



AT WHAT PRICE?

AN ANALYSIS OF THE COMPLEX MARKET FOR FLOOD INSURANCE IN NEW YORK CITY

REPORT FOR THE NEW YORK CITY MAYOR'S OFFICE OF LONG TERM PLANNING AND SUSTAINABILITY

Prepared by:

Master of Science in Sustainability Management
Capstone Workshop Participants, Columbia University

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Authors: Viveka Biyani Mark Buczek Tildy Davidson Joe DeGise Pablo Freund
Jairo Garcia Michael Ginsberg Su Yeone Jeon Kevin Lehman Julia Ragraio Ruiz
Adam Yukelson Alis Zavala

Earth Institute Faculty Advisor: George Sarrinkolaou

Table of Contents

| | |
|--|-----------|
| Executive Summary | 5 |
| Purpose of This Report | 5 |
| Key Findings | 5 |
| 1. Market size and number of properties at risk | 5 |
| 2. NFIP market penetration and compliance | 6 |
| 3. Types of NFIP policies available in New York City | 6 |
| 4. Residential market | 6 |
| 5. Small and middle commercial/industrial market | 7 |
| 6. Large commercial/industrial market | 7 |
| 7. Reinsurance | 7 |
| 8. Flood insurance and climate change | 7 |
| Areas for Further Research | 7 |
| Acknowledgements | 2 |
| The Problem | 3 |
| Research Methodology | 5 |
| Findings | 6 |
| Market Segments | 6 |
| Market Size and Properties at Risk | 6 |
| NFIP: Past and Present | 8 |
| How the NFIP Works | 10 |
| Eligibility | 10 |
| Types of policies | 10 |
| NFIP in NYC | 12 |
| Private Insurance | 13 |
| Market Structure | 13 |
| Types of Private Insurance Policies | 15 |
| Market Analysis | 17 |
| Residential Market Segment | 17 |
| Available products | 17 |
| Market size | 18 |
| Compliance | 20 |
| Commercial and Industrial Insurance Market | 21 |
| Small and middle market segment | 22 |
| Large commercial and industrial market segment | 22 |
| Reinsurance | 23 |
| Climate Change and the Future of the | 26 |
| Flood Insurance Market | 26 |
| Catastrophe Models | 26 |

| | |
|--|----|
| Current catastrophe modeling..... | 26 |
| The future of catastrophe modeling..... | 29 |
| The Emerging Picture..... | 31 |
| Recommendations..... | 32 |
| 1. Conduct a more detailed market analysis..... | 32 |
| 2. Educate the public about the risk of flooding and the availability of flood insurance.. | 32 |
| 3. Strengthen collaboration with the NFIP..... | 32 |
| 4. Engage the reinsurance industry..... | 33 |
| 5. Explore the use of catastrophe bonds..... | 33 |
| Supplemental Information..... | 34 |
| Appendix A..... | 34 |
| Appendix B..... | 35 |
| Appendix C..... | 36 |
| Appendix D..... | 38 |
| Appendix E..... | 40 |
| Appendix F..... | 45 |
| Bibliography..... | 48 |

Executive Summary



Purpose of This Report

New York City is home to more than 30,000 properties in the 100-year floodplain that are uninsured for the risk of flood. Given low National Flood Insurance Program (NFIP) coverage limits, and high property values in New York City, we suspect that many others are underinsured.

Climate change is expected to exacerbate the problem as the 100-year floodplain expands inland. The problem is especially acute in the residential market, where the NFIP is the dominant provider of flood insurance. An estimated 20% of NFIP policies are subsidized, which means that they do not reflect actual flood risk, and, therefore, fail to send an adequate price signal to property owners.

Information about this market, including the role of the private insurance industry, is needed to understand how flood insurance could help New York City prepare and manage for the increasing risk of flood. This report will provide such information, and lay the groundwork for further research, strategy development, and policy making.

Key Findings

1. Market size and number of properties at risk

Aerts & Botzen (2011) identified 33,122 buildings at risk in the 100-year floodplain in New York City. While this figure most likely does not capture all properties, it is the most accurate published figure available since it is difficult to capture and quantify all at-risk properties.

2. NFIP market penetration and compliance

Data from the NFIP Statistics Bureau indicated that, as of December 31st, 2011, a total of 13,147 NFIP contracts were in force in the 100-year floodplain in New York City. The NFIP uses contracts in force as a proxy for the total number of insured properties. This figure represents roughly 40% of the market.

It has been difficult to determine the extent of compliance with NFIP requirements in New York City. Nevertheless, studies suggest that over four million single-family homes are located in 100-year floodplain nationwide. An estimated 50% of these homes have flood insurance. While this figure excludes multi-family residential properties, tracking penetration of insurance rates in the single-family home market is indicative of the market penetration in other residential property types.

Outside the 100-year floodplain, the NFIP market penetration drops to 1%. Even though the national statistics suggest that approximately one of every two homes in the floodplain is insured, there are significant differences in insurance penetration rates across the country. The market penetration in the Northeast is estimated between 20% and 30%. National estimates do not account for New York City, according to the RAND Corporation, which published these figures.

3. Types of NFIP policies available in New York City

Every building in New York City is eligible for the Standard Flood Insurance Policy (SFIP). Coverage under SFIP falls under four broad segments: Residential (1-4 families), Other Residential (4+ families), Condominium, and Non-Residential.

Residential properties are eligible for coverage up to \$250,000 for structural damage and \$100,000 for contents. For condominiums, coverage is equal to the number of units in the building multiplied by the \$250,000 and \$100,000 limits for residential structures. Apartment owners in condominium units can purchase single-family residential policies. For non-residential properties, coverage is available up to \$500,000 for structural damage and up to \$500,000 in personal property coverage.

4. Residential market

The NFIP dominates the residential market for flood insurance. There are currently 19,237 residential NFIP insurance policies in place. A dearth of available information about the total number of residential properties in the 100-year floodplain suggests that a more extensive study is required in order to ascertain the market penetration of flood insurance in New York City.

Private insurance companies write excess and surplus insurance for high-value residential properties where the NFIP coverage limits are too low.

5. Small and middle commercial/industrial market

The small and middle market segments, comprising commercial and industrial properties of up to \$1 million in coverage limits, are also largely insured by NFIP. The maximum insurance coverage is \$1 million. Recent data indicates that as of December 31, 2011 only 1,284 non-residential NFIP policies were in force in New York City. Supplementary insurance products are available to this market too. No information was available to us about the extent of insurance coverage in this market segment.

6. Large commercial/industrial market

This market segment comprises properties with coverage of over \$1 million. While NFIP coverage of up to \$500,000 is available to these properties, flood insurance coverage is largely provided by private insurance. Flooding is covered as part of so-called All Risk policies. Another type of policy available is called Difference In Conditions, which covers perils in excess of standard property policies. Market penetration is reportedly 100%. Coverage of more than \$25 million often requires that several insurance companies become involved in insuring the property. The extent of coverage and the corresponding insurance premiums are a function of lending requirements, an engineering evaluation of risk, affordability, and a business decision about the amount of risk an insurance company is willing to cover.

7. Reinsurance

The reinsurance industry determines the extent to which private insurance firms insure for flood. Reinsurers have largely turned away from the residential market for flood insurance because of obstacles that prevent the industry from spreading and pricing risk adequately. There is, however, some indication that reinsurers and their private insurance clients are considering ways to enter discrete parts of the residential market, where they might be able to compete with the NFIP.

8. Flood insurance and climate change

Catastrophe (CAT) models, which determine risks and help the insurance industry set rates, use historical data, and may not account for future climate risks. According to interviews with catastrophe modelers, the incidence of hurricanes in the Atlantic present the only risk for which the historical record is *inadequate* in predicting vulnerability over the next five years.

We did learn, however, that catastrophe modelers are actively investing in developing models that do incorporate various emissions and impact scenarios into modeling.

Areas for Further Research

Comprehensive information about the flood insurance market in New York is lacking, which hinders the development of strategies and policies to use insurance in bolstering the city's resilience to coastal flooding. We collected

information on market size; how the NFIP works; the role of the private insurance and reinsurance industries, including the available insurance products; and the market penetration of both flood insurance provided through the NFIP and private firms.

Of these areas, further research is especially needed in establishing the market size in the 100-year floodplain; the role of private insurance and reinsurance, especially in the small-to-medium size market; and the market penetration of all products, both those provided through NFIP and private firms.

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The Problem

In New York City, most properties that face the greatest risk of coastal flooding are uninsured. We estimate that the number of uninsured properties amounts to some 20,000, or 60 percent of all properties in the 100-year floodplain. The problem is especially acute in the residential market, where the federal government's National Flood Insurance Program (NFIP), rather than private insurance firms, provides most flood insurance coverage. The NFIP's requirements are such that most residential property owners forego flood insurance.



Moreover, about 20% of properties that do carry flood insurance through the NFIP are charged subsidized premiums (CBO, 2009). In other words, one out of every five property-owners, whose properties are insured for flood along New York City's vulnerable coastline, receives an inadequate price signal about the level of risk that he or she faces. NFIP flood insurance limits may also result in inadequate levels of flood insurance coverage.

Several obstacles prevent the private insurance industry from increasing flood insurance coverage. Perhaps the most fundamental of these problems is adverse selection, a type of market failure caused by the propensity of those facing the greatest risk to buy insurance and the insurance provider's inability to price insurance in a way that reflects this high level of risk. Raising premiums would provide further incentive for only those with the highest levels of risk to buy insurance. A further increase in premiums would threaten a collapse of the insurance market.

Congress created the NFIP to address this problem at a time when property owners were finding it difficult to buy flood insurance from private firms (CoverHound, 2012). Moreover, the NFIP was designed as a means of discouraging unwise occupancy of flood prone areas by promulgating improved building standards (FEMA, 2002).

The participation of the private insurance industry in the flood insurance market is further limited by the technical difficulty of predicting floods. The unpredictability of catastrophic floods requires that private firms charge premiums that cover their cost of capital and provide reserves for future losses. As we will detail later in this report, interviews with insurance industry representatives suggest that premiums would need to be higher than

those of the NFIP, which, as a federal program, can withstand deficits in its operation. Indeed, since Hurricane Katrina, the NFIP has carried an \$18 billion deficit (CBO, 2009).

The problems of the flood insurance market are manifesting against the backdrop of climate change. Sea-level rise, higher storm surge, more intense and more frequent storms, and more downpours, are expected to exacerbate flood risks as the 100-year floodplain expands inland. The New York City Panel on Climate Change estimates that, because of sea level rise alone, the 1-in-100 year flood may occur approximately four times as often by the end of the century (NYC Panel, 2010).

Over the same period of time, expected population growth and future waterfront development are expected to expose more people and property to the risk of flood (PlaNYC, 2007).

Comprehensive information about the flood insurance market in New York is lacking, which hinders the development of strategies and policies to address this problem. The information needs include:

1. Determining the size of the market for flood insurance;
2. Learning about the NFIP;
3. Understanding the role of the private insurance and reinsurance industries, including the available insurance products; and
4. Ascertaining the market penetration of both flood insurance provided through the NFIP and private firms

The goal of our research was to provide this information, in order for the New York City Mayor's Office of Long Term Planning and Sustainability to develop strategies and policies that increase the city's resilience to flooding.

Research Methodology

Our team, comprising graduate students in the Master of Science in Sustainability Management Program at Columbia University's Earth Institute, conducted a market analysis to help address these information needs.

Determining market size (i.e. the number of properties at risk in the 100-year floodplain) was a first step in this analysis because that information speaks to the total number of properties at risk, and because it is necessary in determining the extent of flood insurance (i.e. market penetration).

As a second step, a market analysis, organized by market segment, was necessary to understand the function of the NFIP and the role of private insurance in flood insurance. The market comprises residential, so-called small, middle market, and large commercial and industrial properties. For each market segment, we examined the available insurance products, and their market penetration. Although the team sought to determine the size of each market segment, which would allow for tailored approaches to boosting coverage, data was unavailable. It was infeasible to collect and analyze such data within the project schedule, which spanned February to April of 2012.

Additionally, we sought to understand the insurance industry's views of climate change. Assuming that we would learn more by understanding pricing structures than reviewing published corporate positions about climate change, we researched the connection between climate risk information and catastrophe models – instruments used to help insurers and reinsurers set prices.

The resulting analysis is based on interviews with government officials, private insurance, reinsurance and banking executives, and experts, and a literature review. Note that access to data and information presented a challenge throughout the project, either because the data had yet to be collected, or because it was proprietary. The team's experience in seeking this information indicates that additional effort and resources must be dedicated to understanding New York's flood insurance market.

Findings

Market Segments

The flood insurance market comprises four distinct segments. Those include residential, and small, middle market, and large commercial/industrial. An insured property's coverage level determines whether the property falls within the small, middle market or large commercial and industrial markets. The flood insurance coverage levels that are typically available to each type of property range from \$500,000 for residential properties to more than \$100 million for large commercial/industrial properties.

While there are significant differences in the cost of premiums among small, middle market and large commercial and industrial properties, the exact amounts of those premiums are proprietary and differ according to a variety of factors. These factors include risk assessment, evaluations of replacement costs and whether they are valued at present or future worth, exclusions or inclusions to the policy, and the percentage of the loss covered (Ginsberg A, 2012).

Market Size and Properties at Risk

We were confronted with two very different published estimates about the number of properties at risk in the 100-year floodplain. In 2009, The New York City's Office of Emergency Management (OEM) Natural Hazard Mitigation Plan estimated that there were 13,341 properties in the 100-year floodplain. In contrast, a separate study published two years later found 33,122 properties at risk (Aerts & Botzen, 2011).

To determine which of the two estimates was reliable, we interviewed the authors of both reports. In the process, OEM staff informed the team that the agency is reviewing its calculations and that it plans to report updated findings. OEM staff were unable to comment on the validity of the larger estimate. Aerts, on the other hand, expressed confidence in the estimate in the 2011 report he co-authored.

The team also sought to use data provided by the NFIP Statistics Bureau to check the two estimates. Using the data and national estimates of NFIP compliance, the team estimated that there were 26,163 *properties located in the current 100-year floodplain*. While national estimates of NFIP compliance excluded information about New York City, the result of this extrapolation suggested that the figure in the Aerts report was likely more accurate than the figure reported by OEM. **There were no published data about the size of each market segment, which represents an important area for further research.**

Data from the NFIP Statistics Bureau indicated that, as of December 31st, 2011, a total of 13,147 NFIP contracts were in force in the 100-year floodplain. The NFIP uses contracts in force as a proxy for the total number of insured properties. The NFIP accounts for a

property in which there are multiple NFIP policies (i.e. a multi-family building) as a single contract.

We assumed that these insured properties accounted for a subset of the entire population of buildings at risk. Because the total size of this subset exceeds OEM's estimate of total properties at risk, **we concluded that OEM underestimated the true population of buildings at risk.**

We used the known number of 13,147 NFIP contracts in force, as well as national averages of the insured populations, reported by the RAND Corporation, to estimate an approximate population size of buildings at-risk (i.e. 26,163). The category "contracts-in-force" is used as a proxy for the number of buildings in the floodplain. This method aggregates into a *single entry* the multiple policies-in-force that might exist in buildings with multiple units, such as condominiums or other multi-family residential properties. In other words, a condominium might have 50 policies in force, but it will only be a single contract in force (NFIP Statistics Bureau, 2012).

The RAND study found that an approximate 75% to 80% of buildings comply with the NFIP flood insurance requirement. We also know that 55% of properties in the 100-year floodplain are subject to the Mandatory Purchase Requirements (MPRs) (RAND 2007). That being the case, we assumed 75% of properties in the 100-year floodplain, or **41% of all properties in that zone, carry the required NFIP insurance at any given time¹.**

The remaining 45% of buildings in the 100-year floodplain are not subject to MPRs. Of these, about 20% carry insurance (Dixon et al., 2007). In other words, **9% of properties in the 100-year floodplain not required to have NFIP insurance actually carry it².** If we combine this figure with the 41% calculated above, we can infer that national averages imply that **about 50% of buildings in the 100-year floodplain have flood insurance³.**

Proportions of Flood Zone Based on National Averages

| MPR Status | Properties in 100-year floodplain | Carry Insurance | Insured Properties in 100-year floodplain |
|---------------------------------|-----------------------------------|-----------------|---|
| No Mandatory Insurance | 45% | 20% | 9% |
| Mandatory Participation in NFIP | 55% | 75% | 41% |
| Total | 100% | | 50% |

(Dixon et al., 2007).

Based on this analysis, we extrapolate from national averages that a total of 26,163 properties are at-risk in the 100-year floodplain in New York City⁴. This figure is within the range of at-risk properties found in the literature, and provides us greater confidence in that range. One limitation in using national averages to calculate New York City values is that national averages fail to account for the density of development along New York

¹ (55% x 75% = 41.25%)

² (45% x 20% = 9%)

³ (41% + 9% = 50.25%)

⁴ (13,147 / 50.25% = 26,163)

City's coastline (Dixon, 2012). Therefore, we do not suggest that 26,163 is the actual number of properties at risk. It is, rather, an attempt to estimate the size of the risk population, in the absence of a more definite figure for market size.

Estimated Population at Risk based on National Averages

| 100-year floodplain | Total # of Buildings | Proportion of 100-year floodplain |
|---------------------|----------------------|-----------------------------------|
| Insured Buildings | 13,147 | 50% |
| Total Buildings | 26,163 | 100% |

NFIP: Past and Present

Until the mid-twentieth century, river and coastal flooding crises were managed locally. In 1936, the federal government passed the Flood Control Act. This legislation paved the way for the construction of dams and levees to achieve flood-control. Still, no mechanism existed to assist disaster victims with flood related losses. Even though billions of dollars were dedicated to improving physical means to reduce the impact of catastrophes, the federal government's expenditure in disaster assistance continued to rise over time, as did the casualties and financial losses brought about by flooding (FEMA, 2002).

As a result, in the decades that followed, the federal government explored alternative means of reducing the mounting burden placed on the budget by flood disaster payments. Insurance was always considered an attractive alternative by legislators. By 1956, the blueprint of the Federal Insurance Act was completed. It was intended to spur the creation of private insurance mechanisms to insure against flood damage.

The law was never passed, since from early on it became apparent that private insurance companies would face significant difficulties in creating profitable products at affordable prices, due to the technical difficulties in finding accurate actuarial rates for risk in the flood zones and overcoming insurance market blockages such as adverse selection.

In 1968, the National Flood Insurance Act was passed, creating the National Flood Insurance Program (NFIP) to be administered by the Federal Emergency Management Agency. It was intended to:

- Alleviate the losses in affected communities through insurance;
- Improve flood resilience through improved building codes;
- Reduce the Federal fund outlay related to flood events; and
- Discourage unwise occupancy of flood prone areas by promulgating improved building standards (FEMA, 2002)

The program created a national insurance pool, into which all collected premiums were deposited. This money was available for disbursement in the case of damages due to flood events. To this day, the program is a major player in the flood market, offering policies at discounted prices.

Low Participation Leads to Mandatory Purchase Requirements

Despite subsidized prices, in the years that followed the creation of the NFIP, participation remained low. In 1972, Tropical Storm Agnes caused widespread devastation, requiring the federal government disburse a record amount of disaster assistance. At the time, a mere 95,000 policies were in force nationwide, a figure that is dwarfed by the 5.6 million policies active as of the end of 2011 (NFIP Statistics Bureau, 2012) (FEMA, 2002).

To increase NFIP participation, the Flood Disaster Protection Act of 1973 stipulated that federally insured or regulated lenders require flood insurance on all home loans and mortgages in floodplains. This requirement, still in effect, is known as the Mandatory Purchase Requirement (MPR). The areas in which it applies are called Special Flood Hazard Areas (SFHAs). SFHAs are the same thing as the 100-year floodplains.

In 1991, the Mortgage Portfolio Protection Program (MPPP) was introduced to the NFIP to support and enable lenders to comply with MPRs by covering mortgaged properties with force-placed insurance should the property owner fail to renew the insurance policy. Then, in 1994, the National Flood Insurance Reform Act stipulated that flood insurance be required for property owners who:

1. Enter into a contractual home loan, mortgage or other asset secured debt obligation with a federally insured, regulated, or supervised secured by property in the 100-year floodplain; or
2. Currently hold a loan or debt title collateralized by a property in the 100-year floodplain, that has been purchased or is in possession of the Federal National Mortgage Association or the Federal Home Loan Mortgage Corporation; or
3. Receives or has received in the past federal financial assistance or credit from a regulated entity, for construction or acquisition of an improvement located in the 100-year floodplain.

Such requirements proved effective. For example, the Federal Reserve System subsequently banned any member bank from making, extending, increasing, or renewing any loan within the 100-year floodplain, unless the property securing the loan is covered by flood insurance for the term of the loan (Dixon et al., 2006). As we describe in the following sections, compliance with NFIP policies tends to be very high for policies under the Mandatory Purchase Requirement.

The history of flood insurance, and the relative success of MPRs, is suggestive of the difficulty inherent in motivating people to purchase flood insurance. This is worth bearing in mind when considering why, at least in the residential market, private insurance has historically stayed out of the market. History may, in this case, also be a guide to the future when thinking about whether private insurance could have a larger share of the residential market in the future.

How the NFIP Works

Eligibility

In order for a building to be eligible for NFIP insurance, it must have at least two walls and a roof, be principally above ground, and not entirely over water. Policies are sold separately for the structure and for the personal property. For tracking and informational purposes, the NFIP also distinguishes between single-family residential buildings and those with 2-4 units (NFIP Statistics Bureau, 2012).

Individual properties can have access to policies offered by the program as long as they are located in a participating community. In order for communities to participate, they must adhere to building codes, ordinances and zoning designations as set forth by FEMA, in order to reduce the risk of damages.

The NFIP officially defines a flood event as “a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (FEMA, 2002). An inundation covered by NFIP insurance policies can be caused by an overflow of inland or tidal water, an unusual accumulation of surface water, a mudflow, or a subsidence of land along the shore of a body of water. Property owners can file claims without a federal declaration of disaster. However, in order for damages to be covered by NFIP insurance, they must be caused by a qualified type of flood.

Types of policies

The NFIP has two types of policies available to its member communities. One is the initial, emergency phase. This policy offers limited coverage to individuals while the community undergoes the evaluation process of joining the NFIP. The emergency program is irrelevant to the majority of participating communities, including New York City, that are members of the full program.

As a member community, New York City is eligible for the second policy, called the Standard Flood Insurance Policy (SFIP). New York City is considered a single participating community, so that nearly every building in the city is eligible for NFIP. Coverage under SFIP falls under four broad segments, shown in the following table:

| Segment | Eligibility | Coverage |
|---|---|--|
| *Residential: 1-4 family units. | Issued to homeowner, residential renter, or owner of residential building containing 1 to 4 units (including single apartment units). Policies are insured under Dwelling Form. | Up to \$250,000 in building coverage and up to \$100,000 in personal property coverage for owners. Renters are eligible for personal property coverage up to \$100,000. |
| Other Residential: 4+ family units | Issued to owner of residential building with 5 or more units. Policies are insured under the General Property Form. | Up to \$250,000 in building coverage and up to \$100,000 on personal property for owners. Apartment buildings with single ownership structures are limited to \$250,000 in building coverage for the entire building. Renters are eligible for personal property coverage up to \$100,000. |
| Condominium | Policies are insured under The Residential Condominium Building Association Policy Form. | Coverage equal to the number of units in the building times the \$250,000 and \$100,000 limitations for residential structures. Individual owners of condominium units can purchase single-family residential policies. |
| Non-Residential | Issued to owner or lessee of non-residential building or unit. Policies are insured under the General Property Form. | Up to \$500,000 in building coverage and up to \$500,000 in personal property coverage. |

*For tracking and informational purposes, the NFIP also distinguishes between single-family residential buildings and those with 2-4 units.

While the majority of NFIP policies are standard policies, there are a few supplemental programs, shown here:

| Policy | Eligibility | Coverage |
|---------------------------------------|---|--|
| Preferred Risk Policies | Outside 100-year floodplain; must be located in B, C or X zones; must meet eligibility requirement related to historical flood claims associate with the structure* | Same as SFIP |
| Mortgage Portfolio Protection Program | Lenders whose mortgagors have failed to obtain a required policy | Same as SFIP; rates are increased. |
| Scheduled Building Policies | Covers groups of up to ten buildings. All buildings must have the same ownership, location, and properties on which buildings are located must be contiguous. | Maximum coverage per building is the same as SFIP. Program is designed to reduce total premiums. |
| Direct Program Policies | Response to a federal disaster | Minimum building and/or content coverage during a 3-year policy period |

*Eligibility requirements for PRP can be found in Appendix A.

The NFIP program was structured to subsidize the cost of flood insurance on existing homes in high risk flood areas, in order to maintain property values, while charging actuarially fair rates on new construction. In 2011, approximately 22% of the NFIP policies in force were written at subsidized rates, while 78% of policies were at actuarially full-risk

premium rates. The vast majority if not all of the subsidized policies were in high-risk flood areas (Thomas L. Hayes, 2011).

Additionally, the average annual NFIP premium across the country is about \$300 for \$100,000 worth of coverage in the residential market (NAMIC, 2005). See Appendix D for complete information.

NFIP in NYC

The Department of Buildings (DOB) is the only city agency that coordinates with the NFIP, and their role is limited to the enforcement of building codes in new and renovated (Griggs, 2012). **The city does not have an organization responsible for coordinating with the NFIP specifically on insurance related matters.** In the event of a federally declared flood emergency, the New York City Office of Emergency Management (OEM) works closely with FEMA. However, a clear communication channel is lacking between the two organizations, perhaps because the OEM does not coordinate with the NFIP on a regular basis. There may be opportunities to increase flood insurance coverage in New York City through closer collaboration and regular communication with the NFIP.

NFIP Policies in New York (All Flood Zones) as of January 31, 2012

| | Policies In Force* | Insured Value (\$) | Premiums Collected (\$) | Percentage of Nation |
|----------------|--------------------|--------------------|-------------------------|----------------------|
| United States | 5,590,375 | 1,266,131,626,300 | 3,487,484,358 | 100% |
| New York State | 167,862 | 40,988,791,500 | 153,960,120 | 3% |
| New York City | 38,985 | 8,906,354,200 | 32,542,605 | 0.7% |

*Policies-In-Force is a count of the total number of active insurance policies, which is different from Contracts-In-Force, which will report multiple policies as a single count for buildings with multiple residential units (NFIP Statistics Bureau, 2012).

Private Insurance

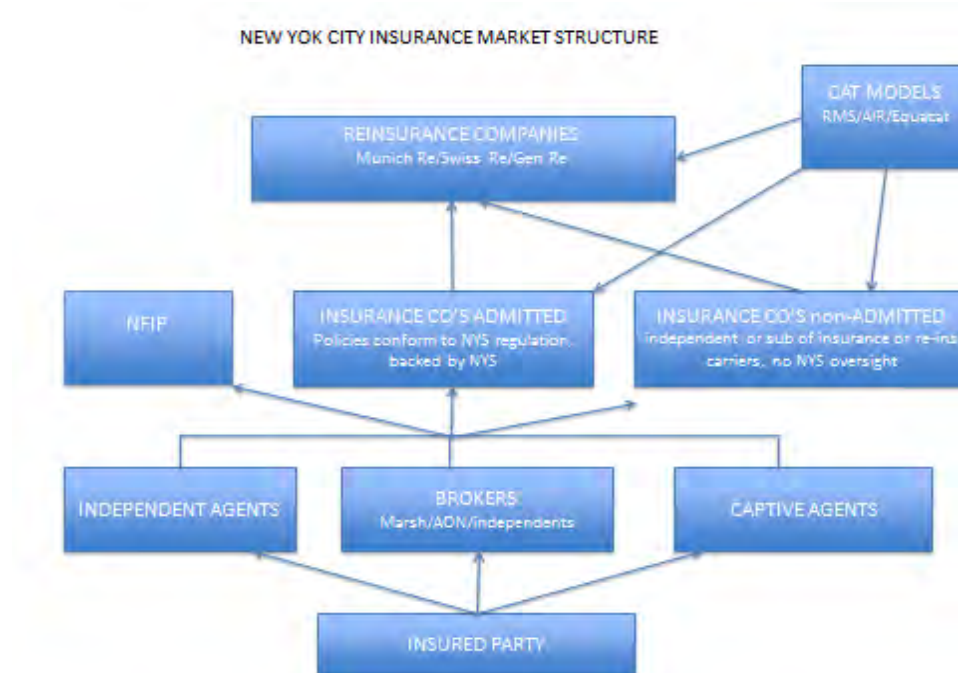
Market Structure

To differing extents, private insurance fills gaps in the NFIP's coverage across the residential, and small, middle market and large commercial and industrial markets. This section briefly explains our understanding of how the private insurance market is structured. Subsequently, we describe products that are available through private insurance to replace and/or supplement NFIP policies. Note that our understanding of the private insurance market structure is based on interviews and a literature review. While we believe we have spoken with representatives of every segment in the market, further research may yield additional relationships that add complexity to the market structure.

Historically, private insurers were unable to provide flood insurance at affordable rates, and flood coverage has traditionally been excluded from standard homeowner policies. Until the establishment of the NFIP in 1968, flood victims relied primarily on government disaster assistance. As previously mentioned, even at subsidized rates, the NFIP struggled to achieve market penetration. The insurance executives we interviewed tended, nevertheless, to cite NFIP's subsidized rates as the primary obstacle to entering the residential flood insurance market. For private insurance to successfully compete in the residential market, companies would have to provide insurance at affordable rates – something that, historically, has not happened – while generating a profit. Furthermore, this would have to happen in an environment of rising sea levels, more frequent and intense storms, and other climate change-related factors that will likely increase risk exposure.

The private flood insurance market structure is complex. The industry includes agents, brokers, insurance companies, reinsurance firms, catastrophe modelers, and the property owners. For instance, as we explore in the following sections, the way catastrophe modelers assess risk determines both reinsurers' and primary insurers' understanding of the location and probability of risks. This understanding, in turn, contributes to setting the foundation for how insurance companies price premiums and decide whether or not to offer coverage. The reinsurance industry's relationship with primary insurers is also crucial. Primary insurance companies essentially decide their risk tolerance, or willingness to assume liability, based on the extent to which they can reinsure the primary policies. As this overview demonstrates, understanding how the relationships in the structure function as a whole is a prerequisite to effective engagement of any single stakeholder in the industry.

Interviews with representatives at all levels of the structure were used as a basis for the following organizational chart. This diagram is intended to represent the relationships among different actors in the private insurance industry.



The insured party must turn to an agent to procure insurance. Agents are firms or individuals that sell insurance to the public. These entities can be either independent, brokers or captive agents. Independent agents are typically individuals or small companies, brokers are larger firms such as Marsh and McLennan, and captive agents are individuals who work for insurance companies (Ginsberg, 2012). While agents and brokers do not underwrite the insurance, they will match the buyer with insurance companies that offer the type and level of coverage desired.

Residential clients primarily work with captive and independent agents, individuals who work exclusively for one insurance carrier or those who represent multiple companies, respectively. Small and middle market property owners' relative use of independent or captive insurance agents to secure coverage is unknown to us. The large commercial and industrial buyers usually work through brokers, who can conduct more sophisticated analyses of risk and structure more complicated ways to meet coverage needs of larger value properties (Andler, 2012). Brokers and the primary insurers with whom they collaborate may conduct engineering analyses to evaluate flood risk. In cases where insurance coverage exceeds \$25 million, brokers also forge deals in which several primary insurers assume successive portions of a risk. Aon, a large insurance broker, reported assembling policies in this way that provided more than \$100 million in coverage.

Primary insurance companies can be either admitted or non-admitted. Admitted insurers are licensed to do business in a certain state, are required to follow state regulations, and receive state guarantees that clients' claims will be paid in the event of insolvency. Non-

admitted insurance companies are not licensed or required to follow state regulations yet they do not receive guarantees; these firms offer excess insurance (Csiszar, 2012).

Primary insurance companies transfer some of their risk to reinsurance companies, such as Munich Re and Swiss Re. The reinsurer agrees to pay some of the primary insurer's losses in exchange for a reinsurance premium. This risk management strategy allows the primary insurer to maintain a financial reserve even in cases of a catastrophic event.

Insurers and reinsurers rely on catastrophe modelers to estimate losses in cases of a devastating natural and anthropogenic events, such as hurricanes or terrorism. The capabilities and limitations of catastrophe models will be discussed in a separate section, below.

For the large commercial/industrial sector, coverage levels and premiums are, therefore, based on a combination of factors: engineering analyses and catastrophe models, which inform a lender's insurance requirements for financing, the cost of capital, and the policyholder's willingness and ability to pay (Martin, 2012). Flood insurance, in other words, is a strategic concern of large firms in the 100-year floodplain, whereas in the residential market it is often either a costly regulatory requirement or a cost to be avoided.

Types of Private Insurance Policies

Interviews with private insurance industry representatives from Aon, XL and Chubb, as well as the National Association of Insurance Commissioners and the Insurance Information Institute, revealed that select policies are offered to cover flood risk. These policies, defined below, can be used either in addition to the NFIP, in combination with one another or independently to cover properties for flood risk. While the types of policies we discuss below are the most common, we list others in appendix D.

Excess: insurance to cover unanticipated or catastrophic losses (IRMI, 2012).

Excess commonly supplements the NFIP, and various lending and insurance institutions offer it. According to Marsh USA, most commercial flood coverage is excess (Marsh, 2012).

All-Risks: covers all perils aside from those that are specifically excluded in the particular All Risks policy offered.

These types of policies range in coverage of perils. It includes a lot of perils but it does not present the policy by listing the perils. Therefore it is not a "named perils" policy (Ginsberg, 2012). All risks policies may also be referred to as "open perils" or "special perils" (IRMI, 2012)

Difference in Conditions (DIC): an extra policy that covers the items not covered in either the All Risks or the standard commercial property policy, or both, because it was previously excluded.

DIC covers additional perils beyond the All Risks coverage (Ginsberg, 2012). DIC may be specifically for earthquake and/or flood exposure (HCC, 2012). **DIC policies may become more important as natural catastrophe losses increase (Martin, 2012).**

Extra Expense Coverage: Time element property insurance that pays for expenses in excess of normal operating expenses that an organization incurs to continue operations while its property is being repaired or replaced after having been damaged by a covered cause of loss (IRMI, 2012).

Business Income Coverage: Insurance covering loss of income suffered by a business when damage to its premises by a covered cause of loss causes a slowdown or suspension of its operations during the time required to repair or replace the damaged property (IRMI, 2012).

Preservation of Property: extension coverage allowing for an insured to recover expenses incurred to reduce a loss before it happens.

For example, think of a carnival operator doing business in a location, and a hurricane is coming. The extension would cover the costs associated with packing all of the rides up and storing them in a safe location while the storm passes over (Carille and Krokovich, 2012)

Market Analysis

Residential Market Segment

KEY LESSONS:

Market segment size: Unknown

NFIP policies in force: 19,237

NFIP coverage limits: \$250,000 in structure coverage; \$100,000 in content coverage.

Other available insurance products: Excess, gap coverage, deficiency coverage.

Market penetration of flood insurance: 49% (national estimate)

Available products

The NFIP dominates the residential market for flood insurance. Flood insurance through the NFIP is available to any residential property owner in New York City. Within the 100-year floodplain however, residential property owners who have federally-backed mortgages are subject to the Mandatory Purchase Requirement (MPR), and accordingly must purchase flood insurance.

The private industry's primary role in providing flood insurance for residential structures is to administer the NFIP, through a program established in 1983 known as Write Your Own (WYO). Under the WYO, member insurers of the National Flood Insurance Association (NFIA) are allowed to write flood insurance policies, directly through their own insurance agents under the NFIA risk pool agreement (FEMA, 2010).

This program was meant to supplement the insurance services provided by the National Flood Insurers Association (NFIA) servicing carriers. The NFIA is a voluntary, unincorporated group of insurance companies. The agreement with the NFIA expired in 1977. By an executive order issued April 1, 1979, operation of the NFIP was transferred to The Federal Emergency Management Agency (FEMA). FEMA pays WYO companies for selling and servicing insurance policies. FEMA pays a flat fee at 15% of premiums for "acquisition" (agents' commissions), reported in Best Aggregates and Averages in recognition of the complex insurance policy writing requirements of the NFIP. We can conclude, therefore, agents have an added incentive to write WYO policies. This was corroborated by an interview with a private agent offering All State policies to clients; this source requested to remain anonymous.

The private insurance industry underwrites flood insurance, outside of WYO policies, in a limited way, through what is known as the voluntary market. In this market, homeowners choose whether to purchase flood insurance underwritten by private insurers or the NFIP. Additionally, private policies offer a number of features that are valuable to lenders seeking to insure their assets. These advantages include the ability to obtain insurance in

excess of the NFIP coverage limitations and automatic coverage policies that force insurance on properties that are out of compliance with the NFIP.

Generally, voluntary market insurance companies target high net worth-households by including flood insurance in a package covering multiple assets and perils. Owners of high-value properties may choose to forego NFIP coverage altogether by electing to obtain private policies. A select group of private insurers can provide such an alternative; these firms typically offer policies that entirely replace the NFIP or provide supplemental gap protection.

Gap policies provide supplemental insurance to properties in excess of the \$250,000 NFIP coverage limitation. For example, the insurer, Chubb Personal Insurance, offers its own primary flood coverage, as well as a surplus policy. The primary coverage can replace the NFIP since Chubb insures starting with the first dollar of loss. Chubb's primary coverage is broader than the NFIP's as it includes temporary living expenses during relocation. Chubb also provides gap coverage, known as excess, which is based on NFIP coverage terms, yet can be written to higher limits (Schussel, 2012). In both cases, Chubb provides limits up to \$15 million, and the customer can determine how to allocate that limit between property and contents. Chubb does not sell the flood insurance independently of homeowner's insurance; rather, the company only sells flood coverage to their existing customers with homeowner's insurance.

In the New York area, Chubb's customers tend to have homes with replacement values of at least \$750,000. Note that replacement cost refers to the cost of rebuilding the home, not the sale value. Therefore, even well-insured properties will lose value in a flood in a prosperous residential market (Schussel, 2012). It should be noted, however, that flood may not cause damages in proportion to the value of the entire home. XL, a large insurance and reinsurance company, estimates that a flood is likely to cause damages equal to roughly 25% of a property's value. For a \$1 million home, NFIP coverage, in this example, would suffice (Martin, 2012).

A 2007 RAND report estimated there to be anywhere from 50,000 to 70,000 residential gap policies nationally (Dixon et al., 2007). The information to estimate the size of the deficiency coverage market accurately is limited at a national and local level. Insurers were reluctant to provide detailed, proprietary information on these markets.

Market size

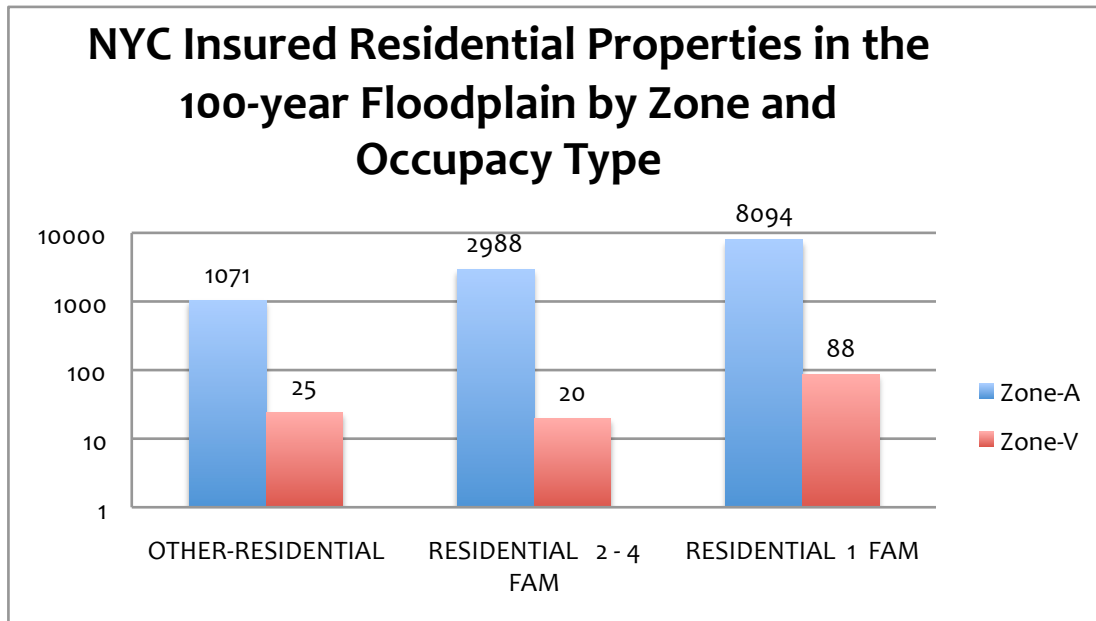
The total number of properties in the residential market segment is unknown, which makes it impossible to determine the extent of flood insurance coverage in this market segment. We know, however, that nationally an estimated 50% of single-family homes located in the 100-year floodplain are insured (through NFIP) and that the market penetration of NFIP flood insurance in the single-family home market is a good proxy for the other residential property types (Dixon et al., 2007).

New York City Residential Policies In Force by Flood-Zone and Occupancy Type

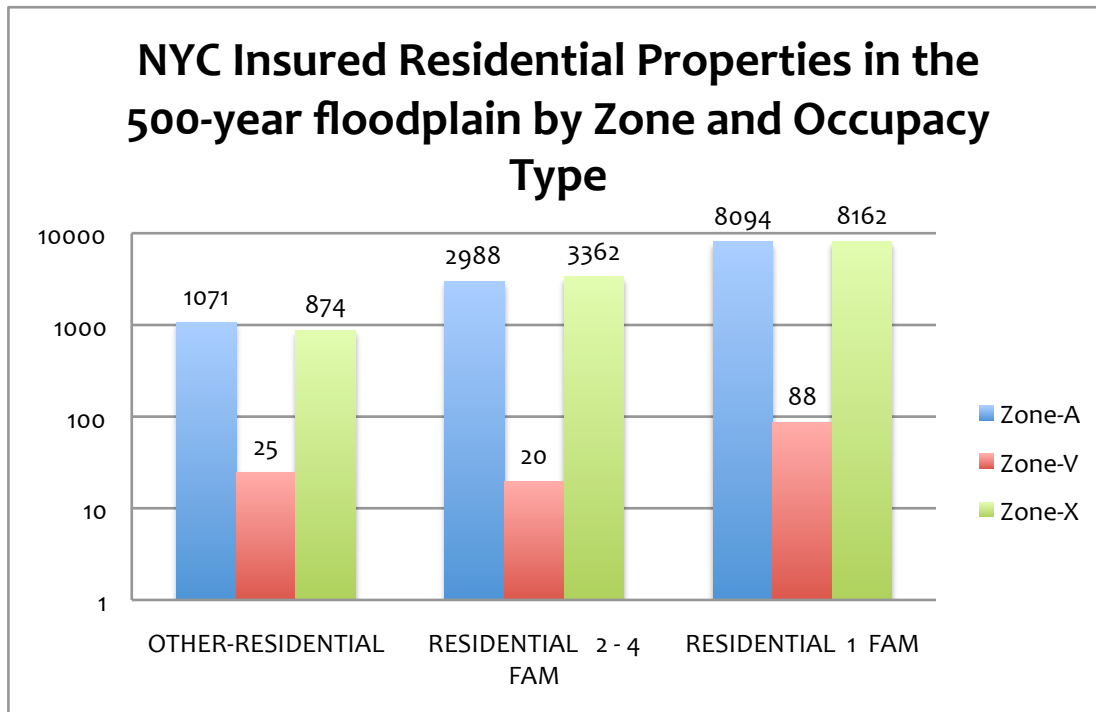
| Flood Zone | Other Residential | 2-4 Family Buildings | Single Family |
|---------------|-------------------|----------------------|---------------|
| Zone-A | 7,832 | 3,036 | 8,152 |
| Zone-V | 107 | 22 | 88 |
| Zone-X | 6,774 | 3,448 | 8,162 |
| Total | 14,713 | 6,506 | 16,402 |

(NFIP Statistics Bureau, 2012)

The NFIP Bureau of Statistics reports that there are 37,621 policies in the 500-year floodplain. This is important because, due to climate change, this floodplain is expected to one day be the 100-year floodplain. Nevertheless, the current 100-year floodplain has 19,237 active residential policies. Single-family homes make up about 43% of active policies. Family buildings with 2 to 4 residencies comprise about 16% of active policies, and the remaining 41% are from other residential units such as condominiums and apartment buildings.



(NFIP Statistics Bureau, 2012)



(NFIP Statistics Bureau, 2012)

Compliance

Data were unavailable to determine NFIP compliance or market penetration of private insurance products in the residential segment.

Determining the rate of compliance with NFIP requirements nationally has even confounded the federal government. In 2002, the U.S. Government General Accounting Office (GAO) published a report titled, “Flood Insurance: Extent of Noncompliance with Purchase Requirements is Unknown.” We sought to determine the extent of compliance with the NFIP in New York City by consulting the available literature and by interviewing bank executives and Lloyd Dixon, a flood insurance expert at the RAND Corporation.

Because NFIP insurance is linked to mortgages, compliance with this requirement tends to be high, especially in cases where mortgages are serviced locally. Interviews with Bank of America loan officers and the editor of ‘Mortgage Daily’, an industry news publication, suggest that compliance with this requirement was near 100 percent (Cuarta, 2012) (Garcia, 2012). However, the RAND Corporation reports that nationally the compliance rate is 80%.

The discrepancy between the two compliance estimates likely has to do with the relationship of the bank to the area that is vulnerable to flooding. Local banks that originate and service these loans may attain full compliance because of their sensitivity to the risk of flood, especially in the years after they make the loan. While compliance rates are likely lower when banks that originate the loans sell them to banks located far from

the vulnerable area (Michel-Kerjan, 2010). In such cases, we suspect that compliance with NFIP requirements decreases as property owners fail to renew NFIP policies and distant banks overlook the requirement.

Whether the true figure is 80%, or closer to 100%, what we know is that an extensive compliance ecosystem exists to ensure that policies subject to MPRs are enforced within the 100-year floodplain. To ensure borrowers subject to MPRs are in compliance, banks use sophisticated systems to monitor compliance. They also have the contractual and regulatory ability to force-place insurance onto properties.

Lenders use flood determination companies to assess if a property is in the 100-year floodplain, using FEMA's Flood Insurance Risk Maps (FIRMs). Many large banks and financial institutions also subcontract the monitoring of coverage to firms referred to as "trackers." The tracker firms are paid on a per loan basis to monitor compliance with all regulatory and internal requirements and to ensure that all the loans in the lender's portfolio are carrying the appropriate types of insurance.

Banks monitor updates to FIRMs throughout the life of a loan. If a property is reclassified to be within the 100-year floodplain, because FIRMs are updated; or if a policy in the 100-year floodplain has expired, lenders must notify customers within 45 days. If the property owner fails to acquire insurance within the 45-day period, the lender will force-place an insurance policy on the collateral property.

This is done to protect the lender in case flood damage degrades the borrower's ability to repay the loan. Force-placed insurance does not require the homeowner's consent.

National studies have found that at any moment, between 100,000 and 200,000 properties have lender-placed insurance (Dixon, 2007). Private insurance companies generally provide force-placed policies, but sometimes lenders automatically contract NFIP policies. Of all force-placed policies half are cancelled within 90 days activation, and two-thirds cancelled by the end of the one-year policy term, as property owners obtain lower-priced NFIP policies (Dixon, 2007).

Because this compliance system is in place, we believe that properties not receiving federal financing constitute the majority of uninsured properties in the 100-year floodplains. In fact, nearly half of homes in the 100-year floodplains are not subject to MPRs. Of this population, as mentioned earlier in this report, it is estimated that about 20% have flood insurance (Dixon, 2007).

Commercial and Industrial Insurance Market

Private insurance plays a more prominent role in the middle, commercial and large commercial and industrial sectors. Lenders often require flood insurance with building coverage in excess of the \$500,000 limit offered by the NFIP, forcing property owners to

pursue private insurance options. According to Michael Andler of Aon, large commercial and industrial properties primarily insure through the private insurance market, entirely avoiding the NFIP (Andler, 2012). As of the end of 2011, 1,284 non-residential NFIP policies were in force in New York City, or just 3% of all NFIP policies in NYC (NFIP Statistics Bureau, 2012).

We found that distinctions are made between small, middle, and large market commercial and industrial segments, but those distinctions seem largely informal and are likely to vary among insurers.

Acknowledging that distinctions between market segments may vary throughout the industry, it is still possible to provide general guidance about the types of insurance coverage available to various segments.

| NFIP-Eligible Non-Residential Structures | |
|---|--|
| <ul style="list-style-type: none"> ▪ Hotel or motel with normal guest occupancy of less than 6 months ▪ Licensed bed-and-breakfast inn ▪ Retail shop, restaurant, or other business ▪ Mercantile building ▪ Grain bin, silo, or other farm building; ▪ Agricultural or industrial processing facility ▪ Factory ▪ Tool Shed | <ul style="list-style-type: none"> ▪ Warehouse ▪ Pool house, clubhouse, or other recreational building ▪ House of worship ▪ School ▪ Nursing home ▪ Non-residential condominium ▪ Condominium building with less than 75% of its total floor area in residential use ▪ Detached garage |

Small and middle market segment

While the industry has not reached a consensus on the range of coverage for properties in this segment, Andler, of Aon, typified small and middle market properties as having a \$1 million coverage limit (Andler, 2012). We do not have information that would further distinguish small from middle market.

In the small and middle markets, properties purchase insurance either from the NFIP or a combination of the NFIP and the private insurance firms. Since almost all standard property insurance policies have exclusions for flood coverage, property owners in this segment must, at least, purchase an all risk policy, which covers all perils, including flood, wind, and hail (Hartwig, 2012). There was no data available to us to determine the market penetration of flood insurance in either of these market segments. **Therefore, further analysis is needed to determine the extent of private insurance coverage in these segments.**

Large commercial and industrial market segment

This market segment is comprised of properties with flood insurance coverage of more than \$1 million, according to Andler. Property owners may buy the first \$500,000 of insurance through the NFIP, or they may choose to forego that option entirely and buy insurance solely from private firms. Andler stated that the large commercial sector is well covered for all types of disasters (Andler, 2012).

To cover a property for more than roughly \$25 million often requires more than one insurance company. Most insurers limit the amount of coverage they can provide on any single high-hazard property ranging anywhere from \$2.5 million to \$25.5 million (Andler, 2012). When property coverage exceeds an insurance company's limit, the broker will arrange for additional firms to assist in covering the property. The first insurer absorbs initial losses incurred up to a certain threshold. The second insurer then steps in to assume losses above that amount up to an established limit, and so on as needed. The following table shows a mock \$50 million policy for a property in an X zone. The policy is divided among 5 insurance companies.

| Mock Policy Liability: Large Commercial/Industrial Building | |
|---|---|
| RSUI: | \$25 million in coverage. Liable for damages between 25-50million. |
| Lloyds: | \$10 million in coverage. Liable for damages between \$15-25 million. |
| Essex: | \$5 million in coverage. Liable for damages between \$10-15 million. |
| Beazley: | \$5million in coverage. Liable for damages between \$5-10million. |
| Arch Specialty: | liable for any damages up to \$5 million (less the deductible). |

*Appendix C contains the coverage limitations for private insurers that participate in this market.

It is evident that insurance companies take on significant amounts of risk when assuming liability for flood, especially for high-valued commercial properties. Insurance companies may mitigate this, freeing capital and protecting against extreme loss, by transferring the risk to reinsurance firms.

Reinsurance

The reinsurance industry can have the greatest effect in reshaping the flood insurance market, according to Klaus Jacob, a disaster mitigation expert at Columbia University and a member of the NYC Panel on Climate Change. Since primary insurance companies decide to offer policies based on whether or not they can reinsure them, reinsurance firms determine the primary industry's general appetite for various forms of risk. The decision to reinsure and the rates these firms set for primary insurance policies influence the availability of policies and the rates for individual premiums in the primary market. Primary companies obtain such policies either directly or through reinsurance brokers (Sporn and Hedde, 2012).

Reinsurance companies determine the primary insurance industry's willingness to insure for flood. Primary insurance firms wishing to reinsure flood bundle the peril with other natural disasters and transfer the risk to reinsurers at a rate set by the reinsurer (Sporn and Hedde, 2012). Primary insurers transfer some risk to reinsurance firms in order to "increase the pool of capital available to support the risk" (Mills, 2001). In the absence of reinsurers "(insurers) would lack the financial reserve strength (surplus) to maintain existing insurance or take on new risks" (Mills, 2001)

Interviews with Munich Re and Swiss Re, the two reinsurance firms, which sell the most premiums worldwide (Burns, 2011), indicated that the reinsurance industry remains hesitant to absorb substantial flood risk, especially in the residential market segment, but also in the commercial sector. Munich Re will not assume liability for flood unless it is bundled with other natural perils and detailed information on loss potential is available (Sporn and Hedde, 2012). Primary insurance firms would not only need to bundle flood with other perils, but show that premiums adequately reflect risks, and present a capital asset pricing model with a rate of return acceptable to Munich Re (Sporn and Hedde 2012). Considering that the NFIP distorts price and that flood is difficult to predict, it should come as no surprise that Munich Re's flood risk exposure is very limited (Sporn and Hedde 2012).

Andrew Castaldi, Senior Vice President and Head of Catastrophe Perils at Swiss Re Americas, characterized the obstacles for reinsurance and primary insurance entry in the flood market as *regulatory* and *psychological*. The main regulatory issue has to do with the NFIP's pricing distortion, as premiums do not reflect the actual risk for properties whose NFIP premiums are subsidized. The NFIP is said to further distort pricing because it can operate even as the program carries a large operational deficit (\$18 billion stemming from losses related to Hurricane Katrina). Private firms would have to charge much higher premiums to prevent such deficits in cases of catastrophic floods. The psychological issue is that homeowners are disinclined to purchase policies, unless the risk is very high, leading to a "portfolio of adverse risks" (Castaldi, 2012).

From the perspective of the insurer this phenomenon is known as adverse selection. Insurers, particularly reinsurers that absorb large amounts of risk, aim to avoid aggregation of high-risk policies and strive to diversify their portfolios. Reinsurers also aim to be "financially positioned to discharge the obligations assumed in a timely fashion," which is especially challenging after a natural disaster (Castaldi, 2012).

Despite these obstacles, there are a number of primary insurers who have persuaded Swiss Re to support, and thus enable, their entrance into the Northeast flood market. With Swiss Re's backing, these primary insurers are currently working to provide either residential or commercial flood coverage, or both, in New York City and other markets in the Northeast, according to Castaldi. Throughout the United States Swiss Re works with roughly six clients attempting to enter the flood market (Castaldi, 2012). It is our

understanding that these private insurers would vie for discrete parts of the flood insurance market, where they could offer competitive rates.

Swiss Re supports these firms since they utilize at least one of the following three business models: under-pricing NFIP, out-pricing NFIP, and excess.

- Primary insurers **under-price** the NFIP by obtaining more accurate risk data than FEMA and offering less expensive premiums than the NFIP. Most often this occurs in select locations of the 100-year floodplain where risk is comparatively low for the area and private insurers can offer less expensive premiums than the NFIP;
- Swiss Re's clients are also seeking to **out-price** the NFIP, which is the same as under-pricing except through WYO policies;
- The final model is **excess**, or retaining liability above the NFIP coverage, which allows for more expensive premiums (Castaldi, 2012).

Climate Change and the Future of the Flood Insurance Market

Climate change is likely to increase the number of properties at risk of flood damage. One goal of our research was to understand industry views on flood risks in the United States, specifically New York City, and whether the industry factors climate change into its risk assessments. We found that, like many organizations, the private insurers have released statements through their websites and other outlets describing their actions or opinions regarding climate change. Rather than rely on those statements for our analysis, we instead researched the risk modeling technology insurers and reinsurers use to assess risk from various perils. Doing so offers important insight into whether climate change is a factor in how these firms set prices.

This section also contains information about reinsurers' views on climate change, obtained from interviews with representatives from leading reinsurance companies.

Catastrophe Models

Current catastrophe modeling

Catastrophe models provide a view of the present-day financial risks associated with catastrophes (natural and manmade) for a specific location or aggregated area and/or portfolio. They are used to support risk management decision-making in general and insurance and reinsurance pricing in particular (AIR, 2008). Models cover a range of perils, including inland flood, storm surge floods, winter storms, hurricanes, wildfire, tornado, earthquakes, infectious disease, terrorism, and more (RMS website). Catastrophe models are statistical models based on historical data and physical modeling (RMS, 2008).

Using catastrophe models, insurers can estimate their losses by inputting the locations of properties in their portfolio into the model. Some models also offer the potential for estimating market-wide losses (RMS, 2008). There are three major companies that create catastrophe models, and those are RMS, EQECAT, and AIR. Reportedly, 80% of private insurance companies use RMS models (Martin, 2012).

Climate change poses a significant challenge for catastrophe modelers. **Our analysis suggests that catastrophe modelers currently use historical data for all perils except Atlantic hurricanes.** In a 2010 statement posted online, RMS described their position on climate change:

As an independent leader in risk modeling, it is RMS' responsibility to determine whether there is enough scientific evidence to suggest that the frequency and severity of catastrophe events is changing to the extent that the historical record is no longer a sufficient baseline for determining medium-term activity rates. *The medium-term is defined as the next five years.* Currently, RMS considers *Atlantic hurricane* to be the *only modeled peril* for which the long-term historical average of annual event frequency is an *inadequate* indicator of future activity over the next five years (all emphasis ours) (RMS, 2010).

The uncertainty inherent in climate projections makes catastrophe modelers hesitant to use climate projections to model most future perils. AIR Worldwide, like RMS, makes an exception for hurricanes. AIR offers near term ("several years") projections meant as a "supplement to, rather than a replacement for, the standard catalog, which is based on more than 100 years of historical data and 20 years of research" (AIR, 2008). RMS has given essentially the same statement, writing "currently, [we] use climate model output to scale present-day climate models in cat models rather than replace it...[we] test a range of scenarios [and] interpret [them] as indicative of scale of impact" (RMS, 2008).

We heard a similar analysis from reinsurance companies. Both Munich Re and Swiss Re acknowledged the importance of climate change as a future risk, but neither firm indicated that it is using climate risk information in its pricing. A representative from Munich Re stated that, "(we) take the effects of climate change into account for long-term strategy, but are not currently reflecting climate change into current risk selection and pricing" (Sporn, 2012).

The explanation for why catastrophe modelers continue to favor historical data is relatively straightforward. One reason has to do with the constraints inherent in modeling climate change by using impact scenarios. "Impact projections from catastrophe models," according to RMS, "are only as good as the climate scenarios driving them" (RMS, 2008). Air Worldwide explains, in a 2008 report titled "Catastrophe Modeling in an Environment of Climate Change", that catastrophe modeling has historically been focused on assessing current risk, and more recently, "near term" risk (meaning several years into the future). To do this, modelers use long-term historical records to run tens of thousands of simulations of what may occur this year or next.

However, things become more complicated if the historical record can no longer inform the current risk environment (AIR, 2008). Some questions a modeler must answer include:

- Whether a given peril has a historical signature that is clearly distinguishable from what we are experiencing today;
- How that signature might change in the future, under various emissions scenarios. (AIR, 2008)

Another important challenge that constrains the use of future projections in catastrophe models is the need to distinguish between time scales. Relevant questions here include:

- What is the influence of climate change on natural catastrophes today?
- What will the nature of these perils be fifty or a hundred years from now (AIR, 2008)

The AIR report places particular emphasis on the importance of time scales, saying:

The clear separation of time scales is important because it has profound implications for the practical application of catastrophe modeling results, the conclusions drawn and appropriate mitigation strategies to adopt. **Should a homeowner's insurance premium reflect current hurricane risk in the Atlantic or what the risk will be in 2050? Few would argue the latter** (emphasis ours) (AIR, 2008).

AIR Worldwide notes it is important to remember that there are drivers of catastrophe risk other than climate change. The firm believes two risk drivers in particular are far more certain in how they will unfold in the future, and will have a far greater impact on insured losses today.

The first, and reportedly the most important driver, is the increase in the number and value of insured properties in areas of high hazard.

AIR estimates that 38% of the total exposure in Gulf and East Coast states is currently located in coastal counties, which accounts for 16% of the total value of properties in the US. Further, AIR estimates that the value of properties in coastal areas of the United States has roughly doubled over the last decade and there is, as yet, no sign that the rate of growth is slowing. That translates directly to a doubling every ten years (~7.0% annual rate) in insured losses *exclusive of any effect of climate change* (AIR, 2008).

To put climate change risks in perspective, AIR recommends comparing climate risks to these types of factors. For example, assuming a future climate scenario accurately predicts an increase in wind speeds of 6%, resulting in a 70% loss at 1% exceedance probability, it is roughly a 0.7% increase in insured losses each year (AIR, 2008). From AIR's perspective, an insurer should ask how a 0.7% annual increase compares with other risk factors? (AIR, 2008)

The second risk driver is “the quality and granularity of data that insurers capture about the properties they insure, including accurate replacement values and other construction characteristics.”

In an analysis of client data performed in 2005, AIR found significant and widespread undervaluation of the properties in insurers' portfolios. A property's

replacement value is the full cost to replace the building in the event of a total loss. Since catastrophe models estimate loss by applying vulnerability functions to the replacement value before applying insurance policy terms and conditions, accurate replacement values are essential for obtaining accurate catastrophe loss estimates. If a property's replacement value is understated by 25 percent, for example, the estimated ground up loss will be understated by that much. Which means that companies will be managing to a much lower level of risk than their true risk (AIR, 2008)

The future of catastrophe modeling

The combination of a warming planet, the uncertainty inherent in forecasting the impacts of climate change, and a business model in which accurate forecasting is essential, puts catastrophe modelers in a difficult position. Faced with climate change, an issue that threatens their value proposition, catastrophe modelers have become active in exploring the how to incorporate climate change into their models.

RMS, the leading modeler in the industry, set up a climate change practice in 2007 to “investigate the implications of climate change for the insurance and the catastrophe modeling industries, and to understand how RMS’ catastrophe risk expertise could be used to help decision-makers manage the risk from climate change” (RMS, 2008).

According to a presentation from 2008, posted online, “RMS [is] exploring how catastrophe models can be used to understand future impacts from extremes [using IPCC 2007 information], particularly to infrastructure, populations and the economy (RMS, 2008).

In the same presentation, RMS demonstrated what they believe to be the value of using a catastrophe model approach for climate change. As an example, they modeled potential future hurricane and surge losses in Florida in 2050. As inputs, they used sea level rise, scenarios of altered hurricane activity rates, and scenarios of exposure growth (RMS, 2008). Using this model, they claim an ability to investigate and possibly compare future losses due to exposure growth projections versus losses due to climate change, along with which adaptation measures work best, and where (RMS, 2008).

In summary, catastrophe models play a central role in how insurers and reinsurers set prices. Understanding whether, for which perils, and how far into the future catastrophe models make projections that incorporate impact scenarios is crucial to understanding how the insurance and reinsurance industries are pricing for future risks. While currently, Atlantic hurricanes are the only peril for which catastrophe modelers cannot rely on historic data to predict future losses, that catastrophe modelers are investing in the development of new models suggests that climate forecasts may soon be incorporated in predicting future losses. The extent to which the risks of climate change matter in pricing, relative to other risks, remains to be seen.

One variable that may impact the relative importance of climate change in pricing is whether insurance policies continue to be written on an annual basis. So long as policies are written on an annual basis premiums are likely to reflect current – not future – risk. Daniel Krokovic, VP of Energy Practice at Marsh, a leading insurance broker, indicated that annual policies are written because, with the number of loopholes in long-term policies, and the rapidly changing markets and risk factors, longer term policies do not benefit the insured or the insurers. From our research, we can speculate that companies would be unwilling to write flood-related policies that extend beyond one year because of the uncertainty to predict flood risk in the future.

The Emerging Picture

Climate change, which is expected to bring a rise in sea levels, is likely to increase the number of people and property in New York City (and worldwide) at risk of financial loss due to flood.

The federal government, in response to lagging supply and demand for flood insurance, created the NFIP and eventually mandated that anyone in an at-risk flood zone with a federally backed mortgage purchase flood insurance. Though well-intentioned, the NFIP now poses a number of challenges to New York City: it distorts price signals, leaves most property owners in New York City uninsured, and creates a barrier to entry for private insurers.

Private insurers, for their part, are well-capitalized (Martin, 2012). They are also, however, experiencing greater losses because of natural catastrophes than anytime in at least the past decade (Martin, 2012). Anecdotal evidence suggests that if risk from natural catastrophes continues to increase, insurers will limit their coverage in areas where the risk is deemed too high (Martin, 2012). Flood is an especially difficult risk to insure because, to paraphrase one insurance executive, you can engineer for wind, but you cannot engineer for flood. Once a basement is in place, it's there for good – the most you can do is move valuable property out of it (Martin, 2012).

Climate change, therefore, has the potential to create a situation in which the government's incentive to protect people directly clashes with insurers' incentives to restrict coverage due to increasing risk.

There are, as we have shown, other stakeholders who are positioned to influence the nature and availability of flood insurance in the future. Reinsurers are increasingly vocal about the threat of climate change, more so than primary insurers, perhaps because their interests are more tied to the long term. The catastrophe modelers, whose models are central to how insurers and reinsurers determine pricing, are aware that models based on historical data may soon be unable to forecast future risks accurately. In order to have a meaningful value proposition in the future, catastrophe models will likely need to incorporate various impact scenarios.

In this scenario, the most important role that local government could play in protecting people and property is to advocate for NFIP reform. This strategy, however, was outside the scope of our project. Our recommendations, therefore, are limited to practical steps that the City of New York can take within the existing market structure.

Recommendations

1. Conduct a more detailed market analysis

A market analysis that would enrich what we have found could serve as a stronger basis for developing strategies and policies that bolster the city's resilience to coastal flooding. A more detailed market analysis would also position the City of New York to better engage the insurance industry. Asked how the City may be able to work with the industry in increasing coverage in the residential flood insurance market, one executive said that a comprehensive market analysis was necessary: "Ask the City: What is the insured value of the state of New York? What is the largest insured location? What is the overall limit you'd be looking for? What is your largest loss estimate for single event – flood, wind?" (Martin, 2012). The analysis we are recommending would begin by determining the total number of properties at risk in both the 100-year floodplain and 500-year floodplain, as well as the size of each market segment.

2. Educate the public about the risk of flooding and the availability of flood insurance

A public education campaign that helps people understand the risk of flood and informs them about the availability of the NFIP could increase the number of insured properties in New York City. Using maps to illustrate the risk of flooding in particular neighborhoods may be an effective means to communicate risk to New Yorkers (Byrd, 2012). It would also be important to help property owners in the 100-year floodplain understand that ordinary property insurance excludes flood. One way to communicate this point would be by requiring that property owners who are not subject to NFIP requirements to sign waivers that clearly state that their basic property insurance does not provide for flooding (Ginsberg, 2012).

3. Strengthen collaboration with the NFIP

The City would benefit from closer collaboration with the NFIP, as it provides most of the flood insurance coverage in New York. Currently, the only City agency that is tasked with collaborating with the NFIP Region II Coordinator (Region II includes NY & NJ) is the Department of Buildings (DOB). The DOB's role though, is limited to the enforcement of building codes only. There is no City agency that aggregates information on insurance policies and coverage, or coordinates and analyzes information having to do with FIRMS⁵, zoning plans, and properties at risk. A task force could be created specifically to aggregate, analyze, and share information across city agencies and other stakeholders.

⁵ The DOB analyzes FIRMS to a small extent

4. Engage the reinsurance industry

Reinsurers, more than primary insurance companies, are better positioned to underwrite flood insurance coverage in currently uninsured segments of the market, as well as to integrate climate risk information in the pricing of flood insurance. Individual insurance firms would be unable to enter the flood insurance market unless they had the backing of reinsurers and they would jeopardize their competitiveness by unilaterally raising prices to account for climate change. The City of New York, therefore, ought to engage the reinsurance industry primarily as it considers how insurance can help address coastal flooding.

5. Explore the use of catastrophe bonds

As one insurance executive suggested, the City, like primary insurers, could turn to so-called catastrophe bonds to manage flood risk (Martin, 2012). Catastrophe bonds are risk-linked securities used to cover losses resulting from natural disasters. In the absence of reinsurance, primary insurers often transfer risk to the capital markets in the form of catastrophe bonds and other financial instruments (Sporn, 2012). Catastrophe bonds were primarily developed in the 1990s in the aftermath of Hurricane Andrew and the Northridge Earthquake, natural disasters that presented severe liquidity problems for insurers. These financial instruments are used either when insurers have not purchased enough reinsurance or reinsurers do not have “sufficient capital to meet their existing obligations.” These mechanisms, however, represent a small share of the property-casualty market, less than 0.5%, according to Swiss Re (Nelligan, 2002).

Supplemental Information

Appendix A

Eligibility Requirements for Preferred Risk Policies:

Loss History: A building's eligibility for the PRP is based on the preceding requirements and on the building's flood loss history. If one of the following conditions exists within any 10-year period, regardless of any change(s) in ownership of the building, then the building is not eligible for the PRP:

- 2 flood insurance claim payments for separate losses, each more than \$1,000; or
- 3 or more flood insurance claim payments for separate losses, regardless of amount; or
- 2 Federal flood disaster relief payments (including loans and grants) for separate occurrences, each more than \$1,000; or
- 3 Federal flood disaster relief payments (including loans and grants) for separate occurrences, regardless of amount; or
- 1 flood insurance claim payment and 1 Federal flood disaster relief payment (including loans and grants), each for separate losses and each more than \$1,000.

Since 1991, the NFIP has administered a Mortgage Portfolio Protection Program to serve as a 'last resort' for members of the mortgage lending industry to comply with NFIP requirements. The program offers a standard policy available to lenders whose mortgagors have failed to obtain a required policy. Lenders have specific obligations to contact their mortgagors before writing a policy under this program.

Scheduled Building Policies are offered to cover a group of up to ten buildings. To qualify, all buildings must have the same ownership and the same location and the properties on which the buildings are located must be contiguous.

Direct Program policies are offered in response to a federal disaster. Applicants for federal relief assistance receive a minimum amount of building and/or contents coverage for a 3-year policy period in exchange for a model premium.

Appendix B

The Community Rating System, or CRS, is a voluntary point system in which communities that are part of the NFIP can participate. The CRS provides incentives for communities to lower their flood insurance premiums through a range of regulations and activities. For example, through the CRS, a community can create a public awareness program, create higher standards for buildings, and improve their storm water management system. In doing so, a community could earn points that could lower the flood insurance premiums of up to 45% (FEMA, 2007).

The point system includes ten classes that reflect the discounts of the premiums, depending on whether or not the community is in a Special Flood Hazard Area, or SFHA.

| How much discount property owners in your community can get | | | |
|---|-------|----------|------------------------|
| Rate Class | SFHA* | Discount | Credit Points Required |
| 1 | 45% | 10% | 4,500 + |
| 2 | 40% | 10% | 4,000 – 4,499 |
| 3 | 35% | 10% | 3,500 – 3,999 |
| 4 | 30% | 10% | 3,000 – 3,499 |
| 5 | 25% | 10% | 2,500 – 2,999 |
| 6 | 20% | 10% | 2,000 – 2,499 |
| 7 | 15% | 5% | 1,500 – 1,999 |
| 8 | 10% | 5% | 1,000 – 1,499 |
| 9 | 5% | 5% | 500 – 999 |
| 10 | 0% | 0% | 0 – 499 |
| * Special Flood Hazard Area | | | |
| ** Preferred Risk Policies are available only in B, C, and X Zones for properties that are shown to have a minimal risk of flood damage. The Preferred Risk Policy does not receive premium rate credits under the CRS because it already has a lower premium than other policies. Although they are in SFHAs, Zones AR and A99 are limited to a 5% discount. Premium reductions are subject to change. | | | |

SOURCE: NFIP Community Rating System: A Local Official's Guide 2006

The CRS has been proven to work in small communities (Griggs, 2012), but is challenging for New York City. The City of New York is considered one community, and the scale of coordinating activities and practices is difficult. To illustrate, New York City must provide FEMA with 100% of its building elevation certificates. The NYC Department of Buildings, the administrator of the NFIP in NYC, may not have the capacity to do such. Also, the scale of implementing such activities as improving the city's storm water management system is expensive and could take too long. The task of coordinating activities and implementing regulations in NYC, for the purpose of enrolling in the CRS, is a problem of scale.

Appendix C

Flood Insurance Market Participant List:

| Carrier | Flood Capacity |
|--|---|
| Endurance | \$10m (Primary, buffer or excess) Can include Flood Zone A |
| AXIS Specialty | \$10M for CAT |
| Hartford Marine | \$10mm or up to \$25MM in zone C or unshaded X |
| Beazley | \$2.5M Zone A; \$5M other |
| SC&F (Seneca, Crum & Foster) | \$2.5mm |
| Swiss Re E&S | \$25mm Flood Zones A & B |
| Berkshire | \$500M |
| Price Forbes - Equinox | \$5M Flood capacity |
| Essex | \$5MM |
| Arrowhead | A, V, Shaded X excluded |
| ASPEN Specialty | Can offer a sub-limit |
| WKF&C | No (Zones A, V and X are excluded) |
| Commonwealth | No restrictions (\$50,000 per mil) |
| Diamond State | No zone A/V |
| RSUI | Varies \$5M-\$25M depending on zones |
| ACE Westchester | Yes |
| American Empire | Yes |
| AmRisc | Yes |
| AWAC | Yes |
| Britt Paulk | Yes |
| Fireman's Fund | Yes |
| FloodWatch/FPRSI | Yes |
| Global Excess Partners- Inland Marine Facility | Yes |
| Global Excess Partners- Middle Market Property Facility | Yes |

| Carrier | Flood Capacity |
|---|--|
| Hartford | Yes |
| James River (Excess Property) | Yes |
| Maiden Re | Yes |
| Performance Trust (underwriters @ Lloyds) | Yes |
| THB Group (Lloyd's Broker) | All zones including A,V and Cobra zones. From Ground Up or Excess of available NFIP limits \$10M maximum limit |
| Kinsale | Yes \$5M |
| Arch Specialty | Yes \$2.5m - \$5m for Zone A |
| WKF&C- Chubb Paper | Zones C & X \$5mm max; Zones B and Shaded X \$2.5mm max; Zones A & V \$1mm max |

(Carille and Krokovic, 2012)

Appendix D

FEMA has an alphabetically coded flood hazard system. Within this system, the areas below are those covered in this report (FEMA, 2002):

Zone A: An area with a 1% annual chance of having a flood event, and a 26% chance of a flood event impact over the life of a 30-year mortgage.

Zone V: Coastal areas with a 1% or greater chance of having a flood event and increased exposure to storm wave hazards. These areas also have a 26% chance of having a flood event over the life of a 30-year mortgage.

Within the context of climate change, FEMA has begun adjusting the existing Flood Insurance Risk Maps (FIRMs), and planners nation wide expect 100-year floodplains to grow beyond their current areas. The expectation is that the 100-year floodplains will converge with 500-year floodplains. According to NFIP this, zone is understood as follows:

Zone X: An area of moderate flood hazard exposure, between the limits of the 100-year and 500-year floods.

NFIP PREMIUMS

NONRESIDENTIAL: Standard Rated Policy for Coastal Areas (V ZONES)

(PRE-FIRM)

A nonresidential policy, based on standard rates, for coastal high-risk areas offers three types of coverage: Building & Contents, Building Only, and Contents Only.

| Building & Contents | | Building Only | | Contents Only | |
|---------------------|-----------------------------|---------------|-----------------------------|---------------|-----------------------------|
| Coverage | Annual Premium ¹ | Coverage | Annual Premium ¹ | Coverage | Annual Premium ² |
| \$100,000/\$50,000 | \$2,280 | \$50,000 | \$660 | \$50,000 | \$1,110 |
| \$200,000/\$100,000 | \$4,990 | \$100,000 | \$1,210 | \$100,000 | \$2,180 |
| \$300,000/\$200,000 | \$11,905 | \$200,000 | \$2,850 | \$200,000 | \$5,835 |
| \$400,000/\$300,000 | \$20,335 | \$300,000 | \$6,110 | \$300,000 | \$11,005 |
| \$500,000/\$400,000 | \$28,750 | \$400,000 | \$9,370 | \$400,000 | \$16,175 |
| \$500,000/\$500,000 | \$33,920 | \$500,000 | \$12,615 | \$500,000 | \$21,345 |

¹ Includes a Federal Policy Fee of \$40 and ICC Premium.

² Higher deductible limits are available, up to \$50,000 for Non-Residential properties.

HIGH-RISK AREAS

► RESIDENTIAL: STANDARD-RATED POLICY (A ZONES)

▼ RESIDENTIAL: STANDARD-RATED POLICY FOR COASTAL AREAS (V ZONES)

A residential policy, based on standard rates, for coastal high-risk areas offers three types of coverage: Building & Contents, Building Only, and Contents Only.

| BUILDING & CONTENTS | | BUILDING ONLY | | CONTENTS ONLY | |
|-------------------------|-----------------------------|---------------|-----------------------------|---------------|-----------------------------|
| Coverage | Annual Premium ¹ | Coverage | Annual Premium ¹ | Coverage | Annual Premium ² |
| \$35,000/ \$10,000 | \$580 | \$35,000 | \$457 | \$10,000 | \$163 |
| \$50,000/ \$15,000 | \$790 | \$50,000 | \$605 | \$15,000 | \$225 |
| \$75,000/ \$20,000 | \$1,205 | \$75,000 | \$959 | \$20,000 | \$286 |
| \$100,000/ \$30,000 | \$1,838 | \$100,000 | \$1,384 | \$30,000 | \$494 |
| \$125,000/ \$40,000 | \$2,554 | \$125,000 | \$1,809 | \$40,000 | \$785 |
| \$150,000/ \$50,000 | \$3,270 | \$150,000 | \$2,234 | \$50,000 | \$1076 |
| \$250,000/ \$100,000 | \$6,410 | \$250,000 | \$3,919 | \$100,000 | \$2,531 |

¹ Includes a Federal Policy Fee of \$40 and ICC Premium.

² Higher deductible limits are available, up to \$5,000 for single-family properties.

*Both charts are from (FloodSmart, 2012)

Appendix E

INSURANCE TERMS

Admitted company

A company licensed or authorized to sell insurance to the general public. In the United States, admitted companies are licensed on a state-by-state basis and differentiated from surplus lines insurers, which are authorized to sell insurance in a state on a non-admitted basis.

Adverse selection

An imbalance in an exposure group created when persons who perceive a high probability of loss for themselves seek to buy insurance to a much greater degree than those who perceive a low probability of loss.

Agent

A person or organization who/that is authorized to act on behalf of another. An insurance agent is a person or organization who/that solicits, negotiates, or instigates insurance contracts on behalf of an insurer, and can be independent or an employee of the insurer. Insurance agents are the legal representatives of insurers, rather than policyholders, with the right to perform certain acts on behalf of the insurers they represent, such as to bind coverage.

Aggregate excess of loss reinsurance

A form of reinsurance that stipulates participation by the reinsurer when aggregate excess losses for the primary insurer exceed a certain stated retention level.

All risks coverage

Property insurance covering losses arising from any fortuitous cause except those that are specifically excluded. This is in contrast to named perils coverage, which applies only to loss arising out of causes that are listed as covered. Although many industry practitioners continue to use the term "all risks" to describe this approach to defining covered causes of loss in a property insurance policy, it is no longer used in insurance policies because of concern that the word "all" suggests coverage that is broader than it actually is. Because of this concern, some industry practitioners have begun to use the term "open perils" or "special perils" instead of "all risks."

Alternative market

A term commonly used in risk financing to refer to one of a number of risk funding techniques (e.g., self-insurance, captive) or facilities (e.g., ACE, XL) that provide coverage or services outside the realm of that provided by most traditional property and casualty insurers. The alternative market may be utilized by large corporations, for example, to provide high limits of coverage over a large self-insured retention, or by smaller entities participating in a risk retention group or group captive program. Note that the distinction between traditional and alternative markets tends to blur over time as many traditional insurers expand their offering of products to encompass alternative type funding techniques, and vice versa. Also, retrospective rating plans, especially paid loss plans, are sometimes identified with the alternative market.

Alternative risk financing facilities

Any risk financing mechanism that does not involve a commercial insurance company, e.g., captive insurers, risk retention groups, pools, and individual self-insurance.

Broker

An insurance intermediary who/that represents the insured rather than the insurer. Since they are not the legal representatives of insurers, brokers, unlike independent agents, often do not have the right to act on behalf of insurers, such as to bind coverage. While some brokers do have agency contracts with some insurers, they usually remain obligated to represent the interests of insured rather than insurers. For example, some state insurance codes impose a fiduciary responsibility to act on behalf of their customers or provide full disclosure of all their compensation from all sources.

Building and personal property coverage form (ISO)

The key Insurance Services Office, Inc. (ISO), direct damage coverage form. This form (CP 00 10) covers buildings, business personal property, and personal property of others for direct loss or damage, subject to the limits shown in the declarations for each of these categories. Also provides additional coverage and coverage extensions, including: debris removal, pollutant cleanup, preservation of property, fire department service charges, increased cost of construction, electronic data, newly acquired or constructed property, personal effects and personal property of others, off-premises property, valuable papers and records, outdoor property, and non-owned detached trailers.

Business income coverage

Insurance covering loss of income suffered by a business when damage to its premises by a covered cause of loss causes a slowdown or suspension of its operations during the time required to repair or replace the damaged property. There are two Insurance Services Office, Inc. (ISO), business income coverage forms: the business income and extra expense coverage form (CP 00 30) or the business income coverage form without extra expense (CP 00 32).

Catastrophe bond

A derivative debt investment vehicle issued by insurers and reinsurers designed to raise investor capital to cover catastrophic loss events. "Cat" bonds are issued to cover either a specifically identified event (e.g., a Japanese earthquake) or the possibility of a certain magnitude of loss associated with hurricane activity in a particular geographic location (e.g., the Texas Gulf coast). Unlike traditional reinsurance that is highly leveraged (i.e., reinsurance limits sold represent many multiples of a reinsurer's capital), "cat" bonds carry no such leverage since their value is equal to the amount of insurance limits for sale.

Catastrophe reinsurance

A form of reinsurance that indemnifies the ceding company for the accumulation of losses in excess of a stipulated sum arising from a single catastrophic event or series of events.

Climate change risk

A risk facing business and governmental entities resulting from climate change and affecting natural and human systems. A common approach in dealing with this loss exposure focuses on reducing the vulnerability associated with climate risk by incorporating climate-sensitive decision-making in the risk management process. The risk manager takes climate-related decisions or actions that make sense in overall business strategy terms, whether or not a specific climate threat actually materializes in the future. Three examples include green house gas (GHG) emission reduction efforts, energy conservation, and the adoption of green building measures and approaches. Climate change risks include physical risks, litigation risks, reputational risks, stockholder risks, regulatory risks, and competition risks.

Commercial property coverage forms (ISO)

Insurance Services Office, Inc. (ISO), commercial property forms that define, limit, and explain what property or property interest is covered. An ISO commercial property policy consists of: one or more coverage forms; one or more causes of loss forms; the commercial property conditions form; and the common policy conditions form. The most widely used ISO commercial property coverage forms are the building and personal property coverage form (CP 00 10) and the business income and extra expense coverage form (CP 00 30).

Deductible

A portion of covered loss that is not paid by the insurer. Most property insurance policies contain a per-occurrence deductible provision that stipulates that the deductible amount specified in the policy declarations will be subtracted from each covered loss in determining the amount of the insured's loss recovery.

Difference-in-conditions (DIC) insurance

(1) An all risks property insurance policy that is purchased in addition to a commercial property policy to obtain coverage for perils not insured against in the commercial property policy (usually flood and earthquake). (2) An endorsement to a contractor's blanket builders risk insurance policy that fills the gaps between a policy provided by the project owner and the contractor's policy. When a project owner elects to provide the builders risk coverage for all parties with an insurable interest, the project is normally removed from coverage under the contractor's policy. A DIC endorsement typically states that, to the extent a loss is not covered under the owner-provided policy, but would be covered under the contractor's policy, coverage will apply on an excess basis.

Digital Flood Insurance Rate Map (DFIRM)

A flood insurance map developed by the Federal Emergency Management Agency (FEMA) for use with Geographic Information Systems (GIS) technology. This product is considered an "intelligent" map, more than just digital drawings. The map is a computer-based analytical tool that can be used for automated analysis and map updates that are not possible with the current paper maps. DFIRM data are now available for many of the highest flood risk areas.

Excess and Surplus (E&S) lines insurance

Any type of coverage that cannot be placed with an insurer admitted to do business in a certain jurisdiction. Risks placed in excess and surplus lines markets are often substandard as respects adverse loss experience, unusual, or unable to be placed in conventional markets due to a shortage of capacity. Captives sometimes qualify as E&S companies. Hefty local premium taxes are payable by the broker.

Exclusive agency system

An insurance distribution system through which agents represent only one company or a group of companies under similar management.

Exposure rating

A method of rating, usually applied to excess of loss reinsurance, under which the rate is determined based on an analysis of the exposure inherent in the business to be covered and not on the loss experience the business has demonstrated in the past. Both exposure rating and loss rating can be used by the reinsurance underwriter to determine the price that is quoted.

Flood coverage

Coverage for damage to property caused by flood. May be available by endorsement to an all risks policy or to a difference-in-conditions policy. Normally, the coverage provided is subject to a per occurrence sublimit, an annual aggregate limit, and a separate deductible. Coverage may also be available from the National Flood Insurance Program (NFIP)

Flood exclusion

A provision found in nearly all property insurance policies (even in all risk policies) eliminating coverage for damage by flood. May also eliminate coverage for other types of water damage, such as seepage and sewer backup. Flood coverage can sometimes be provided by endorsement. If not, a separate flood insurance policy may be available from the National Flood Insurance Program (NFIP).

Flood insurance rate map (FIRM)

The official flood insurance map of a community on which the Federal Emergency Management Agency (FEMA) has indicated both the special flood hazard areas and the risk premium zones for the designated community. It is the most common map that FEMA produces, used by a variety of parties. Insurance agents and insurers use the FIRM to determine the extent of the flood risk faced by properties and buildings. Community officials use the FIRM to administer floodplain management regulations and to mitigate the loss exposure to floods. Lending institutions and federal government entities use the FIRM to locate properties and buildings in relation to mapped flood hazards and to ascertain whether flood insurance is required when making loans or providing grants to rebuild structures following a disaster.

Hard market

One side of the market cycle that is characterized by high rates, low limits, and restricted coverage.

Independent agency system

A system of marketing insurance through independent contractors (agents) who sell insurance on a commission or fee basis with one or more insurers. In contrast to the direct marketing system, the independent agent retains ownership, use, and control of policy records and expiration data.

Insurance Information Institute (III)

An educational, fact-finding, and communications organization for the property and casualty insurance industry. The III is supported by several hundred member insurance companies and serves as the industry's primary public relations organization.

Large line capacity

An insurer's financial ability to assume a significant exposure under a single primary or excess insurance policy. Often, this capacity depends on the aggregations of losses among policies and the amount covered under each one. For exposures above the large line capacity, reinsurance is the recommended option.

Lead reinsurer

This refers to the reinsurer that negotiates the terms, conditions, and premium rates and first signs on to the line slip; reinsurers that subsequently sign on to the same slip are considered following reinsurers and are bound by the same terms and conditions to which the lead reinsurer agreed.

Line of business

A general classification of insurance industry business, e.g., fire, life, health, liability.

Lloyd's of London

An association of independent underwriters operating in England. It is not an insurance company; rather, it operates as a marketplace for large and/or unusual insurance exposures where brokers representing insurance applicants are able to contract with underwriters offering coverage.

Mutual company

A corporation owned and operated by and for its insurers. Every owner of the company is an insured; every insured is an owner.

Named perils coverage

A property insurance term referring to policies that provide coverage only for loss caused by the perils specifically listed as covered. It contrasts with all risks coverage, which applies to loss from all causes not specifically listed as excluded.

National Association of Insurance Commissioners (NAIC)

An organization of all state insurance commissioners that meets periodically to discuss insurance industry problems and issues that might require legislation or regulation. It also addresses the need to make the various state laws more uniform for insurance companies and other parties.

National Flood Insurance Program (NFIP)

A federally funded program established in 1968 to make flood insurance available at a reasonable cost for properties located in participating communities. NFIP flood insurance is available only for direct damage to buildings and contents; there is no time element coverage.

Non-admitted insurer

An insurance company not licensed to do business in a certain state or country. In U.S. jurisdictions, such insurers can nevertheless write coverage through an excess and surplus lines broker licensed in that jurisdiction.

Non-admitted reinsurance

Reinsurance purchased from a company not licensed or authorized to transact business in a particular jurisdiction. Nonadmitted

reinsurance may not be treated as an asset against reinsured losses or unearned premium reserves for insurance company accounting and statement purposes.

Off-balance-sheet risk

The risk posed by factors not appearing on an insurer's or reinsurer's balance sheet. Excessive (imprudent) growth and legal precedents affecting defense cost coverage are examples of off-balance-sheet risk.

Peril

Cause of loss, e.g., fire, windstorm, collision.

Property insurance

First-party insurance that indemnifies the owner or user of property for its loss, or the loss of its income-producing ability, when the loss or damage is caused by a covered peril, such as fire or explosion. In this sense, property insurance encompasses inland marine, boiler and machinery, and crime insurance, as well as what was once known as fire insurance, now simply called property insurance: insurance on buildings and their contents.

Reinsurance

A transaction in which one party, the "reinsurer," in consideration of a premium paid to it, agrees to indemnify another party, the "reinsured," for part or all of the liability assumed by the reinsured under a policy of insurance that it has issued. The reinsured may also be referred to as the "original" or "primary" insurer, or the "ceding company."

Reinsurance/Hedging strategy optimization

The determination of the optimal reinsurance/hedging program, reflecting program costs and risk reduction capability; usually conducted through candidate analysis. The risk reduction capability manifests itself in terms of both reduction in required economic capital and reduction in the cost of capital or required risk-adjusted rate of return.

Replacement cost coverage

A property insurance term that refers to one of the two valuation methods for establishing the value of most of the insured property for purposes of determining the amount the insurer will pay in the event of loss. It is usually defined in the policy as the cost to replace the damaged property with materials of like kind and quality, without any deduction for depreciation.

Retail agent

An insurance agent who acts as an intermediary between an insured and the marketplace. In some instances, retail agents deal directly with an insurer in arranging coverage, while in others, retail agents work with managing general agents or wholesale brokers to secure coverage for their client-insured.

Risk appetite

The degree to which an organization's management is willing to accept the uncertainty of loss for a given risk when it has the option to pay a fixed sum to transfer that risk to an insurer.

Risk management process

The process of making and implementing decisions that will minimize the adverse effects of accidental business losses on an organization. Making these decisions involves a sequence of five steps: identifying and analyzing exposures to loss, examining feasible alternative risk management techniques to handle exposures, selecting the most appropriate risk management techniques to handle exposures, implementing the chosen techniques, and monitoring the results. Implementing these decisions requires performing the four functions of the management process: planning, organizing, leading, and controlling resources.

Single interest insurance

Property insurance protecting the interest of only one of the parties having an insurable interest in the property. Usually refers to insurance protecting a mortgagee or other lending institution but not the owner-borrower.

Soft market

One side of the market cycle that is characterized by low rates, high limits, flexible contracts, and high availability of coverage

Special causes of loss form (ISO)

One of the three Insurance Services Office, Inc. (ISO), causes of loss forms; an ISO commercial property policy must include one or more causes of loss forms. This form (CP 10 30) provides what is commonly referred to as "all risks" coverage: coverage for loss from all causes not specifically excluded.

Special flood hazard areas (SFHA)

A term used by the Federal Emergency Management Agency (FEMA) in the National Flood Insurance Program (NFIP) to refer to the land area covered by the floodwaters of the base or 100-year flood (an area of land which has an approximate 1 percent probability of a flood occurring on it in any given year). In these areas, the NFIP floodplain management regulations must be enforced and the mandatory purchase of flood insurance applies. Structures located in SFHAs have a 26 percent chance of suffering flood damage over the normal 30-year life of a loan, according to FEMA. Structures that are not located in SFHAs are viewed as less subject to flooding.

SFHAs are identified in flood insurance rate maps (FIRMs).

Storm surge

Water that is pushed toward the shore due to the force of winds swirling around a storm advancing across a body of water. This advancing surge combines with the normal tides to generate the hurricane storm tide, which can lead to severe flooding in coastal areas. Numerous coverage disputes over the applicability of flood exclusions to storm surge losses caused by major hurricanes, such as Katrina (often called "wind versus water" cases), have arisen because this term is not often listed as an excluded peril in property insurance forms. Most courts, however, have ruled against coverage for these losses under standard property insurance policies, stating that "storm surge" is little more than a synonym for a "tidal wave" or "wind-driven flood," both of which are excluded under most property forms. In summary, the courts have generally ruled that only flood insurance policies cover these losses.

Surplus lines broker

A broker who is licensed to place coverage with non-admitted insurers (insurers not licensed to do business in a given state). Surplus lines insurers can write coverage through a surplus lines broker if the broker is licensed in the state where coverage is being written. The types of risks typically written by surplus lines brokers are generally substandard risks (e.g., risks with adverse loss experience), unusual risks, and risks for which there is a shortage of capacity in the admitted market.

Underwriting

The process of determining whether to accept a risk and, if so, what amount of insurance the company will write on the acceptable risk, and at what rate. Underwriters are companies, individuals, or insurance companies who carry on this critical activity for their own account or for that of others.

Underwriting risk

Risk of loss borne by insurers and reinsurers. It can take the form of underestimated liabilities from business written in past years (i.e., applying to expired policies) that remain unpaid, or current business (i.e., unexpired policies) that is underpriced.

Wholesale broker

A broker who acts as an intermediary between a retail agent and an insurer, while having no contact with the insured. There are two types of wholesale brokers: managing general agents and surplus lines brokers. The latter work with the retail agent and the insurer to obtain coverage for the insured; but unlike a managing general agent, a surplus lines broker does not have binding authority from the insurer.

Source: International Risk Management Institute, Inc. (IRMI), provider of insurance information to insurance professionals. <http://www.irmi.com>

Appendix F

List of Interviewees

| Name | Organization | Title |
|--------------------|---|---|
| Alexandra Vinceti | Lloyd's of London | Researcher, exposure management |
| Alice LeBlanc | American Insurance Group (AIG) | Independent consultant |
| Andrew Logan | Ceres | Director of Oil & Gas and Insurance Program |
| Andy Castaldi | Swiss Re | Sr V.P & Head of Catastrophe Perils |
| Brenda Kenny | Mortgage Bankers Association of New York, Inc. | Assistant |
| Carl Hedde | Munich Reinsurance America, Inc., | Senior Vice President-the Head of Risk Accumulation |
| Clare Salustro | Risk Management Solutions (RMS) | Associate Manager |
| Daniel Carille | Marsh at Marsh & McLennan Companies Inc. | Associate Client Executive |
| Daniel C. Krokovic | Marsh at Marsh & McLennan Companies Inc. | VP Energy Property |
| David Ginsberg, | DMG Insurance and Financial Services (Florida) | Principal |
| David Major | Center for Climate Systems Research (CCSR), Columbia University Earth Institute | Senior Research Scientist |
| Eric Nordman | National Association of Insurance Commissioners (NAIC) | Directory of Regulatory Services |
| Gary Venter | Gary Venter Company; Columbia University | Actuary-in-Residence |
| George Deodatis | Columbia University School of Engineering and Applied Science | Professor |
| Heather Roiter | The NYC Office of Emergency Management (OEM) | Planner |

| Name | Organization | Title |
|---------------------|--|--|
| Howard Kunreuther | The Wharton School of the University of Pennsylvania | Professor |
| James E. Branigan | Omega Risk Management LLC. | President & CEO |
| Jeroen C.J.H. Aerts | IVM Institute for Environmental Studies | Professor |
| Jeff Hinsely | Farmers Insurance | National Flood Program Manager and Eastern Zone Affinity Sales Manager |
| Joshua Friedman | NYC Office of Emergency | Hazard Impact Modeler, GIS Division |
| Joe Dominguez | State Farm | Insurance Agent |
| Klaus Jacob | Earth Institute Lamont-Doherty Earth Observatory | Special Research Scientist |
| Lloyd Dixon | RAND Corp | Researcher |
| Mark L. Schussel | Chubb Group of Insurance Companies | VP Public Relations |
| Mary Colvin | FEMA | National Flood Insurance Program |
| Matthew Sporn | Munich Reinsurance America, Inc. | |
| Maurice Morgenstern | NYS Department of Financial Services (Insurance) | Deputy Bureau Chief |
| Mike Martin | XL Insurance America | Chief Property Underwriting Officer |
| Neil Pederson | Earth Institute Lamont-Doherty Earth Observatory | Assistant Research Professor |
| Patricia Griggs | Department of Homeland Security | NFIP |
| Paula Tremblay | MassMutual Financial Group | Assistant VP, Communications |
| Ray de Cuarta | Bank of America Loan Office | Bay Harbour-Florida Office |
| Robert Hartwig | Insurance Information Institute | President III, NY |
| Robert Pertain | Provident Savings Bank | Director of Marketing |
| Sabrina McCormick | Evidence Based Media | President |
| Sam Garcia | Mortgage Daily (Dallas, TX) | Editor |

| Name | Organization | Title |
|------------------|---|-----------------------------------|
| Sharlene Leurig | Ceres | Senior Manager, Insurance Program |
| Shaun Marosy | Tokio Marine | Property Underwriter |
| Sonia Pollack | Aon Risk Solutions | Senior VP—Account Executive |
| Steve Pincus | Willis Group Holdings plc | Executive Vice President |
| Terese Rosenthal | Munich Reinsurance America, Inc. | Head of Marketing Communications |
| Timothy Scoville | CSC/NFIP | IT Maintenance Manager |
| Wouter Botzen | IVM Institute for Environmental Studies | Researcher |

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