordable**	**Benefit Cost with Full Participation**[a]	**Without Program**	**With Program**	**Pros**	**Cons**
Basement infill	750	2,400	$100 million	$4,400	$820	Benefits of reduced flood risk exceed mitigation cost; large premium reduction	Few targeted households receive benefits; reduced structure utility; administratively complex
Structure elevation	190	0	$31 million	$10,500	$600	Benefits of reduced flood risk exceed mitigation cost; large premium reduction	Few targeted households receive benefits; possibly reduced structure utility; administratively complex

[a] Does not include administrative cost.

income-based design (design 1). The downside of the housing burdened–based design is the extra information on mortgage, property taxes, and insurance costs that must be collected from households desiring to participate in the program, but the large savings may outweigh the additional administrative burden. As can been seen, the costs for these first three designs, excluding administrative costs, range from $12 to $33 million per year with full participation.

More narrowly targeting these designs can reduce the benefits provided to households that are not housing burdened. For example, the more narrowly targeted version of design 1 examined in this chapter reduced the number of non–housing burdened–households receiving benefits by 30 percent. However, there are trade-offs involved. By lowering the program eligibility cutoff from 165 percent of AMI to 120 percent, this more-narrowly targeted version of design 1 bars the relatively small number of middle-income households that are housing burdened from the program.

The premium reductions and program costs for the deductible subsidy design are more modest than in other programs. We have modeled a program in which the household buys a policy with a $10,000 deductible for building losses and a $10,000 deductible for contents coverage, and the premium reductions (and program costs) could be scaled up if even higher deductibles were allowed.

The results for the mitigation measures were disappointing if evaluated under the current rate schedule and the 2007 FIRM. Few of the 9,700 housing-burdened households in the study area would be eligible to participate in the program. A major reason for the low number of beneficiaries is that the mitigation measures we considered are cost-effective for relatively few structures given the 2007 FIRM and the 2015 NFIP rate schedule. The cost of the grants and low-interest loans can be quite substantial, ranging from $2 million to $100 million. However, it should be noted that, in contrast to the costs reported for the first three designs, these costs are not annually recurring.

The mitigation measures become considerably more attractive assuming risk-based rates based on the PFIRM. For example, the number of households eligible for a structure elevation program rises from 190 to 5,000 when the higher rates are assumed (see last row of Table 6.20). Now some type of elevation makes sense for a substantial proportion of the 31,700 households in owner-occupied structures with incomes below 165 percent of AMI.

While moving to risk-based rates under the PFIRM increases the number of structures for which mitigation is attractive, it also increases the number of households that are housing burdened and the costs of the subsidy-based designs (designs 1 to 3). For example, as shown in Table 6.20, the number of beneficiaries for design 2 (all of whom are housing burdened) increases from 9,700 to 14,200. The costs of the program also rise by a factor of five from $19 million per year to $93 million per year. Retaining grandfathering is one approach to reducing the impact of the PFIRM on New York City homeowners: We found that it substantially reduces the cost of the affordability

Table 6.20
Number of Beneficiaries and Program Costs Under Premium Scenario B and Premium Scenario G

	With Premium Scenario B		With Premium Scenario G	
Design	Number of Beneficiaries	Program Cost	Number of Beneficiaries	Program Cost
1. Income-based subsidy	31,700	$33 M per year	31,700	$120 M per year
2. Housing burdened–based subsidy	9,700	$19 M per year	14,200	$93 M per year
3. Deductible subsidy	31,700	$12 M per year	31,700	$53 M per year
4. Mitigation grants and loans				
Flood vents	220	$2 M	320	$2 M
Raise M&E	5,200	$28 M	15,300	$87 M
Basement infill	3,200	$100 M	11,500	$480 M
Structure elevation	190	$31 M	5,000	$370 M

NOTE: M = million.

programs. However, it comes at the cost of reducing incentives to take risk mitigation measures that would reduce flooding losses over time.

An attractive feature of combining an income-based premium subsidy with mitigation is that the cost of the program to the government is potentially lower than with the premium subsidy alone. We illustrated that this can indeed be the case, but only if a low-income household that qualifies for the income-based subsidy continues to own and live in the property on the order of ten years after start of the program.

CHAPTER SEVEN

Conclusion

In this concluding chapter we summarize answers to the four study questions posed in Chapter One.

To What Extent Is Purchasing Flood Insurance Burdensome for Households Living in One- to Four-Family Homes in the Study Area?

There are approximately 48,100 one- to four-family properties in the study area. Owner-occupied residences account for about 90 percent of these properties and, and just under 40 percent of the households living in them are low income. A considerable number of one- to four-family properties in the study area face substantial flood risk: More than 85 percent of properties in the high-risk areas of the 2007 FIRM are below BFE and two-thirds are 3 feet or more below BFE.

In 2016, the flood-insurance take-up rate was an estimated 43 percent in the study area, substantially higher than in 2012, but even those property owners who have insurance are not fully covered for flood-related losses. Replacement cost is greater than building coverage for about 45 percent of the structures with flood insurance.

Using a definition of *housing burden* based on the PITI ratio, flood insurance is currently burdensome for approximately 11,000 (25 percent) of the households in owner-occupied one- to four-family residences in the study area. As expected, flood insurance is most difficult to afford for low-income households. We found that flood insurance is burdensome for 64 percent of extremely and very low–income households and for 41 percent of low-income households. Take-up rates are also lower for low-income households.

How Might Flood Insurance Premiums Change in the Study Area?

Eliminating pre-FIRM rates given the FIRM currently in place and the 2015 NFIP rate schedule would affect relatively few property owners in high-risk zones of the 2007 FIRM because the pre-FIRM rates (non-elevation-based rates) are already higher than the elevation-based rates for most properties given the types of structures and their elevations relative to 2007 BFE.

Moving to the PFIRM has little impact on properties already in the high-risk zones of the 2007 FIRM if grandfathering is allowed. Pre-FIRM rates may well be largely phased out by the time a revised FIRM is adopted for New York City, but even without pre-FIRM rates, the median premium with grandfathering is not much higher than under the 2007 FIRM. It should be remembered, however, that not all homeowners will keep up with the eligibility requirements for grandfathered rates. The results are very different for newly mapped properties. Premiums for the 25,900 newly mapped properties would gradually increase from \$500 to \$2,700, even with grandfathering.

The removal of grandfathering would have considerable consequences for all one- to four-family properties in the study area. For those already in the high-risk zones of the 2007 FIRM, the median premium would increase from \$3,100 to \$5,600. For newly mapped properties, the median would increase from \$2,700 to \$4,200.

Our analysis also provides an estimate of how much 8 inches of SLR would increase premiums in the study area given the April 2015 NFIP rate schedule. Average premiums would increase on the order of 10 percent from the full-risk rates projected using the PFIRM across the study area as a whole.

What Effect Will Flood Insurance Premium Increases Have on Households and Communities in the Study Area?

We projected how premium increases would affect the number of households in owner-occupied structures that are housing burdened. If a FIRM such as the PFIRM is adopted and pre-FIRM rates and grandfathering are eliminated, the percentage of households that are housing burdened would rise from the 25 percent currently observed in the study area to 33 percent.

We also examined the impacts of shifting from premiums that are based on the 2007 FIRM and current FEMA pricing practices to premiums that are based on the PFIRM and the elimination of grandfathering and pre-FIRM rates. We found that newly mapped properties will see the value of their property decrease by roughly \$10,000 to \$100,000 from what they would be had premiums not increased. Inside the high-risk zones of the 2007 FIRM, the impact is more variable and can be far more severe. The impact ranges from declines of \$20,000 or less to the property value falling by many hundreds of thousands of dollars.

This drop in property value has a wide variety of further implications. Lower property values reduce the value of the property tax base. Property tax revenue in the study area is likely to decrease by \$22 million. Households with mortgages are effectively buying their home from a lender. Large declines in property value can leave the homeowner purchasing a less-valuable asset for the same price, and homeowners are unable to raise enough funds from selling their homes to pay off their mortgage. As a result, we estimate the default rate will increase by 50 percent in the study area, resulting in defaults rising from roughly just more than 300 per year to roughly 450 per year, or 1.5 percent of homes with mortgages per year. Most of these defaults will be in the high-risk zones of the effective FIRM. Some study areas, such as the Rockaway Peninsula, could be particularly hard hit by increased default rates.

What Are Some Promising Options for a Program That Helps Reduce the Impact of Higher Flood Insurance Premiums in the Study Area and How Much Would They Cost?

We considered five different designs for a flood insurance affordability program. Affordability programs in other settings and approaches discussed in the literature motivated these designs. The first three subsidize flood insurance premiums in different ways. The fourth makes flood insurance premiums more affordable by funding or subsidizing structure-specific mitigation measures, and the fifth combines mitigation assistance with a premium subsidy.

The first three designs target households and determined benefits in different ways. Cost of the programs given the 2007 FIRM and the 2015 NFIP rate schedule range from $12 to $33 million per year. The programs vary in terms of the extent to which they focus benefits only on households that are housing burdened, the extent to which they reduce housing burden, and the amount of information required from potential beneficiaries.

The results for the mitigation measures are disappointing given the 2007 FIRM and the 2015 NFIP rate schedule. Relatively few of the housing-burdened households in the study area would be eligible to participate in the program. A major reason for the low number of beneficiaries is that mitigation measures we considered are cost-effective for relatively few structures given the 2007 FIRM and the 2015 NFIP rate schedule.

The mitigation measures become considerably more attractive assuming risk-based rates based on the PFIRM. For example, the number of households eligible for a structure-elevation program rises from 190 to 5,000 when the higher rates are assumed. While moving to risk-based rates under the PFIRM increases the number of structures for which mitigation is attractive, it also increases the number of households that are housing burdened and the costs of the subsidy-based designs. Retaining grandfathering is one approach to reducing the impact of the PFIRM on New York City homeowners—we found that it substantially reduces the cost of the financial subsidy programs. However, it comes at the cost of reducing incentives to take risk-mitigation measures that would reduce flooding losses over time.

One attractive feature of combining an income-based premium subsidy with mitigation is that it counters the reduced incentive of households that receive a premium subsidy to mitigate risk. A second is that the cost of a combined mitigation and premium subsidy program to the government is potentially lower than with the premium subsidy alone. We illustrate that this can indeed be the case with savings up to hundreds of millions of certain multiyear scenarios, but only if the low-income households that qualify for the income-based subsidies continue to own and live in the property around ten years after the start of the program.

A number of questions regarding the implementation of a flood insurance affordability program remain to be addressed. First, what is the funding source for the program? Is it funded at the city, state, or federal level, and who bears the cost? Second, how should the program be administered? The administrative requirements for some of the designs are complex. For example, the mitigation grant and loan program would require a process to determine what mitigation measures were cost-effective for each structure. Third, how long should the program remain in effect? Should the program be available only to current residents or also be available to future buyers who subsequently find themselves with high housing costs relative to income? Finally, should program participants be asked to agree to a buyout when the property is sold to reduce the need for future subsidies? The answers to these questions will play an important role in determining how best to proceed.

APPENDIX A

Survey Methods

This appendix first describes the process for selecting the properties that were eligible to participate in the study. It then describes the exhaustive effort to recruit the owners of these properties to participate in the study and the resulting response rate. It finally describes the process that was used to extrapolate from the study sample to all one- to four-family properties in the study area.

Sampling Approach

Sample Frame

The sample frame includes 48,089 one- to four-family structures in the high-risk zones of the PFIRM (the study area). The New York City Office of Recovery and Resiliency identified property parcels in the study area, and the subset of those parcels containing one- to four-family structures was identified by the New York City Department of Finance. In some cases, such as the Breezy Point Cooperative, there are multiple one- to four-family structures on the same parcel.

Each structure in the sample frame was characterized in the following three dimensions:

- study subarea
- housing cost as a percentage of income
- water depth in the 100-year flood according to the PFIRM.

Housing cost as a percentage of income was taken from the American Community Survey at the census-block group level. Water depth in the 100-year flood was calculated from the PFIRM. Table A.1 tabulates the sample frame by these three variables.

Sampling Approach

The study's sampling methodology was designed to meet the following two main objectives:

1. to provide a reliable and representative estimate of the affordability of flood insurance for one- to four-family homes in New York City
2. to provide accurate estimates of flood insurance affordability for one- to four-family homes in each of the five study subareas.

These two objectives are somewhat in conflict in that obtaining the most accurate and representative estimate of insurance affordability for New York City as a whole would suggest drawing samples from each study subarea that are proportional to size. However, for small study subareas, such an approach might not yield a large enough sample to provide an accurate area-specific estimate of affordability. Further, the study subareas were selected because of their policy interest and might, for that reason, be expected to be exceptional in some way (e.g., high-risk flood zones with high percentage of low-income households).

Table A.1
Summary of Sample Frame Stratification Variables

Stratification Variable	Count	Percentage of Total
Total structures	48,089	100%
Study subareas		
Canarsie	4,789	10%
Southern Brooklyn Waterfront	1,845	4%
Jamaica Bay	2,782	5%
Rockaway Peninsula	11,250	23%
East Shore, Staten Island	6,303	13%
Rest of study area	21,120	44%
Housing as percentage of income		
≤ 25	21,556	45%
> 25.1 and ≤ 35	17,575	37%
> 35	8,958	19%
Water depth in flood that occurs with a 1% annual change (in feet)		
≤ 1	12,842	27%
> 1 and ≤ 2	8,413	17%
> 2 and ≤ 3	8,010	17%
> 3 and ≤ 4	7,337	15%
> 4	11,487	24%

To address these issues, a stratified design with modified probability proportional to size sampling was used. The sample draw proceeded in the following two stages. At the first stage, a minimum sample of 200 structures was drawn from each of the six study subareas. The minimum size of 200 structures at the first stage was selected so that, with a 25-percent response rate, a two-sample t-test comparing the mean affordability of one study area with another would be able to detect a 5-percent difference with 80-percent power with a simple random sample design. For this calculation, the share of income spent on housing was used to estimate the probable distributional characteristics of the affordability outcome of the study. The power calculation is expected to be a conservative estimate because its sample design will be more efficient than simple random sampling.

The allocation of the sample was determined by distributing the 200 × 6 = 1,200 households across the housing-to-income and water-depth strata in proportion to their size. Using this approach, strata with a large number of one- to four-family homes will generally be allocated more of the sample.

In the second stage, 1,600 additional structures were drawn using probability proportional to size sampling with respect to the population sizes of the housing-to-income and water-depth strata for the sample frame. Study subarea was not a factor in sampling in this stage, so the additional sample would be expected to be proportional to the representation of each study area among the sample frame structures. The final sample size was 2,800 structures with an expected 700 completed surveys.

Drawn Sample

Table A.2 shows the characteristics of the final selected sample of 2,800 properties.

Recruitment of Study Participants

After selecting the sample properties, we developed an outreach strategy to recruit participants into the study. Participation in the study involved two activities. First, the homeowners were asked to take a survey either online or by telephone, and, second, homeowners were asked to be available for a site visit by land surveyors to take the necessary measurements for an EC.

We developed a website that (1) provided background information on the study, such as who was sponsoring the study and why, what was required to participate in the study, and how the data collected for the study would be used; (2) described the value of an EC and what was involved in the site visit necessary for the EC; and (3) provided information about RAND and its study team partners. Participants could also access the survey through this website. The website and the survey were available in English, Spanish, Haitian Creole, Russian, and Chinese (Mandarin). The mayor's office also

Table A.2
Selected Sample of Properties

Stratification Variable	Count	Percentage of Total
Total structures	2,800	100%
Study subarea		
Canarsie	358	13%
Southern Brooklyn Waterfront	267	9%
Jamaica Bay	293	10%
Rockaway Peninsula	578	21%
East Shore, Staten Island	435	16%
Rest of study area	869	31%
Housing as percentage of income		
≤ 25	1,246	45%
> 25.1 and ≤ 35	1,034	37%
> 35	520	19%
Water depth in flood that occurs with a 1% annual change (in feet)		
≤ 1	687	25%
> 1 and ≤ 2	494	18%
> 2 and ≤ 3	507	18%
> 3 and ≤ 4	449	16%
> 4	663	24%

posted an announcement about the study on its website so that participants could be assured that it was a legitimate study sponsored by the city.

At the beginning of the study, the study team engaged in a variety of outreach activities such as sending targeted emails to community leaders and elected officials informing them of the study and asking them to encourage their community members or constituents to participate. The study team and members of the mayor's office described and promoted the study at various community events.

Invitation Letters to Property Owners

Letters inviting each of the 2,800 selected property owners to participate in the study were mailed in six separate waves of varying sizes. This approach was taken to better facilitate management of the incoming responses and the future scheduling of site visits. The six waves were sent between September 2015 and May 2016. Waves were organized in part by geographic location.

To enable survey results to be projected to the study area as a whole, properties eligible to participate in the study were randomly selected; consequently, we could not accept volunteers into the study. Each property address in the sample was assigned a personal identification number (PIN). Participants used this PIN to log into the study online or provided their PIN over the phone if they preferred to take the survey via the phone.

While the core content of the letters remained consistent for the duration of the project, some refinements were made as the study progressed to make the letters as effective and concise as possible. A copy of the letter sent as part of the last mailing wave in May 2016 is provided in Figure A.1. Key points of the invitation letter include:

- benefits of participating
  - participation will help the city develop programs to reduce the cost of flood insurance in local communities
  - participants will receive a free EC, which typically costs $800 to $1,000 and can help property owners qualify for lower flood insurance premiums
  - participants will also receive a $50 gift card (Amazon or Visa)

- how to participate
  - participation is strictly voluntary
  - participants must complete a survey either online or via a toll-free telephone number using the PIN provided in the letter to answer a series of questions about the selected property and to provide information about their household (e.g., income, mortgage, insurance)
  - at a later date, participants must be available during a site visit to the selected property by a local surveyor from the project team

- all information provided by the property owner will be kept strictly confidential and the names of properties owners or the addresses of properties participating in the study will not be shared directly with the city.

Both the website and the invitation letters indicated in multiple languages that the information and survey were available in five languages.

Study Help Line

A phone- and email-based help center was established to make project staff available to answer questions from prospective and current study participants and to assist in the completion of the study questionnaire for those who could not or chose not to complete it online. A toll-free number was established and staffed by project team members. A project email address, info@FloodAffordabilityStudyNYC.org, was also established for

Figure A.1
Invitation Letter to Participants

Mayor's Office of
Recovery & Resiliency

253 Broadway, 10th Floor
New York, NY 10007

NYC Flood Insurance
Affordability Study

Чтобы узнать побольше об этом приглашении и о предлагаемом подарке на русском языке посетите этот сайт:
www.floodaffordabilitystudyNYC.org

如要了解这邀请和礼品的详情，请浏览我们的中文网页:
www.floodaffordabilitystudyNYC.org

Para saber más de esta invitación y de la oferta del regalo en español visite:
www.floodaffordabilitystudyNYC.org

Pou konnen plis de invitasyon sa an kreyol ale nan:
www.floodaffordabilitystudyNYC.org

March 1, 2016

Dear [redacted]:

We invite you to participate in a flood insurance affordability study sponsored by the New York City Mayor's Office of Recovery and Resiliency, and conducted by the RAND Corporation, a nonprofit research firm that **will not disclose** survey responses to the City. This study will benefit you and your community, and you will also receive a $50 gift card for participating.

Here's why you should take part: The City is developing programs to reduce the cost of flood insurance in your community. This survey collects information on the types of households and the types of structures in your community needed to develop these programs. We need your participation to ensure that all types of New York City households are included.

In addition to **helping your community**, you will receive a **free elevation certificate** for your property if you participate in this study. The elevation certificate will be prepared by a licensed surveyor and can help you qualify for a lower flood insurance premium. An elevation certificate typically costs between $800 and $1,000–yours will be free of charge.

To acknowledge the value of your time, you will also receive **a $50 gift card** (Visa or Amazon) by participating in the study.

As mentioned above, the study is conducted by an outside organization, RAND Corporation, and **identities of the people and properties participating in the study will be kept confidential and will not be provided to the City** or any other public or private entity. Only anonymous information will be provided to the City for the analysis of flood insurance issues. The study will not collect any information about the condition or use of your property.

Use the PIN on the back of this page to enroll. If you have any questions about the study, you can contact our study team by e-mail at **info@FloodAffordabilityStudyNYC.org** or by phone at **1-844-228-2761 (toll free)**.

You can also learn more about the study and your property's flood risk by visiting the official New York City website at **www.NYC.gov/floodmaps.**

Thank you for your time and response!

Daniel Zarrilli
Senior Director, Climate Policy and Programs
NYC Mayor's Office

RAND *RR1776-A.1*

Figure A.1—Continued

NYC Flood Insurance
Affordability Study

How do I enroll in the study?

1. Sign up online at **www.FloodAffordabilityStudyNYC.org** or call **1-844-228-2761** for assistance.

2. Provide your **Personal Identification Number** - D5553

3. Complete a 10-15 minute online survey regarding the following property:

[redacted]

*If you are not the owner of this property please let us know at **1-844-228-2761.***

The survey contains questions necessary to understand the financial impact of higher flood insurance costs on you and homeowners like you. *Your name and the property address will be kept strictly confidential and will not be provided to the City.*

If you prefer, you can also complete the survey by phone by calling *1-844-228-2761.* The phone line will be open business days between 9am and 6pm eastern. To make an appointment to complete the survey by phone outside these hours, simply call 1-844-228-2761 and leave a message indicating the desired time along with your name and phone number.

After I complete the survey, what happens next?

You will be contacted by the study team to schedule a 1-hour visit to your property by a land surveyor at a convenient time for you. The surveyors will provide you with their official credentials when they arrive at your property.

To prepare your Elevation Certificate, surveyors need to measure heights of different areas of your property. Most of their measurements are taken outside the property, but they will need to spend 5-10 minutes inside the property to measure the lowest floor level and will need access to your basement if you have one. *The survey crew members are credentialed land surveyors who will only be making the required measurements on your property. You or your family members may be with them at all times while they are on your property.*

What do I receive if I participate in the study?

Once the site visit is completed you will receive via mail or e-mail:

- A $50 gift card (Visa or Amazon)

A few weeks after the site visit you will also receive:

- A FEMA-approved Elevation Certificate (EC) for your home prepared by a licensed surveyor ($800 to $1000 value). The EC will only be provided to you and will not be provided to the City.

How can I learn more?

If you have questions, you can read more at **www.FloodAffordabilityStudyNYC.org** or contact the study team by phone at 1-844-228-2761 or by e-mail at **info@FloodAffordabilityStudyNYC.org**.

To confirm the authenticity of this study and learn more about FEMA's remapping of New York City go to **www.NYC.gov/floodmaps.**

RAND *RR1776-A.1 (continued)*

those who preferred to communicate online. A script, including answers to common questions, was developed for the use of support staff to ensure accurate information was communicated in response to inquiries. Staff fluent in Spanish, Chinese, Russian, and other languages were available on call as needed.

During the course of the study, 345 phone-based inquiries were received through the toll-free number. Of those, 135 (22 percent of the 615 surveys completed overall) were requests to complete the study questionnaire over the phone. The remainder were typically inquiries relating to:

- when the site visit for their property would be scheduled
- when they would receive their EC and/or gift card following the site visit
- people who were interested in participating in the study but who did not receive invitation letters
- general questions about flood insurance.

The call center was staffed from 9:00 a.m. to 6:00 p.m., Monday through Friday, with callers having the option of leaving a voicemail message to request a call back time outside of normally staffed hours.

An additional 26 inquiries were received through the project email address.

Follow-Up Activities

Follow-Up Letters

If a completed questionnaire was not received within approximately two weeks of the initial invitation letter, a duplicate letter was mailed to each person in the mailing wave who had not yet responded.

Additionally, in May 2016, following the mailing of the last wave of letters, a third and final "last-chance" letter was mailed to all property owners who had not yet participated and who had not expressly declined to participate in the study previously (see Figure A.2).

Phone-Based Outreach

A list of phone numbers associated with the property addresses in the selected sample of 2,800 properties was purchased from a third-party vendor to enable additional phone-based outreach to encourage participation in the study. The list obtained included phone numbers for 78 percent of the properties in the sample set. Calls were made to property owners who had not responded to the initial two invitation letters.

Door-to-Door Outreach

Once all the invitation letters had been mailed, we assessed our response rates in the six study subareas. To address response bias (those neighborhoods for which there was a particularly low response rate), we engaged three community-based organizations in Brooklyn, Queens, and Staten Island to do door-to-door outreach. In November and

Figure A.2
Last-Chance Letter

NYC
Mayor's Office of
Recovery & Resiliency

253 Broadway, 10th Floor
New York, NY 10007

NYC Flood Insurance
Affordability Study

Hi [redacted],

This is your last chance—you must respond within 1 week!

Don't lose this opportunity for a **$50 Gift Card** and a FREE Elevation Certificate (**$1,000 Value**) for participating in the Flood Insurance Affordability Study, which is helping the City develop programs to **reduce flood insurance costs** in your neighborhood. The study is conducted by the RAND Corporation, a nonprofit research firm, and is sponsored by the NYC Mayor's Office.

To participate…

Visit: www.FloodStudyNYC.org

Enter Your Unique PIN: **G5553**

Complete 12-min survey on expenses for:

[redacted]

For Participating You Get:

Gift Card $50 + Elevation Certificate

Amazon or Visa Gift Card

Can help lower your flood insurance premiums

After the survey, we'll schedule a 1-hour property visit by a land surveyor to measure heights on your property at a time convenient for you. Your name, address, and information about the condition or use of your property will be kept confidential and won't be shared with the City.

A **$50 Gift Card** and a FREE Elevation Certificate **($1,000 Value)** will be mailed or emailed to you following the visit. The elevation certificate can help you qualify for lower flood insurance premiums—while actual savings will vary depending on your property's characteristics, a typical household can **save $1,200 per year!**

Thank you for your time and response!

Daniel Zarrilli
Senior Director, Climate Policy and Programs
NYC Mayor's Office

www.FloodStudyNYC.org 1-844-228-2761 info@FloodStudyNYC.org

Чтобы узнать побольше об этом приглашении и о предлагаемом подарке на русском языке посетите этот сайт: www.floodaffordabilitystudyNYC.org

如要了解这邀请和礼品的详情，请浏览我们的中文网页: www.floodaffordabilitystudyNYC.org

Para saber más de esta invitación y de la oferta del regalo en español visite: www.floodaffordabilitystudyNYC.org

Pou konnen plis de invitasyon sa an kreyol ale nan: www.floodaffordabilitystudyNYC.org

RAND *RR1776-A.2*

December 2015, Northfield Community Local Development Corporation knocked on doors for addresses in the East Shore, Staten Island, study subarea that had not responded to letters or calls. Between August and October 2016, Neighborhood Housing Services of East Flatbush and Neighborhood Housing Services of Northern Queens knocked on doors in Brooklyn and Queens. Overall, this effort yielded approximately 60 study participants.

Site Visits and Elevation Certificates

Following completion of the questionnaire by study participants, the project-scheduling team contacted each participant by phone and/or email to schedule the site visit for the land surveyors to take the necessary measurements of the property for the EC. Following completion of the site visit, the EC and gift card were sent to participants by email or U.S. Postal Service. A fact sheet about using the EC and general information about flood insurance was also provided to each property owner with the issued EC. A copy of this fact sheet is provided in Figure A.3. The community-based organizations also conducted door-to-door outreach to certain homes that had completed the survey but were unreachable to schedule the site visit.

Recruitment Challenges

Recruiting participants for this study was a challenge. Over the course of the study, we increased our sample size from 1,400 to 2,800 because of a lower response rate than expected. The recruitment period was also extended by several months to increase our response rates, and many of the follow-up activities described above were added in an attempt to recruit more participants. We also experienced an attrition rate of about 20 percent between completing the survey and participating in the site visit. Our *a priori* assumption was that the incentives, especially the free EC, would be attractive to homeowners because of its substantial cost ($800 to $1,000) and its potential to lower flood insurance premiums. However, we found that homeowners' knowledge of flood risk was low and the value of an EC to lower flood insurance premiums is not widely appreciated.

Study Response Rates

The response rates that resulted from the extensive recruitment efforts are shown in Table A.3.

Figure A.3
Flood Insurance Fact Sheet Provided to Study Participants

Mayor's Office of
Recovery & Resiliency

NYC Flood Insurance
Affordability Study

Your Property is at Risk for Flooding

You are receiving this invitation to participate in the Flood Insurance Affordability Study because your property is located in or near a high-risk flood area.

An Elevation Certificate could lower your flood insurance rate

Flood insurance rates are going up. Depending on your home's elevation, getting an Elevation Certificate could lower your flood insurance rate.

An Elevation Certificate (worth $1000) tells you the height of your home relative to the expected flood waters in a storm. It is used to determine your flood risk and the cost of your flood insurance premium in high-risk areas.

Flood insurance can protect your home

Homeowners insurance does not cover flood damage. Property owners in or near the high-risk flood zone should purchase flood insurance. If you have a mortgage, and live in a high-risk area, you are required to purchase flood insurance.

You will receive a **free** **Elevation Certificate (worth $1000)** for participating in the Flood Insurance Affordability Study.

This information will help determine the cost of flood insurance for your property.

To Participate in the Study

Go to **www.floodaffordabilitystudyNYC.org** or call 1-844-228-2761 (toll free)

Call the Center for NYC Neighborhoods Homeowner Helpline at (646) 786-0888 or visit www.FloodHelpNY.org for more information and help understanding your flood risk, how to reduce your risk, and where to buy flood insurance.

Additional Helpful Resources

The City's webpage, www.nyc.gov/floodmaps, provides information to help residents and property owners understand the new FIRMs and map update process.

Created by the Center for NYC Neighborhoods, FloodHelpNY.org provides City residents with flood insurance and flood risk information related to the FIRMs.

FloodSmart.gov, the official NFIP website, provides information about flood risk and flood insurance, including referrals to insurance agents, to help homeowners and business owners protect property from flooding.

RAND *RR1776-A.3*

Figure A.3—Continued

Frequently Asked Questions

What is the Flood Insurance Rate Map?

The Flood Insurance Rate Map (FIRM), released by The Federal Emergency Management Agency (FEMA) in January 2015 shows coastal and riverine areas at risk for flooding. The City is appealing FEMA's map and the map could change before it becomes final.

Why do I need an Elevation Certificate?

An Elevation Certificate (worth $1000) is used by FEMA to determine your flood risk and the cost of your flood insurance premium in high-risk areas.

What information is found on an Elevation Certificate?

It tells you the height of your home relative to the expected flood waters in a storm.

Why do I need flood insurance?

Homeowners insurance does not cover flood damage. Property owners in or near the high-risk flood zone on the preliminary FIRM should purchase flood insurance. If you have a mortgage, and live in a high-risk area, you are required to purchase flood insurance.

What determines my flood insurance rate?

Flood insurance rates depend on several factors:

- The amount of coverage purchased;
- The age, occupancy, and design of the building;
- And, for buildings in high-risk areas (zones beginning with "A" or "V" on a flood map), the elevation of the building's lowest floor (including the basement) in relation to the Base Flood Elevation on the effective FIRM.

RAND *RR1776-A.3 continued*

Sample Weights

The selection probability for each structure in the selected sample of 2,800 structures was calculated based on the method described in the "Sampling Approach" section in this appendix. The probability that a property owner participated in the survey once selected varied by characteristics of the property and the household. To account for these differences, we developed a response-rate model. Two different models were developed: one for completion of the survey and one for completion of both the survey and the EC. Different sampling weights were then developed using these two models to (1) extrapolate from the respondents who completed the survey to the sample frame of 48,089 structures and (2) to extrapolate from those study participants who completed the survey and the EC to the sample frame.

The response-rate model was estimated using STATA's (a data-analysis software) logistic command. The outcome variable is an indicator variable for participation in the study (1 indicating yes), and the explanatory variables are also all indicator variables. As shown in Table A.4, the following variables are included in the response-rate model:

Table A.3
Study Response Rates

Stratification Variable	Selected Sample	Property Owners Completing Survey: Number	Property Owners Completing Survey: Response Rate (Percentage)	Property Owners Completing Survey and EC: Number	Property Owners Completing Survey and EC: Response Rate (Percentage)
Total structures	2,800	615	22%	485	17%
Study subareas					
Canarsie	358	82	23%	59	16%
Southern Brooklyn Waterfront	267	51	19%	46	17%
Jamaica Bay	293	88	30%	65	22%
Rockaway Peninsula	578	147	25%	108	19%
East Shore, Staten Island	435	92	21%	83	19%
Rest of study area	869	155	18%	124	14%
Housing as percentage of income					
≤ 25	1,246	259	21%	206	17%
> 25.1 and ≤ 35	1,034	238	23%	186	18%
> 35	520	118	23%	93	18%
Water depth (in feet)					
≤ 1	687	116	17%	88	13%
> 1 and ≤ 22	494	110	22%	85	17%
> 2 and ≤ 3	507	124	24%	92	18%
> 3 and ≤ 4	449	94	21%	79	18%
> 4	663	171	26%	141	21%

- study subarea
- whether the property qualifies for New York State's School Tax Relief Program (STAR)
- whether the property is in New York City's Build It Back program
- whether there was an NFIP policy with building coverage at the property as of June 30, 2016.

To qualify for a STAR exemption, the property must be an owner-occupied, primary residence for which the resident owners' and their spouses' incomes are less than $500,000 (NYC Department of Finance, undated). The New York City Build It Back program provides funds to rebuild homes damaged by Hurricane Sandy (NYC Build It Back, undated[b]).

As can be seen from Table A.4, properties in the STAR program, with a flood insurance policy, and in the Build It Back program are all more likely to complete the survey as well as to complete the survey and the EC. The response rates were lower outside the five study subareas. This is partly due to the fact that the door-to-door outreach was concentrated inside these five study subareas.

A number of other variables were tested for inclusion in the response-rate model, but they were dropped because their coefficients were not significantly different than one. These include water depth in the 100-year flood, flood zone, structure market value, property market value, whether the structure was built before the first FIRM was released for New York City (a pre-FIRM structure), and median income and housing cost as a percentage of income for the census tract or census-block group in which the property lies.

Each of the two sets of sample weights was calculated using the following formula:

Table A.4
Response-Rate Model

	For Completion of Survey		For Completion of Survey and EC	
Variable	**Coefficient**	**Prob > |z|**	**Coefficient**	**Prob > |z|**
Study subarea				
Canarsie	1.102	0.56	1.122	0.54
Southern Brooklyn Waterfront	0.679	0.04	0.908	0.63
Jamaica Bay	1.097	0.56	1.070	0.71
Rockaway Peninsula	Reference	—	Reference	—
East Shore, Staten Island	0.791	0.13	1.052	0.76
All remaining areas	0.750	0.04	0.877	0.38
In STAR program	1.834	0.00	1.894	0.00
Has flood insurance policy	1.848	0.00	1.996	0.00
In Build It Back program	1.805	0.00	1.836	0.00
Constant	0.137	0.00	0.083	0.00
Likelihood ratio chi-square (8)	162.94	—	145.64	
Prob > chi-square	0.000	—	0.00	
N	2,800	—	2,800	

$$sample\ weight = a \times \frac{1}{selection\ probability} \times \frac{1}{response\ probability}$$

where

selection probability =	the probability the observation is selected for the study (for the 2,800 properties selected from the sample frame of 48,089 properties)
response probability =	the predicted probability from the appropriate response rate model in Table A.4
a =	a factor that adjusts the sample weights to sum to the number of properties in the sample frame (48,089).

Summary statistics for the two sets of sample weights are shown in Table A.5. It also shows the selection weight that is used in some projections (inverse of the selection probability). Because of the larger sample size, the mean weight for properties for which a survey is completed (78.2) is smaller than the mean weight for properties with both a completed survey and an EC (99.2). The within-group variation for each set of weights is fairly large, reflecting the variation in response rate by property characteristic and the probability that the property was included in the study sample of 2,800.

The value for *a* is very close to 1.0 for each set of weights—1.0005 for weights for properties with completed surveys and 1.0153 for weights for properties with completed surveys and ECs.

The design effect for the study (mean of squared weights divided by [mean of weights]^2) is 1.45.

Table A.5
Summary Statistics for Sample Weights

	For Study Sample	For Completion of Survey	For Completion of Survey and EC
Minimum	7.2	19.8	21.1
5th percentile	7.2	20.1	25.5
Median	19.6	62.0	84.6
95th percentile	23.3	162.7	194.1
Max	23.3	249.7	345.3
Mean	17.2	78.2	99.2
N	2,800	615	485

APPENDIX B

Development of the Project Geodatabase

This appendix describes the methodology used to assemble and prepare the Geographic Information Systems (GIS) data used throughout the New York City Flood Insurance Affordability study. The study data were developed and manipulated in a geodatabase and shared with all study team members through an ArcGIS Online geoportal.

This appendix provides a summary of the development of the study geodatabase including the data sources used to prepare the study data, the processes used to manipulate and combine the study data, maintenance of the study geodatabase throughout the study duration, creation of maps for use by door-to-door canvassers, the process used to match the study addresses to the NFIP policy database, and the process used to match the study addresses to the Build It Back database.

Geodatabase Development: Data Sources

An initial study geodatabase was developed by combining data from the following sources:

- New York City Borough Block and Lot (BBL) database was provided by New York City and contained detailed tabular information about property owner, property address, mailing address, and tax assessment information for the years 2012 through 2015. The BBL database was filtered to only those records that represented the 71,714 one- to four-family structures in the city.
- New York City Primary Land Use Tax Lot Output (PLUTO) geodatabase (PLUTO14v1) was provided by New York City in Shapefile format. The PLUTO data included 857,532 parcel polygons with detailed attributes for parcel location, land use, structure information, and tax assessment.
- U.S. Census Bureau American Community Survey (ACS) data at the tract and block-group levels were downloaded from the U.S. Census Bureau. The following fields were used at the block-group level:
  - B19013e1: median income
  - B25071e1: median gross rent as a percentage of household income

– B25092e1: median selected monthly ownership cost as a percentage of household income.

The following fields were used at the census tract level:
– B19013e1: median income
– B25071e1: median gross rent as a percentage of household income
– B25092e1: median selected monthly ownership cost as a percentage of household income
– B25118e1 to B25118e25: distribution of household income by tenure
– B25119e2: median income of owner-occupied household
– B25119e3: median income of renter-occupied household.

- FEMA effective FIRM for New York City (2007 FIRM database), with an effective date of September 5, 2007, was downloaded from the FEMA Map Service Center. The database contains information about the current flood zones and BFEs used for insurance rating.
- FEMA preliminary FIRM database for New York City, dated December 5, 2013, was downloaded from the FEMA Map Service Center. The preliminary FEMA FIRM database contains information about the potential future flood zones and BFEs. Note that a revised preliminary FIRM for New York City was issued by FEMA on January 30, 2015, but it was determined that the originally issued preliminary FIRM should be used for this study.
- New York City Digital Elevation Model was created from its 2010 1-foot lidar data.
- New York City provided Shapefiles for select neighborhoods drawn from its Resilient Neighborhoods study. The neighborhoods were grouped as follows for this study:
  – Broad Channel, Howard Beach, Old Howard Beach, Hamilton Beach
  – Canarsie
  – Rockaway Peninsula including Rockaway Park and Rockaway Beach
  – Sheepshead Bay, Gerritsen Beach
  – South Beach, Midland Beach, New Dorp Beach, Oakwood.

Source Data Manipulation

The following data-manipulation steps were performed on the supplied data to prepare the study geodatabase for use by the study team members.

Join BBL Database to PLUTO Parcels

The BBL database was joined to the PLUTO database using the field "BBL" which was common to both databases. For unknown reasons, 218 properties did not match when the BBL database was joined to the PLUTO database, resulting in only 71,496 parcels with one- to four-family structures on them.

Overlay Census Data onto PLUTO Parcels

The census tracts and block groups were each overlaid on the PLUTO parcel polygons and a spatial join was used to assign the attributes from the census tract and block group to the parcels that fall within each tract or block group. Only the specific fields needed for the study (listed above) were retained from the ACS data and the numerous remaining ACS fields were removed.

Overlay Neighborhoods onto PLUTO Parcels

The New York City neighborhoods were overlaid on the PLUTO parcel polygons and a spatial join was used to assign the neighborhood name from the neighborhood polygons to the parcels that fall within each neighborhood.

Calculate Lowest Adjacent Grade and Highest Adjacent Grade for Each Parcel from Digital Elevation Model

Zonal statistics were run on the New York City Digital Elevation Model and the PLUTO parcels to calculate the maximum and minimum values of the raster cells that fell within each parcel. The maximum value was assigned as the Highest Adjacent Grade (HAG) and the minimum value was assigned as the Lowest Adjacent Grade (LAG). The highest and lowest elevation tables were joined to the PLUTO parcels and the HAG and LAG were assigned to each parcel polygon.

Calculate Maximum Flood Zone and BFE from Preliminary and 2007 FIRMs for Each Parcel

Each parcel was assigned the maximum flood zone from the effective FEMA FIRM database and the preliminary FEMA FIRM database. Where a parcel was intersected by more than one flood zone, the zone with the highest flood hazard was assigned using the following order:

- VE
- AE
- AO
- A
- 0.2-percent annual chance flood hazard
- X
- open water.

Each parcel was assigned the maximum BFE from the effective FEMA FIRM database and the preliminary FEMA FIRM database. For coastal areas, the BFEs are stored in the FIRM database as polygon attributes (field name *STATIC_BFE*) whereby the BFE applies uniformly across the polygon. Similarly to the flood zone calculation, where a parcel was intersected by more than one static BFE, the BFE with the highest elevation was assigned to the parcel.

For riverine areas, the BFEs are stored in the FIRM database as attributes to line features that cross the floodplain perpendicular to stream flow. Using the elevation of the BFE lines as input and the zone AE flood hazard areas as a mask, a Triangulated Irregular Network of the water surface elevations was created for the effective and preliminary BFEs. This Triangulated Irregular Network was then used to calculate the maximum whole-foot BFE values that fall within the PLUTO parcel.

For the zone AO areas in the preliminary FIRM database, the BFE information is stored as depth of shallow flooding as a polygon attribute (field name *DEPTH*). For the zone AO areas, the depth value was added to the maximum ground elevation (HAG) and assigned to the PLUTO parcel.

Export Study Geodatabase

The study geodatabase of 71,496 records was exported as a comma-delimited text file and used to select a statistically significant sample set.

Add Fields from Statistical Analysis

Using a spreadsheet with the first target 1,400 addresses identified, we added fields to the study geodatabase to hold select variables used for the statistical analysis along with a field (*Order*) identifying the order of the addresses from 1 to 1,400. This process was repeated when the sample selection was increased from 1,400 to 2,800.

Pare Down from 74,496 to 1,400 Records

To speed subsequent processing, the original 71,496 parcels with one- to four-family structures on them were pared down to just the 1,400 parcels initially chosen for the study. This process was repeated when the sample selection was increased from 1,400 to 2,800.

Identify Languages Spoken

To determine what languages, in addition to English, the online questionnaire and letters to the homeowners would need to be translated into, the U.S. Census Bureau ACS file B16001, "Language spoken at home by the ability to speak English for the population 5 years and over," was downloaded at the census-tract level and analyzed. The top three languages besides English were identified per census tract. Then the census tracts with the initial 1,400 study addresses in them were selected and the overall top four languages besides English for the anticipated study participants were identified. The top four languages spoken in the census tracts with the initial 1,400 study addresses were Spanish, Russian, Chinese, and French Creole.

Add Mailing Wave and Study PINs

In preparation for the mailings to the homeowners in the study sample set, unique PINs were created and added to the study geodatabase. Initially the PINs were set by using the Order field with an alphanumeric prefix that would denote the mailing wave. However, it was later determined that the PINs should not include the numbers 0 or 1, and a list of PINs that could be used for mailing waves A through J was developed. PINs were assigned for the first 300 addresses in wave A. PINs were assigned for subsequent mailing waves as the mailing waves were identified (number of addresses and neighborhoods).

Prepare Data for Mailings and Telephone Outreach

The study data were prepared for mail merge. Because the property owner names were provided in varying formats (e.g., last name, first name; first name last name), a manual process was used to parse property owners' names into separate fields for first and last name. These fields and their contents were added to the study geodatabase. This process was repeated when the sample selection was increased from 1,400 to 2,800.

Telephone numbers were purchased from a third-party vendor for the 1,400 initial study sample addresses. Fields for phone number and a wireless flag were added to the study geodatabase along with their contents for the 1,400 addresses. This process was repeated when the sample selection was increased from 1,400 to 2,800.

Addresses in the cooperative communities of Breezy Point, Edgewater Park, and Silver Beach fell within the study sample. In most cases, in the information provided by the BBL and PLUTO databases, there was a single parcel with multiple buildings and units and no specific address or property owner information for the individual units. The cooperative communities were contacted and asked if unit addresses and owner names could be provided for this study. Unit addresses, but not owner names, were provided for the study sample addresses within the cooperative communities. Fields that identified the cooperative community name and the individual unit addresses were added to the study geodatabase.

Add Fields to Study Geodatabase for Study Tracking

Fields were added to the study geodatabase for use in tracking specific aspects of the study process. These included fields to track the status of the initial outreach letter mailing as well as subsequent mailings and telephone outreach, online questionnaire completion, scheduling the EC surveys, gift card mailings, and overall study progress. These fields were maintained throughout the study as specific study activities (e.g., mailings, surveys) were scheduled or completed. Additionally, fields to hold the results of the EC field surveys were added.

Generate Parcel Centroids and Prepare Data for ArcGIS Online

Esri's ArcGIS Online (AGOL) was chosen as the mechanism for sharing and updating study data by study team members. Parcel centroids were generated for ease of display of the study data in an AGOL viewer. For cooperatives and other parcels where there were multiple study addresses, additional points were added and the study data were linked to the points. The manually added points were initially distributed randomly within the parcel. Subsequently, the cooperative addresses were geocoded and their points were moved to locations that better represented real-world locations.

To improve the display of tabular information in AGOL, only selected fields were kept in the study geodatabase that was prepared for AGOL use. Fields that supported the selection process but would not be relevant for study management were dropped. However, because the PIN and Order number fields were retained, the AGOL database could be joined back to the original study geodatabase at any time if needed.

Study Geodatabase and Feature Service Maintenance

The study geodatabase was maintained as a feature service in AGOL throughout the duration of the project. Study team members had the ability to update the study data directly in AGOL so that multiple users could work from the same hosted versioned database. For those who did not feel comfortable doing this, a spreadsheet was exported and placed on the study Sharepoint site each time data were uploaded/synced to the AGOL feature service.

The AGOL geodatabase was updated and exported each time a new batch of online questionnaire responses was made available, a new outreach mailing took place, a new batch of EC survey data was made available, or a new batch of gift card updates was made available. A series of model-builder tools were designed and used to automate the process of migrating data from the Microsoft Access database containing the EC survey data to the AGOL geodatabase. These processes were used in conjunction with several manual review steps to ensure that survey and questionnaire data were correctly imported.

As EC surveys were scheduled, Gayron de Bruin updated the AGOL feature service directly with the status of their scheduling and fieldwork dates. This allowed the study team members to view the EC survey scheduling progress in real time.

The study geodatabase information was also periodically exported into spreadsheets set up for specific additional activities. This included the creation of phone trackers for use by outreach teams and trackers for door-to-door canvassers.

Door-to-Door Maps

As described in Appendix A, study outreach was conducted in select neighborhoods by door-to-door canvassers. Maps showing optimal walking routes were created for each neighborhood, showing the walking route and the order of the study addresses. The neighborhood door-to-door maps were accompanied by spreadsheets ordered in the same way as the walking route for ease of use in recording the outreach results.

The target neighborhoods were Staten Island, Broad Channel, Canarsie, Howard Beach/Hamilton Beach, Rockaway Peninsula, and Sheepshead Bay/Gerritsen Beach.

The first door-to-door maps for Staten Island were created using Esri's Network Analyst and a StreetMap USA base map. The study points for the chosen neighborhood were loaded into the tool. A starting and ending location for each route was chosen, and an ordered route and directions were output. Once the route was created, map sheets at a size and scale that could be printed and carried in the field were generated. Each study address was shown with an order number along the route.

However, because the route was optimized for driving, it was decided for subsequent door-to-door maps to use ArcGIS Online. Again, the study points for each chosen neighborhood were loaded into the tool. "Walking route" was chosen along with a starting and ending location for each route, and an ordered route and points were output. Once the routes were created, printable map sheets for use in the field were generated. Each study address was shown with an order number along the route.

National Flood Insurance Program Policy Data

FEMA provided a database containing information about 36,987 New York City NFIP policyholders and their flood insurance premiums as of June 30, 2016. We wanted to be able to identify which of the study participants had NFIP policies. The address information in the two databases was structured differently, and there was no common identifier between the two databases. Each of the two databases was geocoded using the Google geocoder. In addition to creating a point location for each address, the geocoder also created a field with the concatenated and standardized address. The study addresses and the NFIP policy addresses were matched two ways—spatially and through a text match of their concatenated addresses. Of the 2,800 study addresses, 1,214 matched the NFIP policy database using this process.

Build It Back Data

The City of New York provided a database containing information about 12,323 Build It Back program participants as of November 16, 2015. RAND wanted to be able to identify which of the study participants were also participating in the Build It Back program. The Build It Back database contained BBLs, so a first pass match was made using the BBLs. However, because of the presence of multi-address parcels (e.g., cooperatives) a similar process as that used for the NFIP policy data was used to match the addresses with duplicate BBLs. The Build It Back database was geocoded using the Google geocoder. The study addresses and the Build It Back addresses were matched two ways—spatially and through a text match of their concatenated addresses. Of the 2,800 study addresses, 692 matched the Build It Back database using this process.

APPENDIX C

AMI-Based Income Categories and the Correlation Between Household Income and Net Worth

This appendix describes the income cutoffs used to define the income ranges used in this study (e.g., very low–income household, moderate-income household). It then summarizes data from the U.S. Census Bureau on the relationship between household income and household net worth. These data are based on statistics for households nationwide, but they provide an initial sense of how adding an asset test to an income-based eligibility criterion could reduce the number of households eligible for a flood insurance affordability program.

AMI-Based Income Categories

Table C.1 reports the cutoffs for the AMI-based income categories for the New York, New York, Metro Fair Market Rent Area.

These income categories go back to the National Housing Act of 1937. The Act defines "low-income families" as those "whose incomes do not exceed 80 per centum of the median income for the area," and defines "very-low income families" as "families whose incomes do not exceed 50 per centum of the median family income for the area." Scope is left for the HUD to adjust those cutoffs as necessary (U.S. Housing Act of 1937 as amended by the Quality Housing and Work Responsibility Act of 1998, 1999).

Measuring Household Income

In the study survey, we asked households to report their family household income over the past 12 months before taxes. We asked households to include wages, salaries, self-employment, interest, rental properties, and any other income sources for all members of the household. Rather than ask households to report a specific dollar value, we presented them with ten income ranges and asked households to select which range

Table C.1
AMI-Based Income Categories for the New York, New York, HUD Metro Fair Market Rent Area

	Upper Cutoff for Income Category				
Household Size	Extremely Low (30% of AMI)	Very Low (50% of AMI)	Low (80% of AMI)	Moderate (120% of AMI)	Middle (165% of AMI)
1	$18,150	$30,250	$48,350	$72,550	$99,700
2	$20,750	$34,550	$55,250	$82,900	$113,950
3	$23,350	$38,850	$62,150	$93,250	$128,200
4	$25,900	$43,150	$69,050	$103,600	$142,400
5	$28,410	$46,650	$74,600	$111,900	$153,850
6	$32,570	$50,100	$80,100	$120,150	$165,200
7	$36,730	$53,550	$85,650	$128,500	$176,650
8	$40,890	$57,000	$91,150	$136,750	$188,000

SOURCE: "Income Limits," undated.

NOTE: The New York, New York, HUD Metro Fair Market Rent Area is composed of Bronx County, Kings County, New York County, Putnam County, Queens County, Richmond County, Rockland County, and Westchester County.

contained their household income.[1] Based on the selected income range and reported number of household residents, we then asked if household income was above or below a specific AMI threshold from Table C.1 that fell within the household's selected income range. So if a household with four residents reported an income in the $60,000 to $79,999 range, we then asked if their income was more or less than $69,050.

We then estimated household income as the middle of the narrowest reported income range, after rounding all range bounds to the nearest $1,000. For example, if the household with four residents and income in the $60,000 to $79,999 range reported their income was below $69,050, we took the midpoint of $60,000 and $69,000 to estimate that household's income at $64,500. If the same household reported their income was above $69,050, we took the midpoint of $69,000 and $80,000, estimating their household income as $74,500. We bounded the lowest income range between $0 and $20,000. For households reporting income above $150,000, if they reported income below the follow-up bound, we assigned the midpoint of that income range. For example, if a household of five people reports income of $150,000 or more but below $153,850, we assign their income at $152,000. If a household reports income of $150,000 or more and income above the follow-up cutoff range, we assign them an

1 The ranges were $19,999 or less, $20,000 to $29,999, $30,000 to $39,999, $40,000 to $49,999, $50,000 to $59,999, $60,000 to $79,999, $80,000 to $99,999, $100,000 to $119,999, $120,000 to $149,999, and $150,000 or more.

Table C.2
Correlation Between Household Income and Household Net Worth

	Income Quintile				
Household (HH) Net Worth	Less than $24,000 (Below 35% of AMI for Two-Person HH)	$24,000–$44,200 (Below 64% of AMI for Two-Person HH)	$44,200–$68,500 (Below 99% of AMI for Two-Person HH)	$68,500–$107,500 (Below 156% of AMI for Two-Person HH)	More than $107,500 (Above 156% of AMI for Two-Person HH)
Zero or negative	31.2	20.4	17.1	13.8	8.0
$1–$4,999	19.0	14.6	7.2	3.4	1.3
$5,000–$9,999	6.5	7.2	6.0	3.1	1.2
$10,000–$24,999	6.8	8.1	8.9	5.9	3.1
$25,000–$49,999	5.8	7.4	8.5	8.4	4.6
$50,000–$99,999	8.6	10.5	12.4	12.8	7.9
$100,000–$249,999	12.4	17.1	19.7	20.9	19.5
$250,000–$499,999	5.5	9.1	12.0	16.0	20.6
$500,000 or more	4.2	5.6	8.3	15.6	33.8

NOTE: Data on household net worth by income quintile from U.S. Census Bureau, Survey of Income and Program Participation (SIPP), 2008 Panel, Wave 10 (U.S. Census Bureau, undated[c]). Net worth is defined as total assets less total liabilities. Annual wages for each income quintile are calculated by the authors using SIPP 2008 Panel, Wave 10. We assume that annual income is equal to 12 times monthly income; we then adjust for inflation to 2011 dollars and then round to nearest $100. The AMI in 2015 for a two-person household is $691 per percentage point on average, which, in 2011 dollars, is $656 per percentage point.

income that is as high above $175,000 as their income would be above $150,000 if the household had reported income below the cutoff. If a household of five people reports income of $150,000 or more and above $153,850, we assign their income at $177,000.

Correlation Between Income and Assets

The U.S. Census Bureau's Survey of Income and Program Participation collects information on both income and assets, enabling researchers and policymakers to examine the correlation between income and assets. The correlations in Table C.2 reflect the national averages for correlations between income and assets. The income quintiles have been mapped to the income quintiles for New York City, in 2011 dollars. Higher-income households are clearly more likely to have greater accumulated assets than lower-income households. However, some low-income households are able to save up significant assets, while some high-income households are unable to accumulate significant assets.

An asset-based test can have both benefits and downsides. One benefit of an asset-based test is to help target limited aid resources to where they are most needed. It is generally desired that affordability subsidies be progressive, in that individuals with greater wealth subsidize the costs of individuals with lower wealth. Without an asset test, individuals with greater net worth than the average taxpayer could potentially receive benefits. However, downsides of asset-based tests include that they can discourage saving and can be more costly to implement.[2]

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[2] For discussion of assets tests in federal program, see U.S. Department of Health and Human Services, 1988, and Corporation for Enterprise Development, 2013.

APPENDIX D

Components of Housing Costs and Relationship Between Amount of Flood Coverage, Structure Replacement Cost, and Mortgage Balance

This first part of this appendix provides statistics on the components that make up PITI as well as on the amounts households in the study area pay for utilities. The second part examines the relationship between the amount of flood insurance coverage chosen by policyholders, the replacement cost for the structure, and the balance remaining on the mortgage.

PITI Components

PITI costs are largely driven by the principal and interest components, which we examine as total mortgage expenditure. Table D.1 estimates that just more than one-quarter of households have no mortgage. Households in the high-risk flood zone that have a mortgage spend an average of 29 percent of household income on the mortgage. Roughly one out of three households in the high-risk flood zone are spending between 15 percent to 30 percent of their income on direct mortgage expenses. Some households, particularly lower-income households, are spending more than 30 percent of their income on the mortgage alone.

It is unlikely that households with housing burden over 40 percent would have received a loan that put their housing burden at the time of the loan significantly above 40 percent. It is more likely that household income has changed since the mortgage was initially obtained. It could be that an unemployment spell or a change in jobs has reduced household income. It could also be the case that workers in the household have retired. The extent to which remaining costs are unsustainable to a household depends on their level of accumulated assets. The role of assets is discussed later in this appendix.

Other components of PITI can also take up a non-trivial percentage of household income. The median household in the high-risk flood zone spends an average of 3.7 percent of their income on insurance. Almost one-half of those households stated that they do not purchase flood insurance. Of households with flood insurance, the median household spent 1.3 percent of its income on flood insurance. One in four households in the high-risk flood zone spend more than 6 percent of their annual income on insurance costs. Presently, the number of individuals reporting spending more than 6 percent of their income on flood insurance in particular was much smaller, suggesting that flood insurance is not viewed as the primary driver of PITI. However, there was considerable discrepancy between the self-reported flood insurance premium and the administrative data on flood insurance premium.

Similarly, the median household in the high-risk flood zone spent 5.1 percent of its income on property taxes. As shown in Table D.1, the majority of households spend between 3 percent and 10 percent of their income on property taxes, but nontrivial numbers of individuals fall both below and above this range.

Finally, the median household in the high-risk flood zone spent 6.6 percent of its income on utilities. The percentage of income spent on utilities varies highly, with most households in the high-risk flood zone spending less than 10 percent of income on utilities. However, just more than 10 percent of these households spend more than 20 percent of their income on utilities.

It is important to note that while some costs do vary with income, others do not. Households with more income do tend to purchase more expensive houses, and hence tend to spend more on principal, interest, and property taxes. However, other costs associated with homeownership, such as utilities and insurance, do not significantly vary across income levels. Figure D.1 shows that the vast majority of households spend between $5,000 and $20,000 per year on utilities and insurance, and that the amount spent is not significantly correlated with the household's AMI. In other words, households with a relatively large amount of income for their family size do not necessarily spend more on utilities and insurance than households with a smaller amount of income for their family size.

Table D.2 reports the percentage of income households spend on PITI and utilities. As seen by comparing the first set of rows with the second, including utilities causes a substantial movement of households to the higher-income share categories.

Relationship Between Building Coverage, Contents Coverage, Replacement Cost, and Mortgage Balance

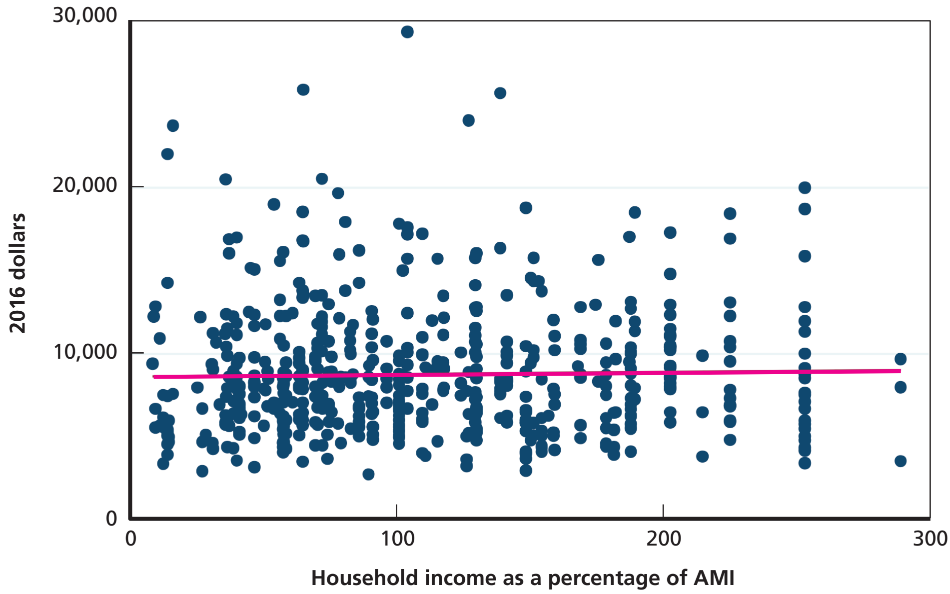
The top section of Table D.3 examines the relationship between building coverage for flood losses, structure replacement cost, and the mortgage balance. Mortgage balance is relevant because the federal mandatory purchase requirement requires property owners to carry flood insurance at least equal to the lesser of the mortgage balance, insurable value of the property, and maximum amount available through the NFIP (e.g., $250,000 for residential properties) (Federal Deposit Insurance Corporation, 2016).

Table D.1
Fraction of Income Spent by One- to Four-Family Households in the Study Area on the Components of PITI, Owner-Occupied Residences Only

	Number of Households	Percentage of Households	95% Confidence Interval	
Percentage of household income spent on mortgage				
0%	12,200	28.3%	10,500–14,200	24.2–32.7%
0% < x ≤ 15%	8,200	19.0%	6,800–9,900	15.6–23.0%
15% < x ≤ 30%	13,200	30.5%	11,400–15,200	26.4–35.1%
30% < x ≤ 45%	5,700	13.1%	4,300–7,400	10.0–17.1%
45% < x ≤ 60%	1,500	3.6%	1,000–2,500	2.2–5.7%
60% < x	2,300	5.4%	1,600–3,500	3.7–8.0%
Percentage of household income spent on any insurance				
0% < x ≤ 3%	17,300	39.9%	15,300–19,300	35.3–44.7%
3% < x ≤ 6%	14,900	34.4%	13,000–16,900	30.0–39.1%
6% < x ≤ 10%	5,500	12.8%	4,400–7,000	10.1–16.1%
10% < x	5,600	12.9%	4,400–7,100	10.1–16.3%
Percentage of household income spent on flood insurance				
0%	19,300	44.6%	17,200–21,400	39.9–49.4%
0% < x ≤ 3%	18,600	43.0%	16,600–20,700	38.4–47.8%
3% < x ≤ 6%	3,500	8.2%	2,600–4,800	6.0–11.1%
6% < x ≤ 10%	1,200	2.8%	700–2,000	1.7–4.7%
10% < x	600	1.4%	300–1,300	0.6–3.0%
Percentage of household income spent on property taxes				
0% < x ≤ 3%	7,900	18.3%	6,500–9,700	14.9–22.3%
3% < x ≤ 6%	16,700	38.6%	14,700–18,900	33.9–43.6%
6% < x ≤ 10%	10,100	23.4%	8,400–12,100	19.4–28.0%
10% < x	8,500	19.6%	6,800–10,400	15.8–24.1%
Percentage of household income spent on utilities				
0% ≤ x ≤ 5%	16,000	36.9%	14,000–18,000	32.4–41.6%
5% < x ≤ 10%	13,800	31.9%	12,000–15,800	27.6–36.4%
10% < x ≤ 15%	6,000	13.8%	4,700–7,600	10.8–17.5%
15% < x ≤ 20%	2,900	6.7%	2,100–4,000	4.8–9.3%
20% < x	4,700	10.8%	3,500–6,200	8.0–14.3%

NOTE: These values are based on a sample of 569 owner-occupied residence households. Categories may not add exactly to total because of rounding to nearest 100. Sample weights as described in Appendix A. Counts are households greater than or equal to the lower bound and less than the upper bound.

Figure D.1
Expenditure on Utilities and Insurance by Household AMI



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The amount of coverage and the replacement cost (which according to past FEMA guidance is the insurable value [FEMA, 2007b] are reported in the PMF for those structures with NFIP policies.[1] Mortgage balance is reported by survey respondents.

Properties with building coverage are divided into three groups:

1. those with a mortgage and mortgage balance less than or equal to replacement cost
2. those with a mortgage and mortgage balance greater than replacement cost
3. those without a mortgage.

The amount of coverage is then analyzed separately for each group.

When mortgage balance is less than replacement cost, nearly all property owners purchase an amount of building coverage that is greater than or equal to the mortgage balance or equal to the maximum offered by the NFIP. A high percentage of property owners (87 percent) in this situation also purchase coverage in excess of replacement cost or equal to the maximum offered by the NFIP. When mortgage balance is greater than replacement cost, a high percentage of property owners (87 percent) still purchase insurance in excess of replacement or equal to $250,000. When there is no mortgage, a lower, but still high, percentage (78 percent) purchase coverage in excess of replace-

[1] In October 2014, FEMA decided to no longer issue guidance on the mandatory purchase requirement.

Table D.2
Fraction of Income Spent on PITI and Utilities by One- to Four-Family Households in Study Area, Owner-Occupied Residences Only

	Number of Households	Percentage of Households	95% Confidence Interval	
Percentage of household income spent on PITI				
0% ≤ x ≤ 15%	11,400	26.4%	9,800–13,300	22.6–30.7%
15% < x ≤ 30%	15,400	35.6%	13,500–17,400	31.2–40.3%
30% < x ≤ 45%	7,400	17.1%	6,000–9,100	13.8–21.0%
45% < x ≤ 60%	4,200	9.7%	3,000–5,700	7.0–13.3%
60% < x	4,800	11.2%	3,700–6,300	8.5–14.6%
Percentage of household income spent on PITI and utilities				
0% ≤ x ≤ 15%	5,800	13.3%	4,600–7,200	10.5–16.7%
15% < x ≤ 30%	15,000	34.7%	13,100–17,000	30.3–39.3%
30% < x ≤ 45%	9,600	22.1%	8,000–11,400	18.4–26.4%
45% < x ≤ 60%	4,600	10.7%	3,500–6,100	8.1–14.1%
60% < x	8,300	19.1%	6,700–10,100	15.6–23.3%

NOTE: These values are based on a sample of 569 owner-occupied residence households. Categories may not add exactly to total because of rounding to nearest 100. Sample weights as described in Appendix A. Counts are households greater than or equal to the lower bound and less than the upper bound.

ment cost or equal to $250,000. Overall, a high percentage of property owners purchase coverage in excess of replacement cost or equal to $250,000.

The bottom section of Table D.3 examines the relationship between building coverage and contents coverage. It divides properties with building coverage into two groups:

1. those with $250,000 in building coverage
2. those with less than $250,000 in building coverage.

When building coverage equals $250,000, three-quarters of policyholders have contents coverage and about three-quarters of those have the maximum amount offered by the NFIP—$100,000. When building coverage is less than $250,000 a lower percentage of policyholders have contents coverage (63 percent), and, when they do, the median ratio of contents-to-building coverage is 0.33. Note that this ratio is somewhat

Table D.3
Relationship Between Building Coverage, Structure Replacement Cost, and Mortgage Balance and Relationship of Contents Coverage to Building Coverage

	Percentage	Data Subset Used for Calculation	*N*
Building coverage			
When mortgage balance ≤ replacement cost			
Coverage ≥ mortgage balance or = \$250,000	96%	Completed survey, has building coverage and mortgage, and mortgage balance ≤ replacement cost	97
Coverage ≥ replacement cost or = \$250,000	87%	Completed survey, has building coverage and mortgage, and mortgage balance ≤ replacement cost	97
When mortgage balance > replacement cost			
Coverage ≥ mortgage balance or = \$250,000	86%	Completed survey, has building coverage and mortgage, and mortgage balance > replacement cost	55
Coverage ≥ replacement cost or = \$250,000	87%	Completed survey, has building coverage and mortgage, and mortgage balance > replacement cost	55
When no mortgage			
Coverage ≥ replacement cost or = \$250,000	78%	Completed survey, has building coverage and no mortgage	73
Contents coverage			
For properties with \$250,000 in building coverage			
Has contents coverage	75%	In 2,800 sample, with \$250,000 in building coverage	946
Has \$100,000 in contents coverage if has contents coverage	74%	In 2,800 sample, with \$250,000 in building coverage and contents coverage	713
For properties with < \$250,000 in building coverage			
Has contents coverage	63%	In 2,800 sample, with < \$250,000 in building coverage	262
Median of ratio of contents coverage to building coverage if has contents coverage	33%	In 2,800 sample, with < \$250,000 in building coverage and contents coverage	166

SOURCE: Coverage amounts are taken from the 2016 NFIP policy database. Mortgage balance is taken from the property owner survey and reflects mortgage balance sometime between fall 2015 and summer 2016, depending on the date the survey was completed. Replacement value is taken from the NFIP policy database for policies in force as of December 31, 2014.

lower than, but similar to, the 0.40 ratio for the maximum amount of contents and building coverage offered by the NFIP ($100,000/$250,000).[2]

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[2] Private insurers typically recommend a contents-to-building-coverage ratio of 0.4. This may be what motivated the NFIP to set the maximum contents coverage available to $100,000, which is 40 percent of the maximum available for building coverage.

Flood Insurance Premium Model

This appendix first describes the model that was developed to project flood insurance premiums under a number of assumptions about the FIRM in effect and the availability of pre-FIRM rates and grandfathering. It then describes the steps that were taken to validate the model and the results of that effort. Finally it discusses discrepancies between the structure characteristics indicated on the NFIP policy master file and those reported on the ECs completed for this study. These discrepancies can cause the amount that is actually paid for a flood insurance policy to be less than the amount indicated by the flood insurance premium model.

Flood Insurance Premium Model

The model begins with the rate components that underlie NFIP premiums. These components are the

- building basic rate (applies to coverage up to $60,000)
- building additional rate (applies to coverage from $60,001 to $250,000)
- contents basic rate (applies to coverage up to $25,000)
- contents additional rate (applies to coverage from $25,001 to $100,000).

Each is specified in dollars per $100 of coverage. Torrent Technologies, Inc., provided these rate components for a large number of different combinations of structure and flood risk measures. The components were provided first using the NFIP rate schedule effective October 1, 2012, and second using the rate schedule effective April 1, 2015.

Torrent provided the rate components separately for non-elevation-based rates, elevation-based rates, and PRP rates. Rates were provided for each combination of the parameters listed in Table E.1. As should be apparent, the rates were provided for a large number of different parameter combinations.

A few simplifying assumptions were made to limit the number of rate scenarios that need to be provided:

Table E.1
Parameter Combinations for Which NFIP Rate Components Were Provided

Rate Type and Parameters	Parameter Values for Which Rates Were Provided
Non-elevation-based rates	
NFIP rate table	2012 and 2015
Flood zone	A, V, and X[a]
Structure type	Basement, slab, crawlspace, subgrade crawlspace, enclosure
Occupancy	Single-family and two- to four- family
Residency	Primary residences of owner, nonprimary residence of owner
Elevation-based rates in AE zones	
NFIP rate table	2012 and 2015
Flood zone	AE
Structure type	Basement, slab, crawlspace, enclosure[b]
Number of floors	1, 2, > 2
Elevation difference	+4 to –13 in feet
M&E	At next floor; below BFE and next floor
Elevation-based rates in VE zones	
NFIP rate table	2012 and 2015
Flood zone	VE
Structure type	Elevated with enclosure, elevated without enclosure, all other
Elevation difference	+4 to –13 in feet
PRP	
NFIP rate table	2012 and 2015
Flood zone	X[a]
Structure type	No basement, crawlspace, or enclosure; has basement, crawlspace, or enclosure
Coverage level	Coverage combinations allowed in the NFIP rate manual

[a] B and C zones are considered together with X zones.
[b] Crawlspace includes subgrade crawlspace.

- crawlspaces are assumed to be 4 feet high with an area less than 1,200 square feet
- enclosures are assumed to be 8 feet high, with an area between 300 and 899 square feet
- for structures in V zones, the ratio of building coverage to replacement cost is assumed to equal or exceed 75 percent

- contents are assumed distributed throughout the structure for two- to four-family residences.[1]

The first two assumptions reflect the average values observed in the study sample with ECs. They affect the premium projections for elevation-rated structures in AE zones. The third assumption affects the premium projections for elevation-rated structures in post-1981 VE zones.

The elevation difference is the difference between the elevation of the structure's lowest floor and the BFE. BFE for the 2007 FIRM is measured using the National Geodetic Vertical Datum of 1929 (NGVD29) reference system while the BFE for the PFIRM and the elevations captured during the elevation surveys for this study were done using North American Vertical Datum of 1988 (NAVD88). The following equation converts between the two:

$$\text{elevation in NAVD88} = \text{elevation in NGVD29} - 1.08 \text{ feet.}$$

Total premium is the sum of the following components:

$$\begin{aligned}\text{total premium} = {} & \text{base premium} + \text{ICC premium} + \\ & \text{deductible adjustment} + \text{reserve fund assessment} + \text{policy fee} + \\ & \text{HFIAA charge}\end{aligned}$$

where

$$\begin{aligned}\text{base premium} = {} & (\text{bldgbasic} \times \min(\text{bldg\_cov}, 60000) + \\ & \text{bldgadd} \times \max(0, \min(\text{bldg\_cov-60000}, 190000)) + \\ & \text{contbasic} \times \min(\text{cont\_cov}, 25000) + \\ & \text{contadd} \times \max(0, \min(\text{cont\_cov-25000}, 75000))/100\end{aligned}$$ [2]

ICC premium varies from \$4 to \$74 depending on the situation.

deductible adjustment = a × base premium where a depends on the deductible chosen. Values for a are taken from the NFIP rate manual

$$\begin{aligned}\text{reserve fund assessment} = {} & 0.10 \times \text{base premium for PRPs and} \\ & 0.15 \times (\text{base premium} + \text{ICC premium}) \text{ for other policies}\end{aligned}$$

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1 The NFIP rating schedules always assume that contents are distributed throughout single-family residences.

2 The base premium for PRPs is specified in the NFIP manual for the combination of building and contents coverage available for that policy. The PRP premium for 2012 includes the ICC premium and the policy fee. For 2015, the PRP premium includes the ICC premium, the policy fee, and the reserve fund assessment.

policy fee = \$20 in 2012 and \$22 in 2015 for PRP policies; \$40 in 2012 and \$45 in 2015 for other policies

HFIAA charge = \$0 in 2012; \$25 in 2015 for primary residences; \$250 in 2015 for nonprimary residences.

This premium information is used to develop the following premiums for each structure in the sample with an EC. The amounts of building and contents coverage assumed for each structure are described in Chapter Three.

Elevations are not available outside the high-risk areas of the 2007 FIRM, so PR2 and PR5 are set to \$99,999 outside the high-risk zones. These rates are then overwritten as one-steps through the pricing algorithm that follows. PR3 and PR5 are the same outside the high-risk zones of the 2007 FIRM because the same rate (the standard X-zone rate) applies to pre-FIRM and post-FIRM structures outside the high-risk zones of the 2007 FIRM.

The different premiums for each structure described in Table E.2 are then used to develop the different premium scenarios presented in Table 3.1 in Chapter Three. In each scenario, each structure is given the lowest premium for which it qualifies. For example, the following steps are used to calculate the premium in scenario A (2012 rate schedule, 2007 FIRM, and availability of pre-FIRM rates):

Step 1: Assign PR2 to each structure.
Step 2: Assign PR7 to the structure if the structure is outside the high-risk zones of the 2007 FIRM and PR7 is less than the rate after Step 1.

Table E.2
Premiums Developed for Each Structure in the Study Sample with an EC

Premium	FIRM	Rate Schedule	Rate Type
PR1	Current	2012	Non-elevation-based
PR2	Current	2012	Elevation-based
PR3	Current	2015	Non-elevation-based
PR4	PFIRM	2015	Non-elevation-based
PR5	Current	2015	Elevation-based
PR6	PFIRM	2015	Elevation-based
PR7	Current and PFIRM	2012	PRP
PR8	Current and PFIRM	2015	PRP

NOTE: PR = premium.

Step 3: Assign PR1 to the structure if the structure is a pre-FIRM structure and PR1 is lower than the rate after Step 2 (allows for pre-FIRM rate).

Step 4: Assign PR1 to the structure if (1) the structure is a post-FIRM structure and (2) the structure is outside high-risk zones of 2007 FIRM, and (3) PR1 is lower than the rate after Step 3 (allows standard X-zone rate for post-FIRM structures outside high-risk zones of 2007 FIRM).

The following steps are used to calculate the premium in scenario D (2015 rate schedule, PFIRM, with grandfathering, and with pre-FIRM rates):

Step 1: Assign PR6 to each structure.

Step 2: Assign PR4 to the structure if the structure is a pre-FIRM structure and PR4 is lower than the rate after Step 2 (allows for pre-FIRM rate).

Step 3: Assign PR5 to the structure if PR5 is lower than the rate after Step 1 (allows for grandfathering).

Step 4: Assign PR3 to the structure if structure is a pre-FIRM structure and PR3 is lower than the rate after Step 3 (allows for pre-FIRM rates for grandfathered structures in high-risk zones of 2007 FIRM and sets rates for newly mapped pre-FIRM prop erties to standard X-zone rate).[3]

Step 5: Assign PR3 to the structure if the structure is post-FIRM and outside high-risk zones of 2007 FIRM and PR3 is lower than the rate after Step 4 (sets rates for newly mapped post-FIRM properties to standard X-zone rate).

Validation of Flood Insurance Premium Model

To test the accuracy of the premium model, model predictions were compared with the partial premiums reported in the 2012 NFIP PMF for New York City (the partial premium does not include the federal policy fee). To do this, we first limited our attention to structures in the study sample that had an EC and an NFIP policy in 2012. We then ran the premium model for scenario A, setting the coverage amounts, deductibles, building characteristics, and flood zones to the values reported in the PMF. We removed the policy fee from the model predictions because the partial premium

[3] Elevations are not available outside the high-risk zones of the 2007 FIRM, so PR2 and PR5 are set to $99,999 outside the high-risk zones. These rates are then overwritten as one-steps through this algorithm.

Table E.3
Comparison of Model Predictions with Premiums in the 2012 Policy Master File (Premiums in Dollars)

	Rating Method				
	PRP	Non-Elevation-Rated	Elevation-Rated	All	Policies Written on or After October 1, 2012
Mean premium predicted with pricing model	370	1,790	840	1,200	1,180
Mean premium in 2012 PMF	360	1,670	830	1,130	1,160
Difference between predicted premium and premium in 2012 PMF					
Mean	7	120	10	70	20
Median	11	80	0	12	0
Min	0	0	–560	–560	1
Max	12	360	870	870	870
Number of observations (*N*)	42	78	32	152	47

NOTE: For properties in sample with EC and NFIP policy.

reported in the 2012 PMF does not include the policy fee. The reserve fund assessment and HFIAA surcharge are not of concern because they did not exist in 2012.

Table E.3 compares the predictions from the premium model with the partial premium in the PMF. For the 152 properties for which comparisons could be made, the predicted premium was on average $70 (6 percent) higher than the premium in the 2012 PMF, and the median difference was $12 (see boxed cells). The model predicted well on average for all three different rating methods: PRP, non-elevation-rated, and elevation-rated.

There was more variation in the difference between the projected premium and the PMF premium for the elevation-rated properties (the differences ranged from –$560 to $870). This is likely because of two main factors. First, as discussed above, we assumed set values for crawlspace size and height and enclosure size and height. The values were based on the average observed for the structures in the sample, but may not be correct for all structures. Second, the premium model requires the location of the M&E for certain types of structures, but this information is not on the PMF. We thus used the location of the M&E as reported on the ECs completed during study—and this location may diverge from what was used to price the policy in 2012.

The 2012 PMF includes policies that were written between January 1, 2012, and December 31, 2012. Thus, many policies were written before the October 2012 rate schedule used in the premium model went into effect. Rates generally increase over time, and one would expect the model to overpredict premiums for policies that used the rate schedules in effect prior to October 2012. The difference between the model prediction and the 2012 PMF for those policies issued after October 1, 2012, is reported in the last column of Table E.3. The sample size is modest, but as can be seen, the mean of the difference is substantially below the whole sample and the median difference has dropped to zero.

Factors That Tend to Depress the Partial Premiums in the 2016 Policies in Force File Relative to the Projections from the Premium Model

Recall from Table 2.8 in Chapter Two that average premium in the 2016 PMF for properties in high-risk zones is less than one-half of the average predicted premium in scenario B (2015 rate table with 2007 FIRM and pre-FIRM rates). There are numerous factors behind this difference. First, the premium model assumes higher coverage limits, particularly for contents coverage, than is the case in the 2016 PMF. Second, as discussed above, the premium in the 2016 PMF does not include the policy fee, the reserve fund assessment, and the HFIAA charge.[4] The gap may also be because of disagreement on structure characteristics and flood risk. We review these disagreements in Tables E.4 through E.7 and look for any evidence of systematic disagreements that would tend to bias the premiums reported in the 2016 PMF downward from what they should be.

Table E.4 compares the flood zone determined during the elevation survey completed for this study with that reported on the PMF. Adding down the diagonal indi-

Table E.4
Comparison of Flood Zone

Flood Zone According to 2016 Policy Master File	Flood Zone According to EC Completed for Study			
	A or AE	V or VE	B, C, and X	Total
A or AE	154	0	3	157
V or VE	0	1	0	1
B, C, X	18	1	114	133
Total	172	2	117	291

SOURCE: Based on 291 properties in a selected sample with a completed EC and building coverage in 2016.

4 It could also be the case that property owners for higher-risk properties are less likely to buy flood insurance than property owners for lower-risk properties (because the premium is higher). We find that the median for premium scenario B is somewhat higher for properties in the high-risk zones without NFIP coverage in 2016 versus those with coverage ($2,986 versus $2,914, respectively). Because of some very large projected premiums for properties without flood coverage, the mean premium is approximately 33 percent higher ($3,988 for those without coverage versus $3,017 for those with coverage).

Table E.5
Comparison of Elevation Difference

Difference Between Elevation Difference Reported in 2016 Policy Master File and Elevation Difference According to the Study ECs (Feet)	Number of Properties	Percentage of Total
≤ –2	4	7%
–1	3	5%
0	23	41%
1	7	12%
2	5	9%
3	2	4%
4	5	9%
5	2	4%
6	2	4%
≥ 7	3	5%
Total	56	100%

NOTE: Based on 291 properties in the study area with a completed EC and building coverage in 2016. Elevation difference was provided on the policy master file for 56 of the 291 properties.

cates that the flood zones agree 92 percent of the time ([154+1+114]/291), although there is a slight tendency for the PMF to understate flood risk: There are 18 properties classified as in A or AE zones on the EC but as B, C, or X zones on the PMF versus only three that are classified as B, C, or X on the EC but as A or AE in the PMF. These discrepancies could in part be because the properties were grandfathered using prior versions of the FIRM. Any potential downward bias in the PMF because of this factor, however, appears to be minimal.

There is more evidence that the structure elevations are systematically lower in the PMF than in the study ECs. Table E.4 reports the difference between (1) the elevation difference reported in the PMF and (2) the elevation difference derived from the study EC. A positive number indicates the structure is higher relative to the BFE in the 2016 PMF than is indicated by the study EC. As can been seen in Table E.5, the elevation differences from the two sources are within 1 foot 58 percent of the time. However, it is much more likely that the structure will be higher relative to the BFE in the PMF: 47 percent of structures are higher relative to the BFE according to the PMF versus 12 percent that are lower (compare two sets of boxed cells). This pattern will tend to push the premium in the PMF down relative to the projections from the premium model.

Table E.6 compares the structure types from the two sources. The structure types agree 72 percent of the time. A high percentage of subgrade crawlspace is misclassi-

Table E.6
Comparison of Structure Type

Structure Type According to 2016 Policy Master File	Building Type According to EC Completed for Study					
	Basement	Slab	Crawlspace	Subgrade Crawlspace	Enclosure	Total
Basement	158	9	0	0	2	169
Slab	22	42	1	14	3	82
Crawlspace	3	1	6	2	1	13
Subgrade crawlspace	4	2	1	5	0	12
Enclosure	5	9	1	0	0	15
Total	192	63	9	21	6	291

NOTE: Based 291 properties in study area with a completed EC and building coverage in 2016.

Table E.7
Comparison of Pre-FIRM Status

Pre-FIRM Status According to 2016 Policy Master File	Pre-FIRM Status According to New York City PLUTO Database		
	Pre-FIRM	Post-FIRM	Total
Pre-FIRM	215	11	226
Post-FIRM	17	48	65
Total	232	59	291

NOTE: Based on 291 properties in the study area with a completed EC and building coverage in 2016.

fied as slabs in the PMF and many basements are misclassified as slabs. More work is needed to understand how these misclassifications affect the premiums reported in the PMF.

Finally, Table E.7 compares the pre-FIRM status. Structures are considered pre-FIRM if constructed prior to November 1983. Pre-FIRM status agrees 90 percent of the time, but it is somewhat more common for structure to be declared pre-FIRM in the PMF when it is post-FIRM on New York City's PLUTO property database than the reverse. Nineteen percent of post-FIRM properties are identified as pre-FIRM in the PMF (11 of 59) versus 7 percent of pre-FIRM properties that are identified as post-FIRM on the PMF (17 of 232). Because non-elevation-based rates in the high-risk zones (for which pre-FIRM structures qualify) can be lower than elevation-based rates (for which both pre- and post-FIRM structures qualify), this can also bias the premiums in the 2016 PMF downward.

In summary, there are a number of reasons why one would expect the partial premiums in the PMF to be lower than the projections from the premium model.

Eligibility Requirements for Pre-FIRM and Grandfathered Rates

Table F.1 summarizes the eligibility requirements for pre-FIRM rates and NFIP guidelines for how the rates will change over time. Table F.2 reviews the most common rating options available for properties affected by flood map changes.

Table F.1
Requirements to Remain Eligible for Pre-FIRM Rates

Rating Option and Scenario	Requirements	Rate Increase	Impact of Lapse
Pre-FIRM ("Subsidized") Rate Pre-FIRM building in a high-risk area (zones A or V)	Current owner must ensure continuous coverage to maintain pre-FIRM rating status for the building.	Nonprimary residences, nonresidential businesses, substantially damaged buildings, and those buildings with severe repetitive loss or cumulative loss history will receive an annual 25% rate increase until they reach full-risk (elevation-rated) rates. An insurance agent must make that determination.	If coverage is required by a lender and it lapses more than 90 days or twice more than 30 days, it will be written using new maps and post-FIRM rates.
	If current owner sells the property, the policy can be assigned to the new owner. Even if that does not happen, the new owner can still use pre-FIRM rates to rate the policy.	All other buildings will have annual rate increases of no less than 5% and no more than 15% per class and 18% per property.	If there is no lender requirement, the lapse rule does not apply.

SOURCE: FEMA, 2016a, Section 5 (Rating).

Table F.2
Rating Options Available When the Flood Insurance Rate Map Changes

Rating Option and Scenario	Requirements	Rate Increase	Impact of Lapse
Newly mapped procedure On a revised FIRM, property is newly identified as being at high risk (i.e., its flood zone changes from zones X to AE or VE)	Policy must be *effective* within 12 months of new map's effective date.[a] Policy will be rated using PRP rates the first year (with slightly higher fees). The building must meet loss-history requirements[b] when it is written and at renewal each year. (If it does not meet them, see grand-fathering as an option.) If the property is sold, the current owner must assign the policy over to the new owner so it can continue being rated using the newly mapped procedure. Otherwise, this rating option will be lost.	Rates will go up no more than 15% per class and 18% per property a year until rate reaches standard zone X rate or rates using the updated map, whichever is less. An insurance agent will need to make that determination of when one rate becomes cheaper to use than the other.	If coverage is required by a lender and it lapses more than 90 days or twice more than 30 days, it must be written using new maps for rating.
Grandfathering Property remains in a high-risk zone on revised FIRM, but BFE increases or flood zone changes from zones A to V. This option also available to a property that does not qualify for the newly mapped procedure.	Two rating options: (1) **Continuous coverage:** available to pre-FIRM and post-FIRM pro-perties; coverage must be purchased before the maps change (this is also the only option for pre-FIRM properties not qualifying for the newly mapped procedure) (2) **Built-in compliance coverage:** this is *only* available for properties built on or after the first FIRM became effective. Evidence must be provided to show it was built in compliance with the flood map at the time of construction (e.g., BFE, flood zone). When selling the property, the policy may be assigned to the new owner to help ensure continuous coverage.	Rates will go up no more than 15% per class and 18% per property a year.	If a grandfathered pre-FIRM policy lapses more than 90 days or twice more than 30 days, it must be written using the new maps for rating. If a post-FIRM policy lapses, it will need to show again that it was built in compliance.

Table F.2—Continued

Rating Option and Scenario	Requirements	Rate Increase	Impact of Lapse
Conversion On a revised FIRM, property is no longer determined to be in a high-risk flood zone (e.g., its flood zone changes from zones A or V to X).	Policy for zone A or V can be canceled and rewritten to a PRP going back to the inception date of the current term (the term the map change took place in). If the building does not qualify for a PRP (based on loss-history requirements[b]), the policy can be endorsed to the zone X rates effective on the map change date. (Note: if the current high-risk policy is cheaper than a zone X policy, the policy can be rated using the high-risk rating.)	Rates will go up no more than 15% per class and 18% per property a year.	None

SOURCE: FEMA, 2016a, Section 5 (Rating), Section 9 (Preferred Risk Policy), and Section 10 (Newly Mapped).

[a] Buying and having a PRP effective before the maps change not only provides financial protection earlier (knowing it is already high risk), but also additional savings. If effective before the maps change, the policy will then renew using the newly mapped procedure later in the 12-month window; this means it starts its path to full-risk rate that much later the next year (and onward).

[b] If any of the following conditions fall within any ten-year period, regardless of any change(s) in ownership of the building, then the building is not eligible for the PRP rates:

- two flood insurance claim payments for separate losses, each more than $1,000
- three or more flood insurance claim payments for separate losses, regardless of amount
- two federal flood disaster relief payments (including loans and grants) for separate occurrences, each more than $1,000
- three federal flood disaster relief payments (including loans and grants) for separate occurrences, regardless of amount
- one flood insurance claim payment and one federal flood disaster relief payment (including loans and grants), each for separate losses and each more than $1,000.

APPENDIX G

Economic Effects Model

This appendix has two sections. The first describes how the elements of PITI are calculated. The second describes how property values the other economic impacts described in Chapter Five are calculated.

Principle, Interest, Taxes, and Insurance (PITI)

PITI is the sum of a household's mortgage (both principal and interest), property taxes, and insurance (both flood insurance and other home insurance).

To calculate mortgage payments, we ask households for their monthly mortgage expenditure on their mortgage and, if applicable, their second mortgage. We ask households the amount they spend on monthly mortgage payment(s) and the balance remaining on each mortgage. We go through several steps to ensure data quality. First, we check to make sure the reported monthly payments, if repeated for 30 years, would pay off the reported mortgage balance. For the small number of households that do not pass this test, as well as one household reporting monthly payments of over $20,000, we replace the reported monthly mortgage payments with the monthly mortgage payment associated with taking a loan worth 80 percent of the 2016 assessed property value at a 5-percent interest rate. For the two remaining primary residences that have mortgages but are still missing mortgage payments, we impute mortgage payments based on a linear regression of the square footage of the home and the number of floors on the monthly mortgage payments.

In addition to asking households the amount spent on monthly mortgage payment(s), we also ask whether property taxes and insurance are included in their mortgage payments. The question about the amount of monthly mortgage payments that go toward property taxes was added to the survey after fielding had begun, so not all households were asked this question. However, all respondents were asked whether insurance costs were included in their mortgage. We found that almost all households that reported that some or all of their insurance costs were included in their mortgage also reported that property tax was included in their mortgage. The majority of households that reported that insurance was not included in their mortgage also reported that property taxes were not included in their mortgage. Thus, for households not asked whether property taxes were included in their mortgage, we assume property taxes were included in the mortgage if the households reported that some or all of their insurance costs were included in their mortgage. We assume that property taxes were not included in the mortgage if the households reported that insurance was not included in their mortgage.

The New York City Department of Finance provided information on the assessed value of the home, as well as the taxable value of the home after incorporating various tax exemptions. The specific property tax rate depends on the tax class. Most homes in our sample fall into Class 1, and as such faced a 2016 property tax rate of 19.554 percent.[1] The only exception is that we assume all cooperatives are Sub-Class 2c (two- to ten-unit cooperative or condominium), and these units are taxed at 12.883 percent.

PITI includes the annual payments on mortgage, property tax, and insurance. Hence, the final element is any expenditure on insurance not already included in the mortgage. We ask households for the amount spent on insurance in addition to any costs included in monthly mortgage payments. We ask about flood insurance prices explicitly, although we replace the reported flood insurance prices with flood insurance prices from the 2016 NFIP PMF. For households reporting that all insurance payments were included in their mortgage, this value is $0. If other households did not report a value for expenditure on insurance not included in their mortgage, or if they reported a value more than $20,000 per year or less than $200 per year, we impute additional insurance expenditures.[2]

Utilities

In addition to the costs associated with PITI, we collect information on utility expenditure as another component of housing cost. We ask homeowners to report their prior month's electric and gas bills, and use data from the U.S. Energy Information Administration to convert monthly costs to annual costs, accounting for month-to-month variance in demand for these utilities.[3] We also ask homeowners to report their annual water and sewage costs, as well as their annual cost of other fuel sources. To ensure data quality, we impute values for all missing and unrealistic utility expenditures.[4] For

1 Veterans face lower property taxes in New York City. We do not observe the household owner's veteran status, so we apply the standard rates to all households.

2 Specifically, we impute monthly mortgage payments based on a linear regression of the square footage of the home, the square footage of the lot, the year the home was built or recently renovated, the number of household residents, whether the owner is white, and whether the household reported some insurance costs were included in the mortgage on the monthly mortgage payment. These variables were selected based on their ability to fit the data and consistency with the imputation methods used in calculating utility costs.

3 Specifically, we use data from U.S. Energy Information Administration, 2017a and 2017b.

4 Specifically, we impute costs when electric and gas costs reported by survey respondents are more than $1,000 per year and for water and sewage and fuel when reported costs are less than $0.

electric, gas, and other fuel, we use a linear regression to impute prices.[5] For water and sewage, because these costs are relatively constant for one- to four-family properties across the city, we use the median price by housing type.[6] Total annual spending on utilities is calculated as the sum of spending on these specific utilities.

Present Value

Table 5.2 in Chapter Five estimates the change in property value associated with increased flood insurance costs. These changes are calculated by converting the annual increase in the price of flood insurance to present value (PV). We assume an interest rate of 4 percent because this is comparable with the current mortgage interest rate. We also assume that any increase in flood insurance prices over time, such as because of climate change, occurs at the same rate in both scenario B and scenario G. Recall that Chapter Five assumed insurance is purchased for 30 years. Under these assumptions, the equation for PV when moving from scenario B to scenario G is

$$PV = \sum_{t=0}^{29} \frac{scenario\ G\ annual\ price - scenario\ B\ annual\ price}{(1.04)^t} .$$

where t is time from the present in years.

An alternative assumption might be that all households purchase insurance indefinitely. This seems unlikely based on current take-up rates, but would be socially desirable because it reduces the risk of households facing sudden unexpected loses. However, such a change in practice would also mean an increase in insurance prices causes a larger reduction in property value. This is because moving from scenario B to scenario G would decrease the PV of a home in a high-risk flood zone by the same amount that the present value of an unending stream of flood insurance payments increases, which is expressed by the following equation:

$$PV = \frac{scenario\ G\ annual\ price - scenario\ B\ annual\ price}{(1 - \frac{1}{1.04})} .$$

[5] Specifically, we impute these utilities based on a linear regression of the square footage of the home, the square footage of the lot, the year the home was built or recently renovated, the number of household residents, and whether the owner is white on the monthly mortgage payment. These variables were selected based on their ability to fit the data.

[6] Housing type includes duplex, triplex, fourplex, and two types of stand-alone family house.

Table G.1 presents the change in home values under this alternative assumption. This alternative assumption also implies less property tax revenue and higher default rates.

Property Tax Revenue

Table 5.3 in Chapter Five presents the impact of the increase in flood insurance on property tax revenue. First, the PV calculated for Table 5.2 is subtracted from the current property value to estimate the new value of the property. We then assume that any exemptions that reduced the taxable value of the property would scale linearly with the value of the home; in other words, we assume exemptions reduce the taxable value of the home by a fixed percentage rather than a fixed amount. We also assume property taxes remain fixed at 2016 tax rates. This puts the focus on changes in revenue caused by declining home values, all else equal. Property tax revenue in scenario G is calculated by multiplying the 2016 tax rates by the estimated taxable property values for that scenario. For 2016 property tax revenue, we multiply the 2016 taxes rates by the taxable value of the property reported by the New York City Department of Finance.

Probability of Default

According to Experian, as of January 2016, the annual rate at which mortgage holders in New York City defaulted was 1.04 percent. We use the mean level of results presented by Wong, Fong, and Sze (2004) to describe how default probability increases as the current loan-to-value ratio increases. Gyourko and Tracy (2014) find similar results using more recent FHA insured mortgage data, but we use values from Wong, Fong, and Sze (2004) because they cover a broader range of current loan-to-value (CLTV) ratios, up to 2.5. Table G.2 presents the values we use to calculate the increased number of defaults.

Table G.1
Decline in Property Value Because of Change in Flood Insurance Premium from Scenario B to Scenario G, Flood Insurance Purchased Indefinitely (2016 Dollars)

	Properties in the High-Risk Zones of the Effective FIRM	Properties in the High-Risk Zones of the PFIRM but Outside the High-Risk Zones of the Effective FIRM
All areas		
5th percentile	$0	$11,000
25th percentile	$29,000	$62,000
50th percentile	$57,000	$97,000
75th percentile	$127,000	$109,000
95th percentile	$790,000	$147,000
Mean	$182,000	$92,000
Number of properties for which present value of premium increase exceeds the current property value	267	$0
Median change by region		
Canarsie	–	$98,000
Southern Brooklyn Waterfront	$35,000	$97,000
Jamaica Bay	$57,000	$97,000
Rockaway Peninsula	$115,000	$97,000
East Shore, Staten Island	$57,000	$98,000
All other areas	$34,000	$80,000

NOTES: Sample limited to one- to four-family owner-occupied properties in the PFIRM with complete ECs. There are no homes in Canarsie in our sample with an EC that are inside the high-risk zones of the effective FIRM. Maximum decline in value is bounded at 2016 home value. Dollar values are rounded to nearest $1,000. Ninety-five-percent confidence intervals for the estimates of the mean change, from left to right, are $138,000–$225,000, $93,000–$152,000, $82,000–$102,000, and $55,000–$68,000. Ninety-five-percent confidence intervals for the number of homes reduced to a value of $0 are –196 to 730 and –33 to 101. No properties outside of the high-risk areas of the effective FIRM have their value reduced to $0. Percentiles do not have confidence intervals.

Table G.2
Increased Probability of Default, by CLTV Ratio

CLTV Ratio	Increased Probability of Default
≤ 0.50	0.0009
0.50–0.75	0.0015
0.75–1.00	0.0026
1.00–1.25	0.0043
1.25–1.50	0.0073
1.50–1.75	0.0122
1.75–2.00	0.0203
2.00–2.25	0.0338
2.25–2.50	0.0557

NOTES: 0.01 = 1% additional probability of default. For households with CLTV greater than 2.5, we estimate the default probability as the maximum of (CLTV/100) × 4 and ($-0.0415214 \times CLTV + 0.0252857 \times CLTV^2$). The latter equation is a quadratic extrapolation of the results from Wong, Fong, and Sze (2004) and the former equation is to ensure the probability of default increases monotonically as CLTV increases.

APPENDIX H

Survey Instrument

The instrument used for the property-owner survey follows. Not all questions were asked of all property owners. For example, questions on income and housing costs were only asked when the property was the primary residence of the owner. An asterisk at the end of a question indicates that the question was mandatory.

Figure H.1
Survey Instrument

Informed Consent

The New York City Mayor's Office of Recovery and Resiliency has initiated a study of policy options that could help to lower flood insurance costs for many households in the City's high-risk flood zones. To do that, we need to better understand flood risks to properties such as yours and better estimate your ability to afford flood insurance. The following survey asks questions about household income and household expenses such as mortgage or rent payments, utilities, and insurance in order to assess affordability of flood insurance. The City has contracted with the RAND Corporation, a non-profit research institution, to lead the study.

Your participation in this study is voluntary. RAND will keep your name and property address completely confidential and will not give any information that could identify you or your property to the City or any other public or private entity. This means that the information you provide about your property or household will remain confidential and will not be used by the City for compliance or tax assessment purposes. Only anonymous information will be provided to the City for the analysis of flood insurance issues. Your survey responses will be briefly stored on a secure server and then removed as soon as possible.

Those who agree to participate in the study are asked to do just two things:

- complete the following survey, which should take 10-15 minutes, and
- schedule a time for our partner, Gayron de Bruin, a New York based professional, licensed land surveyor to come take measurements of your home. The site visit should take approximately one hour.

If you participate in the study you will receive two things:

- a $50 gift card that will be presented by the land surveyor upon completion of the site visit and
- an Elevation Certificate (EC) that will help your insurance agent determine the best flood insurance rate for you. With federal changes to the flood insurance program underway, an EC is becoming even more important. On average, an EC can cost between $500 and $1,000 to have prepared – yours will be free of charge. The EC will only be provided to you and will not be provided to the City.

The study is limited to property owners of one-to-four family homes who were invited to participate through an invitation letter received in the mail. Because of the information needed for the study, answers to some questions are required to participate in the study.

- If you have questions for RAND about the survey or the site visit, please contact Noreen Clancy by email at clancy@rand.org or by phone at (703) 413-1100 x5272.
- If you have questions about your participation in the survey and your rights, please contact RAND's Human Subjects Protection Committee administrator for this study Jim Tebow at tebow@rand.org or (310) 393-0411 x7173.

Do you agree to proceed with the survey?*

○ Yes

RAND *RR1776-H.1-1*

Figure H.1—Continued

2016 Survey for the Flood Insurance Affordability Study Page 2 of 10

○ No

Please enter your first name:*

Please enter your last name:*

Please enter a daytime phone number where we can reach you to schedule a time when the land surveyor can visit the property:*
xxx-xxx-xxxx

Please enter an email address, if available, where we may contact you to schedule a time when the land surveyor can visit the property:*
If no email address is available, please enter "Not available".

Please enter the address of the property selected for the study. The property selected for the study is on the back of the invitation letter and may not be the address to which the invitation letter was sent.

Address - Line 1:*

Address - Line 2:

City/Town:*

Zip code:*

In the questions that follow, "this property" refers to the property selected for the study, which is the address listed on the back side of the invitation letter.

Please check which of the following applies:*
Select one option.

○ This property is owned by me or someone in my family
○ This is an investment property that is owned by a business interest with which I am affiliated
○ This property is not owned by me, someone in my family, or a business interest with which I am affiliated

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RAND *RR1776-H.1-2*

Figure H.1—Continued

Which of the following best describes this property? *
Please select one option.

- ○ A single-family house detached from any other house
- ○ A single-family house attached to one or more houses (for example, a row house, brownstone, townhouse)
- ○ A property with two housing units (duplex)
- ○ A property with three housing units (triplex)
- ○ A property with four housing units
- ○ A property with five or more housing units
- ○ Other

Do you or your spouse or partner live at this address for **at least half of the year**? *

- ○ Yes
- ○ No

Which of the following apply? *

- ○ My spouse/partner or I live in this property sometimes, but typically for less than 6 months in a year
- ○ Neither my spouse/partner nor I live in this property.

Is there a mortgage or a loan on this property? *
Include home equity loans.

- ○ Yes
- ○ No

Please check which of the following apply: *

- ☐ I rent out some or all of the separate housing units on this property. (For example, you rent out one or both units of a duplex.)
- ☐ I rent out one or more of the rooms in the housing unit I occupy on this property. (For example, you live in the single-family home on this property and rent out one of the rooms in the house.)
- ☐ There are no renters on this property.

In what year was this property constructed?
If you don't know, please give us your best estimate.

[ ]

Has a substantial improvement been done to the primary structure on this property since 1980?
(A substantial improvement is one that cost 50% or more of the pre-improvement structure value.)

- ○ Yes
- ○ No
- ○ Don't know

RAND *RR1776-H.1-3*

Figure H.1—Continued

2016 Survey for the Flood Insurance Affordability Study — Page 4 of 10

How many people are living in the house or housing unit that you occupy on this property? *
Do not include people in other units that you rent on this property.

-- Please Select --

What is the age of the person who is financially responsible for the mortgage and other housing costs? *
If more than one person is financially responsible, report the age of the oldest person.

- ○ 24 or younger
- ○ 25-44
- ○ 45-64
- ○ 65 or older

Are you of Hispanic, Latino, or Spanish origin?

- ○ Yes
- ○ No
- ○ Prefer not to answer

Please indicate the racial or ethnic group(s) that best describe you.
Select all that apply.

- ☐ American Indian or Alaska Native
- ☐ Asian Indian
- ☐ Black or African-American
- ☐ Chinese
- ☐ Filipino
- ☐ Haitian
- ☐ Japanese
- ☐ Korean
- ☐ Russian
- ☐ White
- ☐ Prefer not to answer
- ☐ Other, please specify

Last month, what was the cost of electricity for this house or the unit in the building in which you live? *
Give your best estimate in dollars, if you are not sure.

- ○ No charge or electricity not used.
- ○ Amount in dollars

Last month, what was the cost of natural gas for this house or the unit in the building in which you live? *
Give your best estimate in dollars, if you are not sure.

- ○ No charge or natural gas not used
- ○ Amount in dollars

In the past 12 months, what was the cost of water and sewer for this house or property? *
Give your best estimate in dollars, if you are not sure.

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RAND *RR1776-H.1-4*

Figure H.1—Continued

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○ No charge or water/sewer not used
○ Amount in dollars

In the past 12 months, what was the cost of oil, coal, kerosene, wood, propane, etc., for this house or the unit in the building in which you live? *
Give your best estimate in dollars, if you are not sure.

○ No charge or these heating fuels not used
○ Amount in dollars

How much is the regular **monthly** mortgage payment on this property? *
Include payment only on FIRST mortgage or contract to purchase. Give your best estimate if you are not sure.

○ No regular payment required
○ Amount in dollars

Does this monthly mortgage payment include payments for property tax? *

○ Yes
○ No
○ Don't know

Do you or any member of this household have a **second mortgage or a home equity loan** on this property? *

○ Yes
○ No

How much is the regular **monthly** payment on all second mortgages and home equity loans on this property and any other loans that are secured by this property? *

○ No regular payment required
○ Monthly amount in dollars

Approximately how much money do you/your family owe on this property **in total**? Include all mortgages and all home equity loans on this property, or any other loans that are secured by this property. *
Amount in dollars

Are payments for insurance on this property **included** in the regular monthly mortgage payment that you reported previously? *
Note: Consider **all** insurance payments on this property, including homeowners insurance, as well as insurance for hazards such as wind and flood that may be purchased separately from homeowners insurance.

○ All insurance payments on this property are included in the amount I reported for the

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RAND *RR1776-H.1-5*

Figure H.1—Continued

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monthly mortgage payment.

- ○ No insurance payments on this property are included in the amount I reported for the mortgage payment
- ○ Some insurance payments on this property are included in the amount I reported for the monthly mortgage payment and others are not

Approximately how much of the **monthly** mortgage payment is for insurance on this property? (Consider both homeowners insurance and insurance for hazards such as wind and flood.)*
Give your best estimate if you are not sure.

- ○ Don't know
- ○ Amount in dollars (approximate)

Approximately what is the **annual** payment for insurance on this property? (Consider both homeowners insurance and insurance for hazards such as wind and flood.)*
Give your best estimate if you are not sure.

- ○ Don't know
- ○ Amount in dollars (approximate)

Approximately how much of the **monthly** mortgage payment is for insurance on this property? (Consider both homeowners insurance and insurance for hazards such as wind and flood.)*

- ○ Don't know
- ○ Amount in dollars (approximate)

Approximately what is the **annual** payment for insurance on this property that is paid separately from the mortgage? (Consider both homeowners insurance and insurance for hazards such as wind and flood.)*
Give your best estimate if you are not sure.

- ○ Don't know
- ○ Amount in dollars (approximate)

Does the insurance you have on this property cover losses due to flood?*
Note: the cost of any such coverage should have been included in the total payments for insurance that you previously reported.

- ○ Yes
- ○ No
- ○ Don't know

Did you buy a **separate** insurance policy for losses due to flood?*

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RAND *RR1776-H.1-6*

Figure H.1—Continued

○ Yes
○ No

Approximately what was the **annual** flood insurance premium?*
Note: the cost of any such coverage should have been included in the total payments for insurance that you reported previously. Please report only the part of the total that is due to flood insurance here. Give your best estimate if you are not sure.

○ Don't know
○ Amount in dollars (approximate)

Which of the categories below best describes your **family household income** over the past 12 months **before taxes**? *
Include income (in dollars) from ALL SOURCES, including wages, salaries, self-employment, interest, rental properties, etc. Include income for ALL members of your household who live with you.

○ $19,999 or less
○ $20,000 to $29,999
○ $30,000 to $39,999
○ $40,000 to $49,999
○ $50,000 to $59,999
○ $60,000 to $79,999
○ $80,000 to $99,999
○ $100,000 to $119,999
○ $120,000 to $149,999
○ $150,000 or more

Is your **family household income** above or below ?*

○ Above
○ Below
○ Don't know
○ Prefer not to say

What is the **monthly** rent for this house or the units rented on this property?*
(If more than one unit is rented, report the AVERAGE MONTHLY rent PER UNIT across all units.)

We would like you, the owner, to provide some estimates of the renter's housing and utility costs.

Is the cost of electricity included in the rent?*

○ Yes
○ No
○ Don't know

RAND *RR1776-H.1-7*

Figure H.1—Continued

What is a rough estimate of the renter's average **monthly** electric bill over the course of a year **per unit**?*

- No charge or electricity not used
- Don't know
- Total amount in dollars

Is the cost of natural gas included in the rent?*

- Yes
- No
- Don't know

What is a rough estimate of the renter's average **monthly** natural gas bill over the course of a year **per unit**?*

- No charge or natural gas not used
- Don't know
- Total amount in dollars

Is the cost of the oil, coal, kerosene, wood, propane, etc., used to heat this house or unit included in the rent? *

- Yes
- No
- Don't know

What is a rough estimate of the renter's average **annual** heating fuel bill cost over the course of a year **per unit**?*

- No charge or these heating fuels not used
- Don't know
- Total amount in dollars

Is the cost of water and sewer included in the rent?*

- Yes
- No
- Don't know

What is a rough estimate of the average **annual** water and sewer cost over the course of a year **per unit**?*

- No charge or water and sewer not used

RAND *RR1776-H.1-8*

Figure H.1—Continued

○ Don't know
○ Total amount in dollars

Does the insurance you have on this property cover losses due to flood? *
Note: the cost of any such coverage should have been included in the total payments for insurance that you previously reported.

○ Yes
○ No
○ Don't know

How many people live together in the rental unit on this property? *
If you have more than one tenant, answer for the tenant who moved in most recently. Please give us your best estimate.

-- Please Select --

Which of the categories below best describes the household income of the tenant on this property over the past 12 months **before taxes**? *
If you have more than one tenant, answer for the tenant who moved in most recently. Please give us your best estimate.

○ $19,999 or less
○ $20,000 to $49,999
○ $50,000 to $74,999
○ $75,000 to $99,999
○ $100,000 or more

Which of the categories below best describes the age of tenant on this property? *
If you have more than one tenant, answer for the tenant who moved in most recently. For that tenant, report the age of the oldest person in the household. Please give us your best estimate.

○ Under 25 years old
○ 25 to 44 years old
○ 45 to 64 years old
○ 65 or over

How many people live together in the rental unit on this property? *
If you have more than one rental unit, answer for the tenant who moved in most recently.

-- Please Select --

Which of the categories below best describes the household income of this tenant over the past 12 months **before taxes**? *
If you have more than one tenant, answer for the tenant who moved in most recently. Please give us your best estimate.

○ $19,999 or less
○ $20,000 to $49,999
○ $50,000 to $74,999
○ $75,000 to $99,999
○ $100,000 or more

RAND *RR1776-H.1-9*

Figure H.1—Continued

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Which of the categories below best describes the age of this tenant?*
If you have more than one tenant, answer for the tenant who moved in most recently. For that tenant, report the age of the oldest person in the household. Please give us your best estimate.

- ○ Under 25 years old
- ○ 25 to 44 years old
- ○ 45 to 64 years old
- ○ 65 or over

Does the insurance you have on this property cover losses due to flood?
Note: the cost of any such coverage should have been included in the total payments for insurance that you previously reported.

- ○ Yes
- ○ No
- ○ Don't know

Do you have any comments or questions about this study? In the case that you would like a response to your comment, please contact us at Info@FloodAffordabilityStudyNYC.org.

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This report examines the cost of flood insurance in New York City and the ability of homeowners to afford it. It develops projections for how changes in flood maps and the pricing practices of the National Flood Insurance Program might increase premiums and analyzes the potential consequences of those increases on households and communities. It also develops and evaluates several different approaches for assisting households that have difficulty affording flood insurance. These include financial payments to households to offset the cost of flood insurance as well as mitigation grants and loans that reduce flood insurance premiums by making the home less susceptible to flood risk. This report builds on a previous work by the RAND Corporation on flood insurance in New York City, *Flood Insurance in New York City Following Hurricane Sandy*.

In addition to informing New York City's efforts to make its communities more resilient to flood risk, this work is relevant at the national level. Congress instructed the Federal Emergency Management Agency (FEMA) to develop an affordability framework in light of legislation that directs FEMA to gradually eliminate certain program subsidies and to collect additional program fees. This report provides data and analysis that also inform that effort.

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