WATER IS COMING: PLANNING FOR THE FUTURE OF NORTH CAROLINA FLOOD RISK

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Executive Summary

Hurricane Florence magnifies existing concerns about North Carolina's flood risk and the resultant costs of flood insurance. Floods are the most common and most destructive natural disaster in the United States, with 90 percent of natural disasters involving flooding and all 50 states having experienced floods or flash floods in the past five years (National Association of Insurance Commissioners and Floodsmart.gov). In North Carolina, flooding can result from multiple alternative sources – flash flooding, river flooding, tropical storms and related coastal flooding, dam breaks/levy failure, snow melts and debris blockages.

The damage to U.S. homes and businesses from a flood generally is not covered under a property insurance policy, but is instead covered by a special flood insurance policy that is federally backed by the National Flood Insurance Program (NFIP). The NFIP, meanwhile, is under tremendous financial pressure and faces an uncertain future.

The U.S. Geological Survey's floodplain maps, upon which flood insurance requirements have historically been based, are best understood as estimates — and not necessarily reliable ones. Experts agree a large portion of the flood-risk maps are obsolete, and thus the premiums charged under the NFIP do not reflect actual risk. Indeed, FEMA estimates that 15 to 20 percent of insured flood claims happen outside the USGS designated floodplains.

Widely thought to be the best course of action, flood insurance privatization is being considered strongly at Federal and state government levels. Numerous flood risk/loss models are being developed to assist in risk pricing and aggregation for this eventuality. The North Carolina Surplus Lines Association (NCSLA) recognizes the need for improved information regarding the state's exposure to flood, its historic flood losses, flood insurance needs and alternatives for administering and funding flood insurance for residential and commercial property owners in the state.

The NCSLA invited AppR.I.S.E (Appalachian Risk Initiative for Student Engagement) within the Brantley Risk & Insurance Center at Appalachian State University to conduct a flood risk and insurance research project with the overall purposes to review flood exposure and potential in North Carolina and assess the possibility of expanding the private flood insurance market.

North Carolina is well positioned to increase its flood insurance offerings and market penetration with or without the NFIP. Various structures for achieving growth are laid out in the body of this report.

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Executive Summary – Key Findings

- Despite the known benefits of insurance there is a large insurance gap in the U.S., with an estimated 12-15 percent of homeowners having flood insurance. In North Carolina, the gap may be worse than the overall U.S. gap. Based on one estimate, using U.S. Census occupancy estimates and NFIP policy data, North Carolina single-family dwelling homeowners may be insured at a rate as low as 5 percent.
- North Carolina property owners have been especially hard hit by recent tropical storms, with Matthew and Florence wreaking havoc not only in coastal areas, but well inland, even impacting localities in the Western Carolina mountains. Florence resulted in 39 deaths in NC and caused a record $23 billion in damage ("Storms to Life" Report, 2018). Although Hurricane Hazel of 1954 was a more powerful and intense storm, Florence had a bigger financial impact on the state, even after inflation adjusting Hazel's impact.
- Every North Carolina county has significant exposure to flood loss, and every county has experienced at least three flood events, with Mecklenburg County having experienced the most frequency at 95 floods. It is notable that the coastal counties, even those with significant flooding history, have at most experienced roughly half the numbers of floods as has Mecklenburg and other high-flood-frequency inland counties.
- North Carolina is ranked 7th in the nation both in terms of properties at risk of flood as well as value at risk. As of May 31, 2018, NFIP Building Total Insured Value (TIV) exposure across single-family permanent dwellings in North Carolina totaled just under $33 billion, with Building Limits of just under $26 billion.[1]
- As one might expect, the exposure data reveal the highest total NFIP exposure in North Carolina lies in the coastal zip codes. For instance, in Currituck and Dare Counties, three zip codes hold NFIP Building TIV exposure in excess of $1 billion. These high exposures are largely owing to the volume of property owners (at least 2,500 in each zip code above) for whom flood insurance is mandatory, rather than to the value of the building stock, as none of these zip codes averages a Building TIV of greater than $400,000.
- The highest average Building TIVs in the NFIP program are in Duplin (Inner Coastal Plain) and Durham, Gaston and Iredell (all Piedmont) Counties, with five zip codes holding an average Building TIV of $2.25 million or greater. These high average exposure amounts within inland zip codes indicate that, contrary to popular belief, the highest values are not necessarily on or near the coast.
- North Carolina has invested well above the FEMA standard for flood risk assessment. The North Carolina Floodplain Mapping Program (NCFMP), a formal partnership between the state and FEMA, serves as a model for other states with respect to mapping the floodplain and providing flood risk information that is not only beneficial

[1] AIR Worldwide and RMS adjusted exposure data for Actual Cash Value (ACV) and coinsurance factors, but effectively do not impact modeled results meaningfully, having both based their figures on the information provided by the NFIP.

for expansion of the state's flood insurance market, but provides critical and timely information to citizens about their flood risk.

- Demographic trends can be expected to increase North Carolina's flood risk disproportionately into the foreseeable future. U.S. migration toward urban areas and toward the Southern states at least implies that flood exposure in North Carolina will grow faster than the national average.
- Private flood insurance has shown consistent growth over recent years but still only makes up 3-4% of the total flood insurance market. Most private flood coverage is written by surplus lines carriers, and this is especially true in states such as North Carolina where there has been substantial growth in the non-admitted, surplus lines market for flood insurance recently. Data reported to the Surplus Lines Information Portal (SLIP) indicates North Carolina surplus lines premiums from flood insurance increased by roughly 40 percent from 2017 to 2018.
- If the NFIP were to unwind its flood insurance portfolio, North Carolina has public insurance options. The state could establish a stand-alone entity for the provision of flood insurance, but the state also has existing insurance entities that could conceivably step in to provide flood coverage. Either the NCIUA (Beach Plan)/ NCJUA (FAIR Plan) operations or the North Carolina Reinsurance Facility is capable of operationally handling the risk. The best use of these facilities with respect to flood risk, however, would be as markets of last resort in partnership with the private market. Particularly important is the issue of risk correlation; the NCIUA already holds substantial catastrophe risk in coastal areas that would be highly correlated with flood risk in both the coastal and inland regions of North Carolina.
- North Carolina faces operational challenges to establishing a healthy private flood insurance market. In addition to the regulatory, ratemaking and form architecture complexities faced in every state, the private market in North Carolina must overcome some unique obstacles. It is a prior approval state and the North Carolina Rating Bureau coordinates the rating prior approval process for residential property and other "essential lines of insurance coverage." To optimize the private market environment, the state may need either to relax the reliance on the Rating Bureau for homeowners insurance rating, or carve out flood insurance to be treated separately from how it makes rates for other homeowner perils.
- Adequate participation among homeowners is likely the biggest challenge to developing the flood insurance market. Underinsurance is a large and persistent problem. As current competitors with the NFIP, private insurers have some competitive advantages that could help overcome this obstacle. Private companies can exceed the limits of what the NFIP can cover not only via higher policy limits but also through additional offerings e.g., living expenses while property is repaired, basement coverage, coverage for other structures on property). The most powerful advantage in North Carolina in the short term is that insurers can find market pockets where they can effectively undercut the NFIP pricing without compromising their underwriting portfolios, given the advancement of flood loss models and the state-of-the-art NC flood mapping.

1 Introduction and Motivation

You can't trust water; even a straight stick turns crooked in it. W.C. Fields

Flood is the most common and most destructive natural disaster peril in the United States, with 90 percent of natural disasters involving flooding and all 50 states having experienced floods or flash floods in the past five years (National Association of Insurance Commissioners and Floodsmart.gov). In North Carolina, flooding can result from multiple alternative sources – flash flooding, river flooding, tropical storms and accompanying coastal flooding, dam breaks/levy failure, snow melts and debris jams. Based on Lloyd's Realistic Disaster Scenario (RDS) and on industry exposure (assuming flood coverage on all property exposures), average annual losses due to all forms of inland and coastal tropical flooding have the potential to be two-three times as large as all catastrophic losses combined. Assuming a baseline 1-in-100- year industry loss for US hurricane at $125 billion, an extreme flood year for the United States could exceed $200 billion in damage (Lloyds, 2016; CIPR, 2017).

Flood insurance provides the necessary financial assistance to cover the cost of repair and rebuilding; the department of Housing and Urban Development found that flood-insured households were 37% more likely to have rebuilt their homes after Hurricanes Katrina and Rita (Kousky et al., 2018). Flood insurance is a necessary product to limit the local and global impact of severe flooding events and to ensure the resilience of impacted communities.

Hurricane Florence magnifies existing concerns about North Carolina's flood risk, the costs of flood insurance and the challenge of underinsurance. The damage to U.S. homes and businesses from a flood generally is not covered under a traditional property insurance policy. Instead, a special flood insurance policy, federally backed by the National Flood Insurance Program (NFIP), is purchased to protect against flood losses. Despite the risk, most North Carolina property owners do not buy flood insurance, leaving the vast majority of properties within the state uninsured against flood.

The $12 billion plus difference between total and insured losses stemming from Hurricane Florence exposes the extent to which flood risk is underinsured in North Carolina. This issue extends across the United States; looking back at the 2017 hurricane season, Harvey, Irma, and Maria had a combined total cost of damage of $217 billion with only $92 billion being covered by insurance realizing a $125 billion insurance gap (Lloyd's, 2019). The underinsurance of flood risk has severe financial implications for individuals as well as communities. Lloyd's city risk index lists flood as contributing $12.55 billion to the United States' GDP at risk and $42.91 billion of the global GDP at risk (Lloyd's 2018). Despite the known benefits of insurance, the flood insurance gap continues to persist throughout the United States.

Disconcerting details surround U.S. flood risk, the NFIP and the take-up rate on flood insurance among homeowners. Only 15 percent of surveyed U.S. homeowners report having a flood insurance policy despite the fact that 98 percent of U.S. counties are impacted by flood events (Insurance Information Institute, 2019; FEMA). This insurance gap exists despite an increasing

threat from flood nationwide and in North Carolina more specifically. Analysts estimate that in excess of 40 million households face a measurable flooding risk (Rollins, 2019). In addition to the evolving nature of flood risk, the accuracy of the information used to assess flood risk across the United States and the financial viability of the NFIP are in question.

Widely thought to be the best course of action, flood insurance privatization is being considered strongly at Federal and state government levels, and is being vetted for action by many private insurers. This report evaluates flood risk and flood risk financing, with a special focus on North Carolina. Section 2 provides a discussion of flood risk assessment, historic flooding and loss modeling. Section 3 focuses on the U.S. flood insurance marketplace, historically and present. Section 4 follows by speculating on the future of flood insurance. Section 5 provides special treatment of private market challenges, solutions and benefits. Finally, Section 6 summarizes the report and renders conclusions from it.

2 U.S. and North Carolina Flood Risk

"Dear sea, never make me regret to love you so deeply," said the shore. ~ Zainab Mariya

2.1 An Evolving Risk

One reason that flood risk is especially difficult to cover is because it is a widespread and dynamic risk. The entire country is exposed to flood risk, and the flood risk in a particular location transitions over time, due to new development, changes in flood management infrastructure, and environmental changes. According to the Federal Emergency Management Agency (FEMA), there have been 118 "significant flood events" in the United States since 1978. See Appendix A for a table of these events and their respective NFIP costs. Even after inflating each event's costs to $2019, four of the top five events with respect to total cost occurred in 2008 or later, and seven of the top 10 occurred since 2008.[2] The most recent 11 years in the database (2008-2018) have seen more frequent intense flooding and a greater magnitude of flood loss than did the 30 prior years (1978-2007). North Carolina

2.1.1 Sources of Flood Risk

Flooding typically falls into one of three categories: coastal surge flood, fluvial, and pluvial. Coastal flood occurs in areas that lie on the coast of a large body of water and is the result of extreme tidal conditions caused by severe weather. Storm surge is the most common form of coastal flooding and is when high winds from hurricanes and other storms push water onshore (Maddox, 2014). Fluvial, or riverine flooding, occurs when excessive rainfall over an extended

[2] The top five U.S. flood events – inflation-adjusted – are, in descending order, Hurricane Katrina (2005), Hurricane Harvey (2017), Superstorm Sandy (2012), Hurricane Ike (2008) and Louisiana Severe Storms (2016). Of the top 10 flood events, only Tropical Storm Allison (2001), Hurricane Ivan (2004) and Hurricane Katrina (2005) occurred more than 10 years back into the database.

period of time causes a river to exceed its capacity; it can also be caused by heavy snow melt and ice jams (Maddox, 2014). The damage from this type of flooding can be widespread as the overflow in one area affects smaller rivers downstream and can cause dams and dikes to break. According to FEMA, fluvial flooding is the most common type of flood event (Maddox, 2014). The third type of flooding, pluvial or surface flooding, occurs when heavy rainfall creates a flooding event that is independent of an overflowing body of water, although it usually happens in conjunction with coastal or fluvial flooding (Maddox, 2014). This type of flooding typically happens when drainage systems become overwhelmed or when land is so saturated it is unable to absorb runoff. None of these types of flooding are covered under typical homeowners or property insurance coverages but would be covered under a flood insurance policy.

Exposure to all three types of flooding changes over time because of weather patterns, erosion, and new development. According to the 2017 Climate Science Special Report, many parts of the U.S. have experienced an increase in flooding over the last 50 years while others have experienced a decrease (Union of Concerned Scientists, 2018). Climate change is one of the biggest drivers currently altering flood risk around the world. Multiple studies have shown that extreme precipitation events have become more frequent and more intense in parts of the United States since the early 1990s; heavy rainfall events are one of the primary contributors to flooding, and the warming atmosphere is causing these events to occur more frequently (Union of Concerned Scientists, 2018). Trends regarding rain and flooding in the U.S. can be found illustrated in Figure 1. The US National Weather Service recorded 10 rare rain events that led to flooding between May 2015 and August 2016 even though similar events were projected to occur once every 500 years (Union of Concerned Scientists, 2018). An increase in the frequency and severity of high precipitation events increases the likelihood and impact of all 3 types of flooding.

Land use changes including construction in floodplains, increased use of impermeable surfaces such as asphalt, the removal of wetlands and river bank vegetation, deterioration of water-management infrastructure, and the building of dams, levees, or channels can alter the ability of land to accommodate heavy precipitation and can change the natural flow of rivers and streams which in turn increases the potential for flooding. A study of the Mississippi River found that the increase in flooding over the past 150 years cannot be explained by precipitation patterns alone and that river engineering and agricultural expansion are responsible for up to 75% of the increased flood risk (Union of Concerned Scientists, 2018). Additionally, an analysis of Harris County, Texas noted rapid suburban development as reducing the land's natural drainage and contributing to increased flood risk during events such as Hurricane Harvey (Union of Concerned Scientists, 2018). The increase in wildfires from climate and land use changes also has an impact on flooding as less water is retained and erosion increases.

The impact of flooding events is enhanced by the movement of people to hurricane and flood prone areas. Historically, people sought to settle near the coast and along waterways, and those settlements have continued to grow into towns and cities over time.

From 1980 to 2017, there was an increase of 95 people per square mile, more than double, in counties along the U.S. shoreline that experienced hurricane-strength winds from Florence in September 2018 (Dapena, 2018). Overall, areas most vulnerable to hurricane strikes, namely counties along the Gulf and East coast, had an increase of 160 people per square mile, compared to an increase of 26 people per square mile in the mainland over the same period (Dapena, 2018). This increase in population and exposure in hurricane and flood prone areas is a significant driver of the increasing cost of storms and outlines yet another way that flood risk is changing.

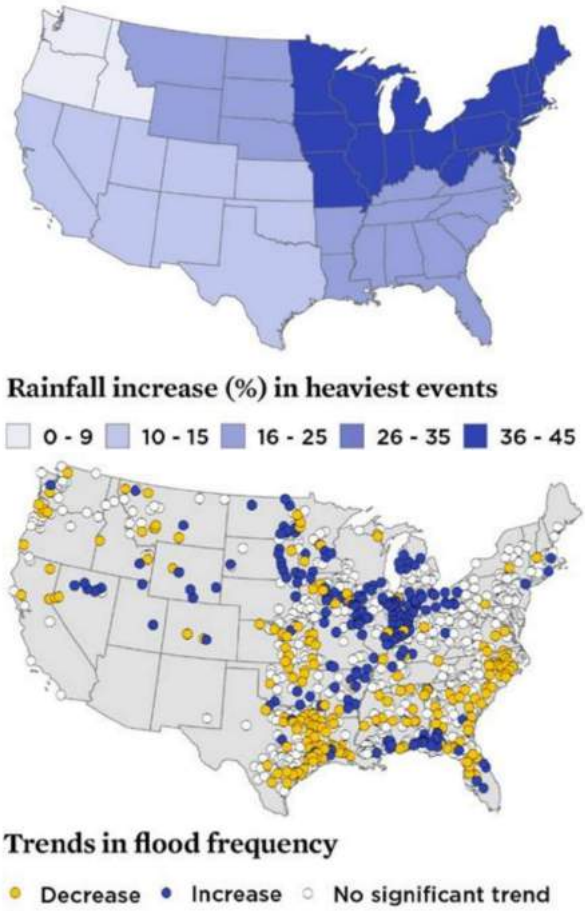
1. 

Figure 1 1980-2017 U.S. Rainfall and Flood Changes (Union of Concerned Scientists, 2018)

2.1.2 A Look at Hurricanes Florence and Hazel

In order to see the evolving nature of flood risk, a closer look at North Carolina and the impact of Hurricanes Hazel and Florence on the state reveals important similarities and contrasts. The two storms lend themselves to a natural comparison because of their nearly identical landfall locations and paths across the state. Hurricane Hazel made landfall as a category 4 hurricane near Calabash, NC on October 15th, 1954 (Storm Events Database). Hurricane Florence made landfall as a category 1 hurricane near Wrightsville Beach, NC, about 50 miles northeast of

Calabash, on September 14th, 2018 (Storm Events Database). Table 1 provides a side-by-side comparison of the two storms' key data.

At the time of its occurrence, Hurricane Hazel was considered the most destructive hurricane to ever affect the state; coastal winds were estimated as high as 150 MPH and storm surge reached 12-18+ feet (Storm Events Database). The storm caused 19 fatalities in North Carolina, destroyed or damaged over 50,000 homes and caused $1.48 billion in total damage to the state (inflated to 2019 dollars) ("Storms to Life" Report, 2010). Current catastrophe models estimate that if Hurricane Hazel were to strike in 2019 rather than in 1954, total damage would likely have reached $4.7 billion.[3] The $3.22 million difference in damages between when the storm actually occurred and the losses if the same storm were to occur today, clearly shows the increase in financial impact that results from the continuing development and redistribution of land use in hurricane prone areas.

Hurricane Florence, although just a Category 1 storm at landfall, had an even greater impact on the state. With wind speeds near 90 MPH and storm surge of 10 feet, Florence resulted in 39 deaths in NC and caused a total of $23 billion in damage ("Storms to Life" Report, 2018). Although Hazel was a more powerful and intense storm, Florence had a bigger financial impact on the state. This seemingly disparate impact of Florence is due not only to demographic and economic changes in North Carolina during the intervening years between Hazel and Florence, but also due to the storm's geographic span and movement after landfall. Florence was a more "spread out" and slower moving storm than Hazel and as such affected a larger portion of the state. After landfall, Hazel continued to move at around 55 MPH, but Florence only traveled forward at a speed of around 5 MPH (Storm Events Database). Because Florence sat and hovered, the state was exposed to its destructive elements for a longer period of time, which resulted in greater damages. Florence brought significantly more rain than did Hazel, resulting in substantially more flooding damage (in addition to wind damages). The Waccamaw River in Freeland, N.C., for example, peaked five days after Florence made landfall, with water levels reaching 22.61 feet. The Waccamaw has flood data going back to 1940 and Florence caused the highest level on record (U.S. Geological Survey).

The difference in the nature of these storms explicitly demonstrates the evolution of catastrophic events over time due to climate change as well as other factors. On average, hurricanes in particular are becoming slower moving and wetter events, therefore causing more damage from extreme flooding and storm duration.

[3] This estimate is based on an average of the modeled losses from three separate and proprietary commercial flood models.

	HAZEL	FLORENCE
LANDFALL DATE	10-15-1954	9-14-2018
LANDFALL LOCATION	Wrightsville Beach, NC	Calabash, NC
LANDFALL CATEGORY	Category 4	Category 1
HIGHEST CATEGORY	Category 4	Category 4
PEAK WIND SPEED	150 MPH	140+ MPH
PEAK STORM SURGE	18 Feet	10 Feet
MAX SUSTAINED WIND SPEED	NA	90 MPH
FORWARD WIND SPEED POST LANDFALL	55 MPH	2-6 MPH
GREATEST PRECIPITATION RECORDED		35.93 inches
NC FATALITIES	19	39
U.S. FATALITIES	1,200	53
HISTORIC NC PROPERTY DAMAGE		
FROM ALL PERILS	$136 million in 1954$ $1.48 billion in 2019$	$23 billion total damage + $2.5 billion economic output loss $9.5-12.5 billion insured property loss
WIND	NA	
FLOOD	NA	$10-13 billion uninsured $4.5-7.5 billion privately insured $10 million NFIP insured
MODELED NC PROPERTY DAMAGE (ASSUMING IT STRUCK IN 2019)		
FROM ALL PERILS	$4.7 billion	
WIND	$1.7 billion	
SURGE	$1.4 billion	
INLAND FLOOD	$1.2 billion	

Table 1 Hurricanes Hazel and Florence – Key Data (Storm data source: Storm Events Database); Hazel financial estimates source: multiple proprietary flood insurance models, 2019; Florence financial estimates: CoreLogic and Karen Clark & Co., 2019)

2.2 FEMA Flood Maps and Data

Floodplain is a general term for a normally dry area subject to flooding from natural waterbodies, including rivers, streams, lakes and the ocean, as a result of storms and sea-level rise. The U.S. Geological Survey's floodplain maps, upon which flood insurance requirements have historically been based, are best understood as estimates — and not necessarily reliable ones. Experts agree a large portion of the flood-risk maps are obsolete, and thus the premiums charged under the NFIP do not reflect actual risk. Indeed, FEMA estimates that 15 to 20 percent of insured flood claims happen outside the USGS designated floodplains.

2.2.1 The Base Flood Concept

The NFIP needed to develop a benchmark level considering both the level of protection and the cost of compliance that could be applied to communities across the country. The 100-year flood standard was established, and is also referred to as the "base flood."[4]When used properly, the term "100-year flood" really means there is a 1-in-100, or 1 percent, chance of a flood occurring in a particular location in any given year. Similarly, a flood with a 1-in-500, or 0.2 percent, chance of occurring every year is referred to as a "500-year flood."

Regardless of whether a property lies in or out of the 100-year floodplain, it is important to understand there is likely a flood risk, no matter how small the probability of occurrence. With enough rain or a big storm surge, almost any location can flood. And the chances of flooding increase the closer the property is to the water source, as well as the longer the period of time considered.

How does this base flood concept relate to personal risk? Let us consider a typical homeowner, who chooses to finance her residence with a conventional 30-year mortgage. If the property is subject to a 1 percent chance of a flood occurring each year, the resulting probability of experiencing the 100-year flood during a 30-year mortgage compounds to 26 percent. Over the 70-year average life of the house, the likelihood of a 100-year flood increases to 51 percent — the flip of a coin.[5]

Floodplain managers and insurance agents use the 100-year floodplain to determine construction standards and flood insurance premiums. Flood safety is one of several hazards

[4] Risk distributions rely on historical recordkeeping, so the longer the records the better the predictions. The longest-running tide gauge in North Carolina has been active for 81 years, but only a few gauges have continuously collected data — the newest gauge for only 13 years. Most river gauges have been around a little longer than those on the coast.

[5] Even in areas with low or moderate flood risk, the average property is five times more likely to experience flood than fire over a 30-year period.

addressed in building codes. Compared to standards for wind, fire and earthquakes, the building requirements for floods are actually the least protective in statistical terms.[6]

2.2.2 FEMA Flood Zone Designations

FEMA defines flood zones according to varying levels of flood risk (depicted on FIRMs by severity and type of flood potential). Four overall zone categories exist (with subzone denotations available as well):[7]

Low Risk areas, typically with less than 1-in-500 year anticipated flood risk (denoted on the maps as C & X zones);
Moderate Risk areas, typically having between a 1-in-500 and a 1-in-100 year anticipated flood risk (denoted as B & X zones);
High Risk areas, with an anticipated 1-in-100 year or greater flood risk (denoted as A zones);
High Risk – Coastal areas (denoted as V zones); and
Undetermined Risk areas (denoted as D zones).

Figure 2 below provides an example of a FIRM. Additional information about FIRM maps and flood hazard zone ratings can be found in Appendix B. One can see the shaded depictions of the flood risk, as well as the flood zone designations.

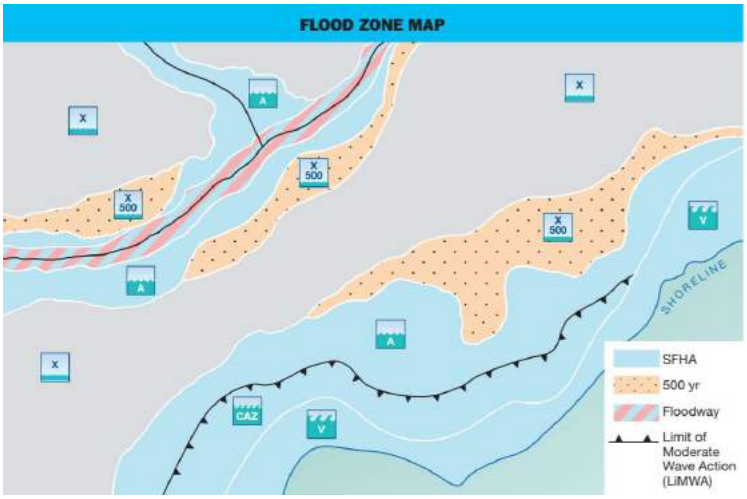


Figure 2 FEMA Floodmap Illustration (FEMA, 2018d)

[6] In many cases, flood damage also can occur with water levels below the 100-year prediction because the building codes usually address floodwater reaching the lowest floor elevation of a house. Everything below the floor — insulation, ductwork and wiring — is susceptible to flooding below the standard.

[7] For all of these zones, NFIP flood insurance is available if the community is a FEMA-participating community.

2.2.3 Criticisms of FEMA Maps & Data

FEMA produces the Flood Insurance Rate Maps (FIRMs) that are used by the NFIP to rate their flood insurance policies, although the accuracy and usefulness of these maps have been under scrutiny from the private insurance market. FIRM maps are used in over 22,000 communities and FEMA has spent $200 million in recent years to update the maps (Adriano, 2018). However, a February 2018 publication by the *Environmental Research Letters* journal reported that more than 40 million Americans are exposed to high flood risk at the 100-year-flood or 1% level which is roughly three times more than the risk suggested by FEMA's flood maps (Adriano, 2018). Even with FEMA's recent spending on mapping updates, in 2017 only 42% of maps were up to date with some of those still in use dating as far back as the 1970s (Adriano, 2018). While FEMA attempts to keep track of land use and gradient changes through letters of map revisions, FEMA flood maps have been criticized for not considering the evolving nature of flood risk, most notably climate change, previously discussed.

This does not necessarily mean that FEMA maps are without value. It is important to remember that these maps were created for purposes beyond just that of insurance pricing; they are also used in the development of zoning and land usage laws. Additionally, to the extent the maps were created specifically for use by the NFIP in policy rating, it is important to note that the goals of the NFIP do not necessarily align with the goals of private insurers. While the NFIP is charged with making flood coverage available to those who need it at an affordable price, private insurers are focused on making flood coverage available at an adequate (although not excessive) and risk-based price. Because of this difference in purpose, the risk rating that FEMA gives a property may not align with the risk rating that the private market would assign it. This means that although the FIRM maps are useful to FEMA and the NFIP, they are not sufficient for use by the private market to rate flood insurance policies. The private market will therefore have to develop their own flood risk evaluation tools and models for use in the policy rating process which will be discussed in section 5.

The private market needs an extensive amount of data regarding both past flooding events and resulting claims in order to develop these models as well as for use in other steps of the ratemaking process. Since flood insurance has not been offered by private companies for so long, they are facing a severe lack of this necessary data. NFIP data on flood losses and claims is largely unavailable to the private market. Increasing access to past NFIP data would allow insurers to better estimate future losses and price their premiums, which ultimately will determine whether they are willing to enter the market and which properties they might be willing to insure. However, the Privacy Act of 1974 prohibits FEMA from releasing policy and claims information that contains personally identifiable information, so FEMA would have to address these privacy concerns in order to be able to provide property level information to insurers (Horn & Webel, 2018). The proposed congressional bills include terms on making claims data available: one would require FEMA to make all NFIP claims data publicly available in a form that conceals personal information, another would authorize FEMA to sell or license individual claims data while requiring aggregate claims data be made available (Horn & Webel, 2018).

2.3 North Carolina Flood Risk Assessment

Knowing the expected frequency and magnitude of flooding is critical to help insurers underwrite appropriately and price optimally. Furthermore, the knowledge can help emergency managers, engineers and community leaders craft building codes and land use policies. North Carolina has made inroads in the assessment of flood risk that may prove invaluable to insurers attempting to price, underwrite and/or provide claims and loss control services for flood risk.

2.3.1 North Carolina's Flood Mapping Project

North Carolina has gone above and beyond the FEMA standard for flood risk assessment. Indeed, the state's risk assessment efforts serve as a model for other states with respect to mapping the floodplain and providing citizens with information about their flood risk. The North Carolina Floodplain Mapping Program (NCFMP) is a formal partnership between the state and the FEMA, created after Hurricane Floyd in 1999 to modernize the state's floodplain maps.[8] An initial $100 million grant from FEMA plus $7 million annually collected by North Carolina at each property purchase settlement/closing largely fund the project. This Flood Risk Information System (FRIS) houses "digitally accessible flood hazard data, models, maps, risk assessments and reports … also provides geospatial base map data, imagery, LiDAR data, along with hydraulic and hydrologic models…" The NCFMP flooding data will enter the historical record and improve the accuracy of flood modeling.

Citizens can search by address or by county and obtain detailed information including digital maps, flood zones, source of flood risk, estimated cost of flood insurance, information about map changes, and the Flood Insurance Reports that document the information. In addition, North Carolina has created the Flood Inundation Mapping and Alert Network (FIMAN). Flood risk within FEMA's FIRM mapping is traditionally communicated by probable risk of flooding in a certain area on a map. For example, the 100-year floodplain is an area that has a one percent risk flooding in any given year, the 500-year floodplain has a 0.2 percent risk, etc. FIMAN, on the other hand, provides the public with up-to-date actual flood data. Figures 3 and 4 are examples of FRIS and FIMAN maps, and illustrate the granularity of information these maps provide.

[8] You can view current maps and learn more about the program at ncfloodmaps.com.

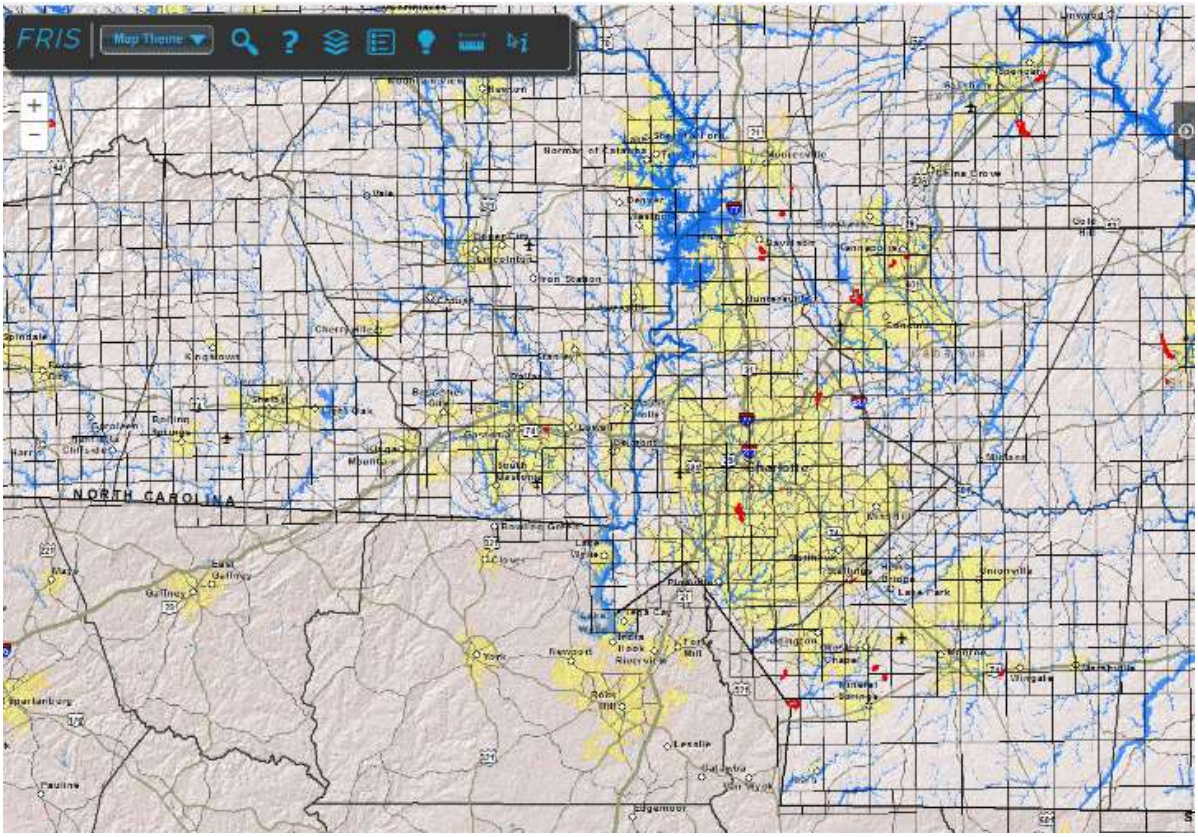


Figure 3 FRIS Mapping Illustration (www.ncfloodmaps.com)

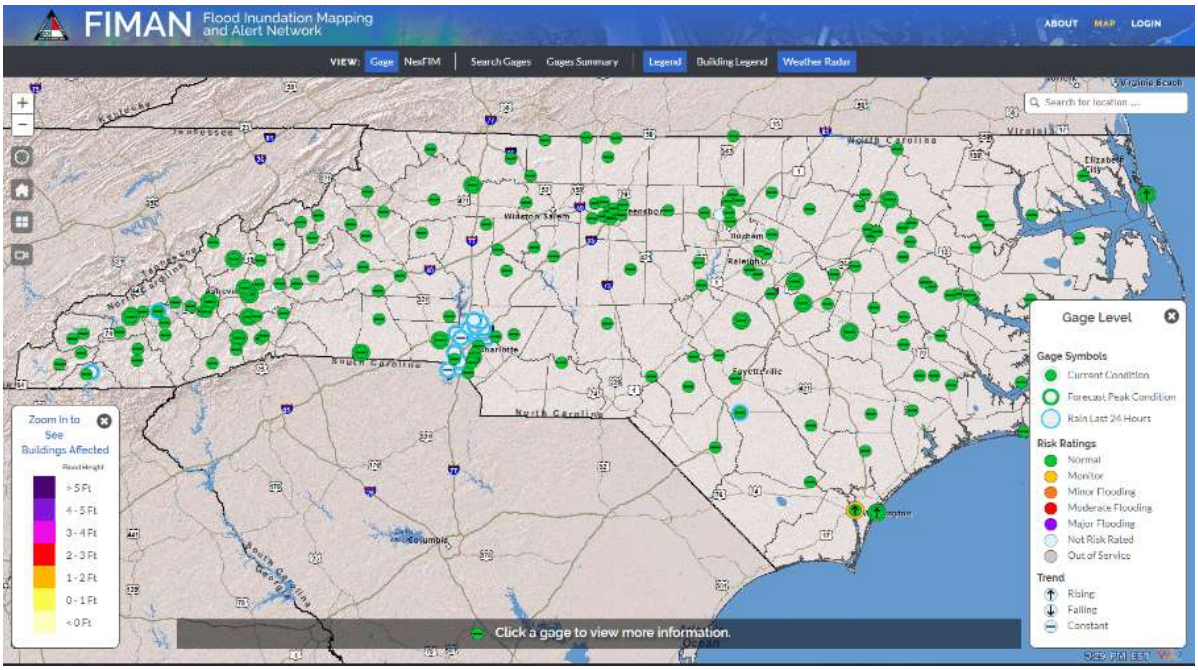


Figure 4 FIMAN Mapping Illustration (www.ncfloodmaps.com)

FIMAN links together U.S. Geological Survey (USGS) and state stream/rainfall gages. Readings from more than 550 gages are updated every 15-30 minutes providing valuable updates on flood situations in various rivers and river basins. FIMAN assigns general flood conditions and documents trends (e.g. increased flood condition) as well as determines inundation mapping (extent of flooding). This information is applied to determine affected buildings and estimated damage. Besides being available to the public at large, maps from FIMAN modeling of future flood inundation were used by the media to educate the public during the flooding events from Matthew and storms in the spring of 2017. Even more recently, data from multiple USGS streamgages in North Carolina indicated the "peaks of record" and record streamflows resulting from Hurricane Florence.

There are limitations on the FIMAN system, most notably that data is limited by the number of gages and distance between gages. Nevertheless, along with North Carolina's advanced floodplain mapping, FIMAN is a tool that could be replicated across the country to better inform the public about flood risks.

2.3.2 Flooding in North Carolina

According to a recent study by the U.S. Geological Survey, Hurricane Florence broke 28 flood records across North and South Carolina, with record streamflows at multiple sites.[9] These "peaks of record" broke previous records that had just been set by Hurricane Matthew in 2016. Despite more than 30 years of available North Carolina stream data (up to 70 years of data at some sites), a majority of the number one and two records are from these two recent flooding events, and others are within the top five levels ever measured at those sites. Of the 28 record-breaking sites in the Carolinas, FEMA data estimated that only 10 of them had a 1-in-67 chance or greater of flooding to that level in any given year. Nine (9) had a less than 1-in-500 chance of flooding to that level, three (3) had a 1-in-500 chance, and six (6) had somewhere between a 1-in-500 chance or a 1-in-100 chance (U.S. Geological Survey). Localities most heavily flooded from Florence (and their probability of experiencing flooding in a given year) include:

- Northeast Cape Fear River near Chinquapin, NC (78 years)
- Waccamaw River in Freeland, NC (77 years)
- Cape Fear River at William O Huske Locke near Tarheel, NC (71 years)
- Black River near Tomahawk, NC (70 years)
- Trent River near Trenton, NC (67 years)
- Little River near Star, NC (64 years)
- Flat Creek near Inverness, NC (50 years)
- Cape Fear at Lock No. 1 near Kelly NC (49 years)
- Big Shoe Heel Creek near Laurinburg, NC (31 years)
- Lumber River near Maxton, NC (30 years).

[9] "Streamflow" is the volume of water passing through a particular point (USGA website), and today can be measured over specified durations of time and/or in real time.

Despite the severity of damages caused by Florence it should not overshadow other flood events that have occurred in the state. Nor should the tropical storm as a cause of flood overshadow other potential flood drivers.

2.3.2.1 North Carolina Flooding by Region

In coastal states such as North Carolina it is easy to believe the greatest flood risk exists in coastal and near coastal counties. This is not necessarily the case. Hurricanes are popularly thought to be the main source of flood events in North Carolina even though non-tropical storm precipitation more frequently actually causes flooding. Furthermore, even when a tropical storm is involved, it is not uncommon for precipitation to wreak havoc in areas far inland of a storm's landfall. Florence was a classic case of this, as seen in previous sections. Indeed, if North Carolina historic flooding is evaluated by region, it is clear that in every portion of the state flooding is a significant risk. Figure 5 shows for each region of the state the number of flood events recorded through January, 2019.

Figure 5 Flood Events by North Carolina Region (Storm Events Database)

The map in Figure 5 makes it possible to visualize the direct relationship of landmass to flood frequency. Here, the state is divided into four geographical regions – Mountains, Piedmont, Inner Coastal Plain and Tidewater.

> **Tidewater.** The easternmost section of North Carolina land along the coast and near the ocean Is known as the Tidewater region. All the beaches of North Carolina are located here, along with capes (projections of land into water) on the coast. The major streams and rivers from the Piedmont region empty into sounds or the Atlantic Ocean. The

Tidewater has eight sounds and many wetlands. Heavy flooding is possible in large swaths of this region.

Inner Coastal Plain. The Inner Coastal Plain is between the Tidewater and the Piedmont regions. Wetlands and high ground swamps dot the area. This is the most rural part of North Carolina, and the region's fertile soil is good for agriculture. Peanuts, tobacco, and soybeans grow well there. Pines and other trees cover half of the region. Flooding here can result from tropical storms, but just as frequently from non-tropical precipitation events, crowding the water out of its banks onto mostly low-lying property.

Piedmont. Elevations in the region vary from 300 feet to 1,100 feet above sea level. Isolated mountain ranges reside here, mostly on the Western side, but few of them reaching over 1,200 feet. The Piedmont has many forests, but is also highly populated. It is the most urbanized and densely populated section, containing the state's largest cities (Charlotte and Raleigh). Due to rapid urbanization over the last 30 years, a significant part of the rural area in this region has been transformed into suburbs. Abundant with rivers and lakes, the area is subject to flooding from multiple sources and due to its dense population is especially vulnerable to large magnitudes of damage to built property.

Mountains. The westernmost section of the state is the Mountain region. It is separated from the Piedmont region by the Blue Ridge Mountains. While smaller in land area than the Piedmont and Inner Coastal Plain, its elevation can reach to more than 6,000 feet high. 40 mountains in the region rise to 6,000 feet, with the highest being Mount Mitchell, at 6,684 feet high. The several mountain ranges in this region are part of the larger Appalachian Mountains. Rivers on the eastern side of the Eastern Continental Divide flow east toward the Atlantic Ocean. Rivers that run on the western side of the divide flow toward the Tennessee and Ohio rivers and into the Gulf of Mexico. The combination of mountains with rivers running through them and the effects of the Continental Divide create ripe opportunity for water overflowing natural boundaries.

Statistically, in North Carolina the likelihood of a flood event in any region is substantial; in any county, there is some non-zero probability of flooding. It is noteworthy that the lowest frequency of flooding has been in Hyde and Tyrell Counties – both in the Tidewater region – where each has experienced only three (3) flood events historically. Meanwhile, the highest frequency of flooding has occurred in Mecklenburg and Wake Counties – both in the Piedmont region – with 95 and 88 flood events, respectively. Appendix C provides the historic frequency of North Carolina flood events by county.

2.3.2.2 Inland Flooding Risk

Inland river flooding linked to hurricanes and heavy storms is a huge risk in the Southeast, but receives far less attention in emergency planning than coastal areas (Colten, 2014). Along the Eastern Seaboard, a dense network of rivers flows down from the eastern Appalachians across

the Piedmont, and drains into the Atlantic Ocean. Steep gradients move water quickly down the mountain slopes. On the Piedmont, many small streams merge, becoming rivers on the low-lying coastal plain. When tropical weather systems come ashore and move inland, they rise toward the Appalachian Mountains. As the saturated air moves upward, it cools and releases huge quantities of rain. Combined with heavy rainfall dumped on lower elevations by these tropical systems these effects create downpours that funnel into rivers and rush toward the sea, often spilling over the banks of overwhelmed bodies of water.

The Great Flood of 1916 (July) is a notable example of how severe such inland flooding can be. According to historical data, the remnants of two tropical systems that both passed near the area within a week led to the flooding. It destroyed hundreds of homes in the Asheville and Western Carolina area, along with industrial plants, warehouses, and businesses sited along the French Broad River. It damaged or washed away railroad tracks and demolished all three bridges across the river in Asheville. Riverside Park, a popular amusement park and gathering place on the French Broad, was demolished by the waters. Upstream from Asheville, the waters breached or destroyed all the dams that supplied hydropower to the city. At the entrance to the Biltmore Estate, water reportedly reached 9 feet deep during the flood. Overall, the damage totaled an estimated $21 million, equivalent to more than $500 million in today's dollars (NOAA, 2016).

2.3.2.3 Development & Urbanization

Development of the built environment has impacted the flood risk significantly. For example, researchers found that during and after Hurricane Harvey, the flood response of the land as well as the storm total rainfall in the Houston, Texas area were exacerbated by urbanization.[10] The changes in land use associated with urban development may increase flooding in multiple ways. Removing vegetation and soil, grading the land surface, and constructing drainage networks increase the runoff from rainfall and snowmelt into streams. As a result, the peak discharge, volume, and frequency of floods increase in nearby streams. Changes to stream channels during urban development can limit their capacity to hold and move floodwaters along. Furthermore, existing roads and buildings in flood-prone areas are exposed to increased inundation and erosion as development continues around them.

While Harvey's overall flooding effect on Houston might be unlikely to occur in today's urbanized areas of North Carolina (since they are not located as close to the coast as is Houston), the multiplicative "urban effect" on flooding is nonetheless a risk. Moreover, the relative increase in peak discharge due to development and urbanization is apparently greater for frequent, small floods than for infrequent, large floods (Konrad, 2003). Thus, moderate flooding is disproportionately exacerbated by the increased hazards of development as

[10] Using the Weather Research and Forecast model—a numerical model for simulating weather and climate at regional scales—and statistical models, the researchers quantified the separate contribution of urbanization to rainfall and flooding. They found the probability of extreme flood events, like Harvey, increased on average by about 21 times (i.e., by 2100%) during August 20-25, 2017 because of urbanization alone.

compared with heavy flooding. Such a difference could result in a "severity of frequency," where the cumulative effect of repeated flooding creates economic challenges.
While North Carolina still has a significantly smaller share of its population living in urban areas than the national average, the state has increasingly urbanized over the past two decades. 1920 marked the first year that more U.S. residents lived in urban areas than rural areas (51 percent versus 49 percent). In North Carolina, this transition did not occur until 1990, when 50.4 percent of state residents were living in urban areas compared to 49.6 percent living in rural areas.[11] Even today, among North Carolina's 100 counties, only 8 are as urbanized (or more) as the nation. Mecklenburg County (where the state's largest city, Charlotte, is located) is the most urbanized, with 99 percent of its population living in an urban area and 86% of its land area classified as urban as of 2010. New Hanover, Wake, and Forsyth Counties have more than half of their land area classified as urban as well.

Despite North Carolina's slow urbanization relative to other parts of the U.S., the City of Charlotte was one of the two fastest growing cities in the U.S. during 2000-2016. Similarly, today Raleigh-Durham is reportedly a national "top 10" metro area for population growth. [12] It is notable that these two metropolitan areas are sited within the two counties that have experienced the highest frequency of flooding in the state over the past 20 or so years (Mecklenburg and Wake). Recognizing their vulnerability to flood, the City of Charlotte and Mecklenburg County teamed collaborated with the U.S.G.S. to develop a flood information and notification system (FINS) to address the need for prompt notification of flood conditions (Konrad, 2003). The system automatically notifies the National Weather Service and emergency responders in the region when rainfall and streamflow indicate the likelihood of flooding, giving these agencies additional time to issue warnings and evacuate areas if necessary.

2.4 Flood Loss Modeling

In the previous section, there was discussion of the various ways in which flood risks are assessed. The risk assessment methods do not attempt to estimate future losses, but rather to measure and/or visualize the risk in particular areas. Catastrophe loss models, on the other hand, have as their primary purpose the estimation of losses. This section focuses on loss models and their potential for assisting insurers in the pricing and aggregation of flood risks.

2.4.1 The Advent and Use of Catastrophe Loss Models

Commercial catastrophe models have been available since the mid-1990s, gaining momentum for research and development after Hurricane Andrew devastated South Florida in 1992,

[11] According to the University of North Carolina Population Center, in 1990, only South Dakota (50%), Mississippi (47%), Maine (45%), West Virginia (36%) and Vermont (32%) had smaller shares of their population living in urban areas than did North Carolina. Retrieved from https://demography.cpc.unc.edu/2016/02/25/nc-in-focus-when-did-we-transition-to-majority-urban/

[12] As reported by the U.S. Census Bureau, 2010, and Update, 2017, as well as the University of North Carolina Population Center.

driving insurers to contract their capacity and raise their prices (Medders, Nyce and Karl, 2013). Since then, the use of the models by insurers has become a "given" rather than a competitive advantage. The State of Florida in fact requires insurers to use state-approved hurricane wind models for pricing residential property insurance in the state.[13]

In general, catastrophe models work by combining mathematical representations of the natural occurrence patterns and characteristics of catastrophes and information on property values, construction types, and occupancy class to provide information to insurers about the potential for losses before they occur (Clark, 2002). Insurers use catastrophe modeling to anticipate the likelihood and severity of potential future events so that they can appropriately prepare for the financial impact.

These models are typically built to be capable of estimating Average Annual Losses (AALs), Probable Maximum Loss (PML) and Tal Value-at-Risk (TVaR).[14] AAL is the sum of all modeled event losses divided by the number of years modeled, and can be used to represent the pure premium required annually to cover the loss exposure over time. The PML provides the size of loss associated with a given exceedance probability (the modeled probability of a certain size of loss or greater). The TVaR tells us the average exposure above the PML. All of these measures are subject to substantial uncertainty, and the appropriateness of the assumptions, data and sensitivity of a given model are critical to obtaining useful results.

Hurricane wind modeling is the peril that has seen the most model development, even though earthquake, convective storm/ hail and wildfire are all modeled to varying degrees by commercial models today. Insurers have had a great demand for hurricane wind modeling since the private market is largely responsible for insuring wind losses and tropical wind events have been responsible for the largest U.S. insured losses in the past thirty years.

2.4.2 Flood Loss Models

Numerous flood risk/loss models are being developed to assist in risk pricing and aggregation for the eventuality of private market involvement in flood insurance. In fact, the Florida Commission on Hurricane Loss Projection Methodology, which must approve hurricane wind models for use in setting residential insurance rates in Florida, recently developed model

[13] The Florida Commission on Hurricane Loss Projection Methodology is a state body of experts that reviews submitted models biannually for approval to be used in setting Florida prices. Information regarding Commission standards and approved models can be found at https://www.sbafla.com/methodology/CommissionDocumentsStandards.aspx.

[14] These estimated measures are the summary results yielded by loss models primarily because insurers and reinsurers can utilize these most easily for pricing and risk aggregation purposes. Primers on the fundamentals of catastrophe models and modeled results can be found at commercial modeler websites and n various research reports. The State of Florida hurricane wind model standards contain valuable information about how catastrophe models work and the results to expect. The latest Report of Activities (including standards) is available at https://www.sbafla.com/methodology/Portals/Methodology/2017_HurricaneROA.pdf?ver=2017-11-29-102746-453.

review/approval standards for flood modeling – both coastal and inland (Florida State Board of Administration).

Catastrophe models for flood risk are currently being developed by a variety of modeling companies, but they are not yet widely employed by private insurers for use in the ratemaking process.

In theory, catastrophe models should work well for evaluating flood risk since the lack of past data is a huge barrier to current flood rating; models are based on simulations created by analyzing the characteristics of past and potential events rather than fixating on analysis of past loss history. A variety of companies have produced catastrophe models for flood and are marketing them to insurers, but none of these producers have come forth to provide data or examples of the accuracy of their models despite marketing claims of their credibility. Their hesitancy to discuss model specifics could be due to a desire to keep product information proprietary; however, it could also be due to a lack of relevant loss data to use for model validation purposes causing modelers to be unsure as to the accuracy of their product. The flood events over the last few years are helping insurers, reinsurers, and modeling companies to be able to validate their models against real losses which in conjunction with obtaining more comprehensive data will aid in improving model accuracy.

Despite the complexity of flood risk, it is arguably more definable than hurricane and earthquake risk, and these are already being rated largely based on loss estimates from catastrophe models. Wind is a chaotic process; in a hurricane one house can be hit by strong gusts while the one beside it is spared. Flood, on the other hand has a lower level of intrinsic variability because flood heights are relatively consistent from one patch of land to the next. The difficulty in developing flood models comes from not currently having the necessary data. There are three areas in which information is still needed in order to model flood effectively: property elevation, existence of flood defenses, and information on what is happening below the ground floor (Is there a basement? What is it used for? Are expensive items stored there?) (Howard, 2019).

Many of the current producers of flood catastrophe models also offer other widely used catastrophe models as well: Milliman, AIR Worldwide, KatRisk, and Risk Management Solutions (RMS). As the demand for this product is still developing, there are many other companies vying for a spot as one of the first to develop the best flood model, including new companies focused solely on modeling flood risk. Almost all of the models differentiate between fluvial and pluvial flooding events. Many have integrated flood with existing hurricane and storm surge models to give a more comprehensive view of tropical storm impacts while also providing a model specific to inland flooding. Each company's product boasts unique features in simulation processes as well as output calculations as they try to stand out from their competitors.

Scientists apply models to the short-term existing data to approximate the history we do not have. Then, they test the model outputs against real-life events that are in the historic record to verify their accuracy. In New Hanover County, for example, the storm-surge model closely

predicted Hurricane Fran (1996) retrospectively, which was approximately a 100-year flood. Hurricane Hazel (1954) closely matched the same water levels as Fran. Now observed through 2017, just two 100-year-equivalent flood s in New Hanover County have happened within a span of more than 63 years — indicating the modeling estimations may be doing well generally (FEMA, 2019).

There are no clear superior flood loss models to date since their accuracy is still under intense scrutiny and working to be improved. Industry professionals strongly believe that flood is a definable peril and that the development of robust and accurate catastrophe models is inevitable (Howard, 2019).

2.4.3 North Carolina's Modeled Flood Exposure and Losses

The formal modeling of flood risk is still a relatively new effort, and is evolving as mentioned above. The NFIP in 2017 and 2019 did, however, contract with at least two commercial modelers – AIR Worldwide and RMS – to model its loss exposures in preparation for placing its reinsurance program. The exposure data used for modeling as well as gross AALs[15] are publicly available through FEMA; the North Carolina data are provided in Appendix D.

2.4.3.1 Exposure

According to CoreLogic, North Carolina is a top 10 state with respect to risk of storm surge damage. It is ranked 7th in the nation both in terms of properties at risk as well as value at risk. States with the highest inland flood potential damage include California, Illinois, Louisiana, New York and Texas (CIPR, 2017).

FEMA's NFIP coverage reporting provides the best detailed exposure data publicly available. As of May 31, 2018, NFIP Building Total Insured Value (TIV) exposure across single-family permanent dwellings in North Carolina totaled just under $33 billion, with Building Limits of just under $26 billion.[16] As one might expect, the exposure data reveal the highest total NFIP exposure in North Carolina lies in the coastal zip codes. For instance, in Currituck and Dare Counties, X zip codes hold NFIP Building TIV exposure in excess of $1 billion:

Zip code 27907(Carova Beach, Corolla), Currituck County:	$1.08 billion
Zip code 27949 (Duck, Kitty Hawk, Southern Shores), Dare County:	$1.33 billion
Zip code 27948 (Kill Devil Hills), Dare County:	$1.3 billion

[15] Gross AAL represents ground-up losses, to which insurance policy information, such as deductibles, is not yet applied.

[16] AIR Worldwide and RMS adjusted exposure data for Actual Cash Value (ACV) and coinsurance factors, but effectively do not impact modeled results meaningfully, having both based their figures on the information provided by the NFIP.

These high exposure amounts are largely owing to the volume of property owners (at least 2,500 in each zip code above) for whom flood insurance is mandatory, as none of these zip codes averages a Building TIV of greater than $400,000.

The highest average Building TIVs are in Duplin (Inner Coastal Plain) and Durham, Gaston and Iredell (all Piedmont) Counties:

Zip code 28349 (Kenansvile, Sarecta), Duplin County:	$3.6 million
Zip code 28625 (Statesville and surrounds), Iredell County:	$2.5 million
Zip code 27709 (City of Durham), Durham County:	$2.4 million
Zip code 28166 (Troutman), Iredell County:	$2.3 million
Zip code 28101 (McAdenville), Gaston County:	$2.26 million

These high average exposure amounts within inland zip codes indicate that, contrary to popular belief, the highest values are not necessarily on or near the coast.

2.4.3.2 Modeled Losses

Modeled loss data by state are not publicly available as of the time of this report. The NFIP has made available the modeled gross AALs and exposure data for the Top 100 counties in the nation. Appendix E includes modeled loss results for the top 100 counties (by gross AAL) from two models – AIR Touchstone Version 5.0 and RMS Risklink Version 17 – for exposure data as of May 31, 2018. These data offer interesting discussion points.

Neither model places any North Carolina county within the top 30 with respect to gross AAL resulting from storm surge. New Hanover County tops the North Carolina Counties that appear on the lists, ranking as 35th based on RMS modeling and 41st based on AIR modeling. RMS estimates its gross AAL for 2019 at just over $7.7 million, AIR at just under $7.2 million. Recall the AAL represents the estimated pure premium needed annually to cover losses over time. If we use $7.5 million as a blended AAL result for New Hanover, this means that based on the 11,700 or so insured locations, an average premium per location of only $641 annually is required to cover the gross AAL. Given New Hanover is considered the highest risk North Carolina county for storm surge based on both models, such an estimated premium is encouraging for potential market expansion.

The RMS and AIR models differ with respect to which North Carolina counties make their respective Top 100 Gross AAL county lists. In addition to New Hanover, RMS includes eight more North Carolina Counties: Craven 45th), Brunswick (58th), Pender (61st), Dare (65th), Carteret (73rd), Beaufort (76th), Onslow (79th) and Pamlico (96th). AIR, on the other hand, includes seven additional counties: Brunswick (42nd), Dare (52nd), Onslow (55th), Carteret (64th), Hyde (91st), Pamlico (94th) and Currituck (100th).

AIR Worldwide also modeled inland flood losses for the NFIP. The results did not indicate any of North Carolina's counties are within the top 100 greatest at risk to inland flood (again, based on gross AAL). The 100th ranked county in the country, based on this model, is Santa Barbara

County, California, with gross AAL of $3.445 million. Thus, although the inland flood AALs are not publicly available by state or county, this data implies that no North Carolina county is modeled to have more than $3.4 million in gross AAL due to inland flood (at least not based on AIR modeling).

These differences in modeled results between just two (of several) commercial modelers illuminates the variations that exist between model assumptions, data and processes. Even though catastrophe loss models overall employ similar process (as described earlier in this report), the detailed methods and data employed differ widely. While which models (if any) simulate flood loss estimates that are "in the ballpark" is still relatively unknown, it is clear that for now the use of multiple models is beneficial as it provides more than one set of estimates, and allows for some model comparisons. Because of the complexities of modeling flood and the immaturity of the US models, true exposure and loss to the flooding will take time to analyze. In general, exposure can be expected to track the U.S. population, currently growing at 0.8 percent annually,[17] and development that accompanies its movements.

2.4.4 The Future of Flood Exposure and Loss

Coastline exposure growth had been high since the 1960s, but since 2005 has slowed to approximately 4 percent annually. Four major hurricanes made landfall in Florida in 2004, then hurricanes Katrina, Rita and Wilma made 2005 the costliest U.S. insurance history (AIR, 2016). After multiple "lucky" years, he U.S. eastern and gulf coastlines more recently have experienced multiple major hurricanes (category 3 or stronger) make landfall in 2017 and 2018.

Inland exposure to flood is difficult to assess. Defining whether a property is exposed to inland flooding is problematic the various sources of flooding to which inland properties are exposed. All 50 states are exposed to and have had severe inland flooding events and disaster declarations. Several factors portend greater flood loss potential across the U.S. as well as in North Carolina for the future.

Inflation. The general increase in prices or economic inflation could increase flood losses due to rising cost of building stock, contractors, and other direct and indirect materials impacting claims settlements. Demand surge inflation also remains a strong driver of losses.[18]

Demographics. There is migration toward cities and toward the most southerly parts of the country. Urban areas are growing faster than the rest of the nation, and there is a migration from the northern industrial sector to southern (warmer and often coastal) areas. It seems reasonable to expect with migration and the rise in coastal population the quantity of exposed

[17] Based on estimates since the U.S. Census "Profile of General Population and Housing Characteristics: 2010". Available at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

[18] Demand surge inflation can be accounted for during flood loss modeling, pre and post-underwriting.

property will rise.[19] Additionally, as previously stated, urbanization of the state, especially as it occurs in coastal areas, can be expected to increase the state's flood risk considerably.

Climate change. Setting aside politics and/or views on the causes and mitigation timelines, it is widely acknowledged that climate change has potential consequences for severe weather and catastrophic events. In principle, a warming world would mean increasing frequency and intensity of extreme precipitation events and potentially rising severity of hurricanes, tornado and storm activity, increasing the flood risk for both inland and coastal communities. Even without belief in a warming globe, climate change/ volatility is apparent, and is already linked to upticks in storm severity, over recent years. Although we now have the tools to accurately record all flood events, we will not know for sure if the climate is affecting storm frequency and severity and inland flooding until years from now. Climate change and sea level rise may cause severe flooding, however, even in the absence of storms. According to Coastal Climate Solutions (CCS), flooding from annual King Tides has increased annually for the past 12 years. It forecasts flooding solely from King Tides (i.e., not exacerbated by any form of storm) could increase by more than 400 percent by 2030 (CIPR, 2017).

3 Flood Insurance Coverage – Historic and Present

No individual raindrop ever considers itself responsible for the flood. ~ Douglas Adams

Flood insurance is offered through a federal insurance program largely because the private insurance market found it to be an unprofitable product. The concept of adverse selection is what ultimately led private insurers to withdraw from the flood insurance market. Private insurers offered this coverage from approximately 1895 to 1927, but virtually the only purchasers were property owners in areas highly prone to flooding (National Resource Council, 2015). Even with effective underwriting, insurers found they could not charge an appropriate risk-based premium that was also an affordable premium. Opting for affordability, insurers ultimately paid out more in claims than they collected in premiums. The tremendous losses caused by the 1927 Mississippi River Floods as well as additional 1928 losses resulted in insurers terminating their flood coverages and withdrawing from the market (National Resource Council, 2015).

3.1 The National Flood Insurance Program (NFIP)

3.1.1 History

The National Flood Insurance Program (NFIP) was created in response to the withdrawal of private insurers from the flood insurance market. Without flood insurance to cover a portion of the losses, the federal government was increasingly asked to provide disaster relief after flooding events. It was President Truman who first proposed the request to congress to

[19] Also available at U.S. Census.

"establish a national system of flood disaster insurance" in 1951 (National Resource Council, 2015). After a series of severe loss events in the 60s, President Johnson created a task force who wrote a report titled *A Unified National Program for Managing Flood Losses*; this report, along with congressional testimony from the Department of Housing and Urban Development (HUD) was the origin of the original NFIP legislation (National Resource Council, 2015). The National Flood Insurance Act of 1968 created the National Flood Insurance Program to be administered by HUD, and although it has been modified many times, the act is still the legislative foundation of the NFIP. When created, the National Flood Insurance program had two main objectives: to encourage state and local governments to constrict the development of land exposed to flood hazards, and to provide flood insurance through a cooperative cost sharing program between public and private sectors. However, within a decade, the sharing program had been abandoned, and the NFIP took full responsibility of rate setting and risk bearing (National Resource Council, 2015). The 2012 reauthorization of the National Flood insurance program included provisions aimed at encouraging private flood insurance; legislation passed the house in the 114th congress but was not taken up by the Senate before the end of the Congress (Horn & Webel, 2018). Therefore, most flood insurance coverage in the United States is still provided through the NFIP.

In the past 10 years, there have been various pieces of legislation passed that significantly impact the National Flood Insurance Program. The Biggert-Waters Flood Insurance Reform Act of 2012 was passed to address the fiscal insolvency of the NFIP by funding the national mapping program and allowing certain rate increases to transition the program from subsidized to full actuarial rates reflective of true risk (FEMA, 2018c). In 2014, the Consolidated Appropriations Act prohibited the implementation of certain parts of Biggert-Waters, effectively stopping certain rate increases, while new law was developed to address concerns related to raising rates (FEMA, 2018c). As a result, the Homeowner Flood Insurance Affordability Act of 2014 repealed certain parts of Biggert-Waters, restored grandfathering (allowing low rates remain even if risk is found to be higher), put limits on rate increases, and updated the approach to ensure fiscal soundness by applying a surcharge to all policyholders ($25 for a primary residence and $250 for all others) (FEMA, 2018c).

3.1.2 Current Program Status

The National Flood Insurance Program is currently managed by the Federal Emergency Management Administration (FEMA), and is the primary provider of flood insurance coverage in the U.S. The NFIP provides nearly $1.28 trillion in coverage for over 5 million residential policies, $66 billion in coverage for non-residential properties, and collects about $3.5 million in annual premiums (Horn & Webel, 2018). Over its lifetime, the NFIP has evolved to have three main objectives: to provide flood insurance, to improve floodplain management, and to develop maps of flood hazard zones. While their results from selling insurance are easily measured in their financial outcome, the impacts of their other functions are harder to measure and see. The NFIP operates so that in years of multiple catastrophic disasters they are able to borrow from the Treasury to cover the gap between claims paid and premiums collected. However, over time the NFIP's debts have increased sharply, and with projected total

claims of $9.7 billion for the 2017 hurricane season, Congress had to cancel $16 billion of NFIP debt in order for the program to pay its claims, thus making the cancelled debt a non-transparent, liability for general taxpayers, and as such a subsidy (Horn & Webel, 2018). The NFIP is currently operating on short-term reauthorization until May 31st, 2019 (FEMA, 2018a). A bill for long term reauthorization (H.R. 2874) passed the House in November 2017, however three bills (S. 1313, S. 1368, S. 1571) have been introduced to the Senate but none have been acted on by the full senate (Horn & Webel, 2018). All four of these bills contain various provisions to support the emergence of private flood insurance.

According to FEMA, the NFIP is currently focused on "implementing recent law by adjusting premium increases, issuing new rates and map updates, supporting mitigation and ensuring advocacy to connect policyholders with the information they need to better understand the program" (FEMA, 2018c).

3.1.3 Coverage, Rating and Take-up Rates

Flood coverage through the NFIP is available to anyone in a participating community and purchase is generally voluntary, with the exception of those in Special Flood Hazard Areas (SFHAs). In order to be eligible to participate, communities must adopt specific land use and building code standards. Coverage limits are relatively low, notably so for non-residential properties or properties in high-cost areas, and can be seen outlined in detail in Table 2. There is a mandatory purchase requirement that dictates property owners within SFHAs purchase coverage as a condition for any mortgage made, guaranteed, or purchased by any federal agency, federally regulated lending institution, or government sponsored enterprise (Horn & Webel, 2018). To comply with this mandate, coverage must be purchased through the NFIP or private insurer coverage must be at least as broad as the coverage of the NFIP. This mandatory purchase requirement is not enforced by FEMA but rather by lenders, and lenders can be fined up to $2,000 for each instance of noncompliance (Horn & Webel, 2018). Additionally, property owners who do not obtain insurance when required are not eligible for certain types of disaster relief after a flood. Beyond this legal requirement, some lenders are requiring borrowers outside of SFHAs to purchase flood insurance as well in order to financially secure the property.

NFIP Maximum Available Coverage Limits

	Contents	Building Coverage
Single Family Homes	$100,000	$250,000
Other Residential Buildings	$500,000	$100,000
Non-Residential Buildings	$500,000	$500,000

Table 2 (Horn & Webel, 2018)

Once a community joins the National Flood Insurance Program, a study is completed to issue a Flood Insurance Rate Map (FIRM), based on the community's flood risk and outlining the SFHAs and other applicable risk premium zones. An example of a FIRM can be seen in Figure 2 (in a previous section), and additional information about FIRM maps and flood hazard zones. The NFIP rates policies in different ways dependent upon whether a FIRM has been issued for the community (FEMA, 2015). All buildings constructed after a FIRM has been issued are charged full-risk, actuarially fair premiums that include the full range of loss potential including catastrophic losses; if the new construction is in compliance with floodplain management ordinances, the premium should be reasonable and affordable (Hayes & Neal, 2012). Additionally, this enhances the NFIP goal of discouraging building in areas known to have a high flood risk because the full-risk premiums for coverage would be unaffordable. In addition to new constructions, all buildings found to be outside of SFHAs are charged full-risk premiums since the risk is low the premiums are low as well (Hayes & Neal, 2012). Buildings in SFHAs that were constructed before the development of the FIRM are charged discounted, or subsidized, premiums, since their full-risk premiums would be extremely high (Hayes & Neal, 2012). It is notable that FEMA is not provided funds to offset the subsidized and discounted premiums which has contributed to their need to borrow from the U.S. Treasury to pay NFIP Claims (Horn & Webel, 2018).

The justification for subsidized premiums aligns closely with the goals of the NFIP. Lowering premiums for existing structures made it easier for communities to join the NFIP thereby increasing the number of communities with sound floodplain management and reducing the nation's flood risk exposure. Reasonable premiums also increase the likelihood that a property owner purchases insurance and at least partially fund their own recovery from flood damage which is preferable to disaster relief coming solely from taxpayer funding. Too high premiums for flood insurance could also cause the abandonment of economically viable buildings which does not support the goals of the NFIP. An assessment by the NFIP found that if charged full-risk rates subsidized policies would pay on average two and a half times their current premium, and if the subsidy was eliminated and full-risk rates charged for all NFIP policies, the aggregate premium for the program would increase between 50%-75% (Hayes & Neal, 2012).

In addition to subsidized premiums, NFIP policyholders can receive reduced rates through the Community Rating System (CRS). The purpose of the CRS is to encourage floodplain management activities that exceed the NFIP minimum standards, and depending on the extent of participation, policyholder's premiums can be reduced by as much as 45% (FEMA, 2018b). Beyond just the reduction in insurance premiums, FEMA claims that CRS floodplain management activities "enhance public safety, reduce damage to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment" (FEMA, 2018b). Currently, nearly 3.6 million policyholders in 1,444 communities participate in the community rating system; CRS communities represent only 5% of the 22,000 communities participating in the NFIP, but due to the increase in affordability that the CRS provides, 69% of all flood insurance policies are written in CRS communities (FEMA, 2017). Communities are classified based on their participation in 19 credible activities that fall into four categories: public information, mapping and regulations, flood damage reduction, and

warning and response (FEMA, 2017) Communities also have access to technical assistance for designing and implementing some activities at no charge (FEMA, 2018b). Participation in this program provides communities an additional incentive to improve and maintain their floodplain management program and can even get them to qualify for other federal assistance programs (FEMA, 2018b). The community rating system is a way for the NFIP to offer direct premium reductions on policies where there is an active effort to reduce risk exposure.
The 2018 Insurance Information Institute *Pulse* survey found that 15 percent of U.S. homeowners had a flood insurance policy.[20] Although this is up from a reported 12 percent in the 2016 survey, the take-up rate for coverage remains quite low.[21] The NFIP insures a total estimated 449,000 residential and commercial policies in North Carolina, South Carolina and Virginia, with just over 138,000 of these being North Carolina residential policies (latest FEMA reported figures were 445,000 and 134,000, across the tri-states and North Carolina, respectively, as of 9/30/2018).[22] Using U.S. Census data, there were just over 4.5 million estimated housing units in North Carolina in 2017, up from just over 4.3 million in 2010. The 2010 U.S. Census reported 86.5 percent of North Carolina housing units were occupied and 66.7 percent of those occupied were owner-occupied.[23] If these rates hold into 2017, then of the slightly more than 4.5 million estimated North Carolina housing units in 2017, approximately 2.6 million were likely owner-occupied. Simple math indicates an estimated NFIP flood insurance take-up rate of only 5.1 percent or so among North Carolinian homeowners (134,000 policies divided by 2.6 million owner-occupied residences).

3.2 Private Market Involvement

Although private insurers have taken on minimal flood risk since initially withdrawing from the market, they have been involved with the National Flood Insurance Program through both the administration of policies and reinsurance. Additionally, a few companies offer private flood insurance.

3.2.1 Administration of Policies

The main way in which the private market is directly involved with the NFIP is through the administration of policies. While FEMA provides management to the NFIP and is ultimately the risk bearer, the day-to-day operations of the NFIP are handled by private companies. This includes all aspects of the insurance process including marketing, selling and writing policies, and all aspects of the claim process. There are two types of arrangements that the NFIP has

[20] Information available at https://www.iii.org/article/spotlight-on-flood-insurance

[21] Some ascribe the 3 percent uptick in NFIP coverage from 2016 to 2018 to losses from recent major hurricanes. A recent analysis of take-up rates for flood insurance in areas impacted by Hurricanes Harvey, Irma and Maria found that as many as 80 percent of Texas, 60 percent of Florida and 99 percent of Puerto Rico homeowners lacked flood insurance.

[22] FEMA NFIP "Policy Statistics Country-wide as of 9/30/2018." https://bsa.nfipstat.fema.gov/reports/1011.htm The data can be viewed by county online.

[23] U.S. Census "Profile of General Population and Housing Characteristics: 2010". Available at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF.

with private insurers, and in both, the NFIP retains the financial risk of paying the claims and the policy terms and premiums are the same. The first is the Direct Servicing Agent (DSA) in which the private insurer acts as a private contractor selling NFIP policies on behalf of FEMA to individuals seeking to purchase coverage directly from the NFIP (Horn & Webel, 2018).

The second arrangement is the Write-Your-Own (WYO) program. Through this program, companies are paid to write and service the standard NFIP flood insurance policies in their own name. The WYO program has three main goals: increase the NFIP policy base and geographic distribution, improve service to NFIP policyholders, and to provide the insurance industry with direct operating experience with flood insurance (FEMA, 2019c). About 12% of the NFIP policy portfolio is managed through the DSA program with the remaining 88% administered through the 60 companies participating in the WYO program (FEMA, 2019c) (Horn & Webel, 2018). The companies participating in the WYO program as of August 2018 can be found in Appendix F.

3.2.2 Reinsurance

The 2014 Homeowner Flood Insurance Affordability Act enabled the private market to begin bearing a portion of the NFIP flood risk by giving FEMA the authority to secure reinsurance for the NFIP from private reinsures as well as the capital market (Horn & Webel, 2018). There were a few motives for implementing this change, the most notable being that it reduces the chance that FEMA will need to borrow from the treasury to pay claims. Additionally, it allows FEMA to price policies more efficiently because they can factor what they are paying in reinsurance premiums into their own pricing model. The main benefit of reinsurance for the NFIP, but also in general, is that it creates stability and reduces the volatility of losses over time especially when potentially extreme events are involved.

For the past three years, FEMA has purchased reinsurance to cover losses from individual flood events, as opposed to aggregate losses, and the structure of these various reinsurance agreements can be seen in Figure 6. FEMA contracted with Guy Carpenter and Company, a subsidiary of Marsh & McLennan Companies to provide broker services to secure reinsurance placement, and they contracted with Aon for financial advisory throughout the reinsurance process (FEMA, 2019a). The 2019 agreement for $1.32 billion in reinsurance coverage is composed of contracts with 28 private reinsurers who can be found listed in Appendix G. In August 2018, FEMA transferred additional NFIP risk to private markets by securing $500 million of reinsurance from the capital markets through the issuance of the FloodSmart Re. catastrophe bond (Artemis, 2018). The transaction was facilitated with assistance from Hannover Re through the Hannover Re Designated Activity Company and is backed by more than 35 insurance-linked securities investors. It is designed as a three-year bond term running from August 1st, 2018 to July 31st, 2021 (Artemis, 2018). Three of the proposed bills currently in congress require or encourage the NFIP to continue to transfer risk to the private reinsurance market (Horn & Webel, 2018).

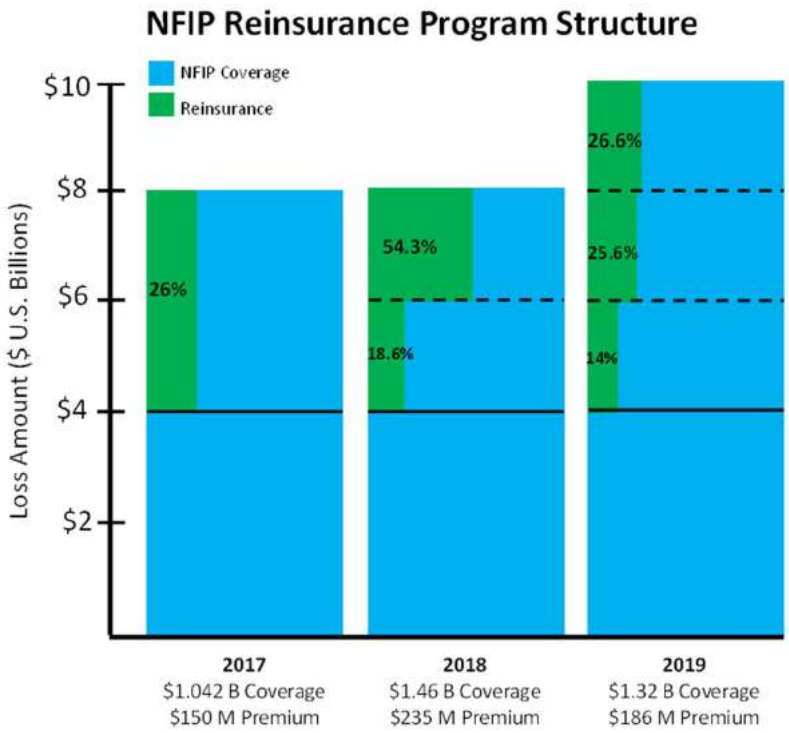


Figure 6 (FEMA, 2019a)

3.2.3 Private Market Flood Insurance

In addition to the NFIP, there are a few private companies that have started to break into the market in recent years and currently offer flood insurance coverage to consumers. Private company policies generally provide commercial coverage or coverage beyond the NFIP coverage limits. Additionally, the private market tends to focus on high-value properties which have higher premiums which therefore justify the extra expenses of flood underwriting (Horn & Webel, 2018). Private flood insurance has shown consistent growth over recent years but still only makes up 3-4% of the total market. This is particularly true in North Carolina. Table 3 indicates substantial growth in the non-admitted, surplus lines market for flood insurance in North Carolina just between 2017 and 2018, based on data reported to the Surplus Lines Information Portal (SLIP).

	2018		2017	
	Premiums Written	Policy #	Premiums Written	Policy #
Commercial Flood	$2,423,366.56	242	$1,732,995.45	136
Commercial Flood (Excess)	$1,924,509.13	281	$1,372,141.16	158
CBRA Flood	$1,888,788.82	264	$1,024,162.48	132
Residential Flood - Primary	$3,219,007.92	1706	$2,550,942.49	786
Residential Flood - Excess	$4,351,784.22	1783	$3,839,871.72	1783

Table 3 Growth in North Carolina's Nonadmitted Flood Insurance Market, 2017-18 (SLIP, 2019)

Most private flood coverage is written by surplus lines carriers however some admitted carriers have begun to offer it has well. The most recent study regarding private flood insurance was conducted in 2017 by the National Association of Insurance Commissioners (NAIC), and results were published in June 2018. NAIC reported $630 million in private market flood premiums for 2017, up from the $412 million written in 2016 but still a fraction of the NFIP premiums of $3.5 billion (Carrier Management, 2018). Commercial lines still represent the majority of business written, with approximately 64% of the market, down from 66% in 2016; this is due to a $104 million increase in residential private flood largely driven by Assurant's entrance to the market and their $88.2 million written in new residential flood insurance (Carrier Management, 2018). Other carriers that contributed to a significant portion of the 2017 market growth include ZurichRe, FM Global, Berkshire Hathaway, and Liberty Mutual (Carrier Management, 2018). The top eight (8) carriers of both private commercial and residential flood as well as their 2017 direct premiums written are outlined in Figures 7 and 8 below.

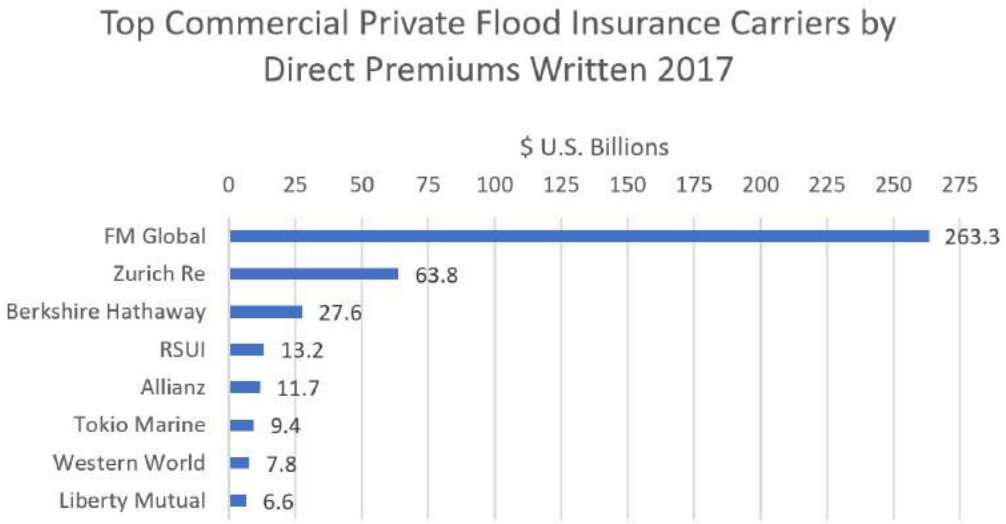


Figure 7 (Carrier Management, 2018)

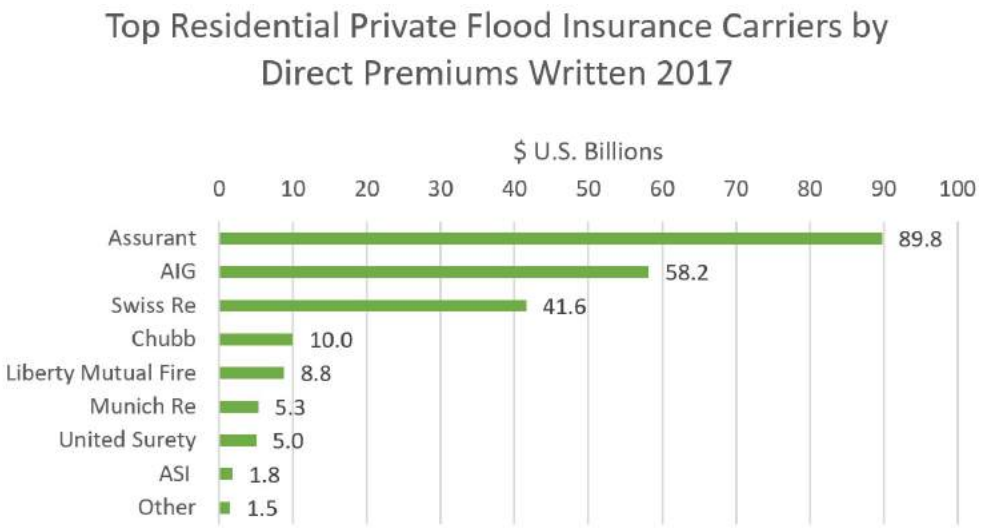


Figure 8 (Carrier Management, 2018)

4 The Future of Flood Insurance

And really, it wasn't much good having anything exciting like floods, if you couldn't share them with somebody. ~ A.A. Milne (Winnie-the-Pooh)

With the May 2019 reauthorization of the NFIP still pending and the expansion of private flood coverage beginning to take hold, the future of United States flood insurance is still widely uncertain. Most experts believe that the NFIP will continue to operate in some capacity although their role may evolve over time to serve as more of a federal backstop rather than as a primary insurer. FEMA is currently working to strengthen the NFIP's position as an insurance provider by acknowledging the financial shortcomings of the NFIP's current insurance operations and actively working to revise many of the policies that contributed to the extensive accumulation of debt. While the NFIP will likely always act as an insurer to some extent through providing coverage to high risk properties the private market is unwilling to underwrite, FEMA may shift even more focus onto its role in floodplain management and flood mitigation as private insurers continue to grow their market share.

It is imperative that FEMA continue their support of floodplain management and risk mitigation even if no longer as a part of the NFIP. As the only entity to exist with this focus as a central function, the continuation of these efforts is critical to the resiliency of the United States. Private insurance providers are still faced with extensive obstacles they have to overcome in order to increase their market share of flood coverage, but they have made it apparent they are up for the challenge. It's unknown what the interaction between the public and private sectors will be as these changes continue to shape the future of the United States' flood insurance market.

4.1 Public Options in North Carolina

Were the NFIP to disband or become unacceptable as a primary insurer for North Carolina's flood risks, the state could consider public insurance options. The North Carolina Assembly could establish a stand-alone entity for the provision of flood insurance, but given the up-front and maintenance expenses of such a program and the downside economic and political risks, this option does not seem warranted or likely. More likely (and feasible) is the option to use one or more of the state's existing insurance entities to provide flood coverage.

The North Carolina Insurance Underwriting Association (NCIUA, aka Beach Plan)/ North Carolina Joint Underwriting Association (NCJUA, aka FAIR Plan).[24] These are tax-exempt entities co-housed and operated to as markets of last resort to provide property insurance to property owners having North Carolina property that is difficult to insure (but technically insurable). These plans enjoy a reputation for being well run and administered, and so are obvious contenders for consideration as frameworks for the provision of flood insurance to the state's property owners. The primary obstacle to this idea is a basic mathematical problem. One of the two entities – the NCIUA – already makes catastrophe insurance available for beach properties. Although not all floods are hurricane/tropical storm related, the correlation of risk between tropical storm and flood risk is high. Thus, the flood risk would be correlated with the wind risk the NCIUA already holds. Moreover, flood is a concentrated risk, and as such could result in extremely large numbers of magnitude of claims stemming from just one event.[25]

North Carolina Reinsurance Facility (Facility). [26] This is a mechanism for pooling auto liability insurance risks for auto owners who cannot obtain coverage otherwise. Premiums, losses, and expenses are shared by the Facility's member companies in proportion to their respective North Carolina automobile liability insurance writings. Under the Facility law, licensed and writing carriers and agents must accept and insure any eligible applicant for coverages and limits which may be ceded to the Facility. The Facility accepts cession of bodily injury and property damage liability, medical payments, uninsured and combined uninsured/underinsured motorists coverage. Automobile physical damage coverages are not eligible for cession, so there is no direct property insurance involved. Given the lack of first-party property risk in the Facility, one could assume the correlation with flood risk to be low. Nevertheless, an attempt to charge this mechanism with flood insurance coverage would be problematic. The existing expertise within the entity's operations is liability oriented and geared for that purpose. The Facility could be utilized to assist with flood insurance provision, at least for difficult-to-place properties, but just as with the NCIUA/NCJUA there is little incentive to do so to date.

[24] https://www.ncjua-nciua.org/

[25] The authors of this report speculate that most states have little interest or incentive to utilize their beach or fair plans to provide flood risk. Even in the case of California, a state where coastal surge is not a concern or at least not a concentrated risk, there would be little reason (other than political) to offer flood insurance through a public property insurance entity.

[26] See http://www.ncrb.org/ncrf/AboutNCRF/tabid/247/Default.aspx.

4.2 Proposed Public-Private Market Structures

In the discussions around what the future of U.S. flood insurance might look like, a variety of models have been considered that outline alternative ways the private and public sectors may share flood risk exposure (Friedman, n.d.). Figure 9 outlines the estimated ease of implementation and degree of risk sharing for each model. These models can be used policy planning for the future of flood insurance in the state.

The Crop Insurance Model. Private carriers write a certain level of coverage and reinsure catastrophic levels with the federal government. Additionally, more protection can be added and risk spread through reinsurers offering excess-of-loss coverage to cap the government's aggregate exposure. The advantage to this is that federal funds are only required to cap the industry's maximum loss in intense catastrophe years.

The Reinsurance Model. This is similar to what currently exists. The NFIP spreads their risk by purchasing reinsurance from the private sector. This model can be structured in different ways with reinsurance taking on high-level losses, or middle-range losses (with the NFIP coming back in to cover high losses). With the Biggert-Waters Act already allowing the NFIP to secure reinsurance, the implementation of this model is relatively simple, and one of the biggest benefits is the flexibility of reinsurance program structures.

The Capital Market Model. In addition to private primary and reinsurance, capital market avenues, such as catastrophe bonds, are used to further spread risk. The use of catastrophe bonds for spreading wind and earthquake exposures is well established, so continuing to expand this practice to flood risks should be relatively straightforward.

The Pooling Model. Set up a flood insurance pool, similar to that of the California Earthquake Authority (CEA), where participating insurers can sell flood coverage bundled with standard homeowners insurance. Insurers have the advantage of pooling their resources and paying out of that pool, therefore diversifying their risks. There are many skeptics of this concept as the CEA resilience has not been tested by an actual loss event. Additionally, there is potential for a low take-up rate given the cost of coverage for high-risk properties.

The Partial Privatization Model. Private markets pick up moderate flood risks while leaving the NFIP in place for those who cannot get coverage through the private market. This model has the potential to exacerbate the adverse selection issue that already exists in the NFIP and leave the program financially unstable even if actuarially fair prices are charged.

The Bundling Model. This is based on the United Kingdom flood insurance program structure. Flood insurance is included in standard homeowner's policies and is a

mandatory coverage. Additionally, the government is reducing flood exposures through infrastructure development. This would ensure everyone has coverage therefore removing the issue of adverse selection and insurers would have a large enough pool to diversify their exposure and keep premiums at an affordable rate. Home owners who face minimal flood risk may be angry about the mandate to buy coverage they do not feel they need.

The 'Opt-Out' Model. Requiring that all property owners are offered flood insurance along with their standard homeowners policy but being allowed to opt-out of that coverage. Could boost coverage participation similar to how opt-out provisions boosted employee participation in 401(k) plans. Additionally, participation can be increased by having those who turned down coverage become ineligible for federal disaster assistance if an event occurs; there is wide skepticism as to if the government would be able to follow through on this pledge.

The 'Lend a Hand' Model. The federal government, or individual states, offer financial support to high-risk homeowners who cannot afford to pay risk-based rates for flood insurance or to help them mitigate flood exposure. Connecticut has already implemented such a policy with their Shoreline Resiliency Fund to provide low-interest rate to flood prone property owners to elevate their homes.

The 'It Takes A Village' Model. Flood insurance sold on a community-rated basis, similar to group health insurance, where residents can pay a lower premium than if they bought individual coverage. By improving affordability, more homeowners in flood prone areas may purchase coverage, and local governments may be more motivated to implement flood mitigation efforts. This approach could be utilized by the NFIP or private carriers. The Homeowner Flood Insurance Affordability Act of 2014 required that FEMA study the feasibility of incorporating a community-rating option into the NFIP.

These models are not mutually exclusive, and the future of North Carolina flood insurance could be a combination of these proposals. The possibility also exists that the private insurance and reinsurance markets can largely shoulder the burden of flood insurance in North Carolina. Section 5 explores the implications and challenges of heavy private market involvement.

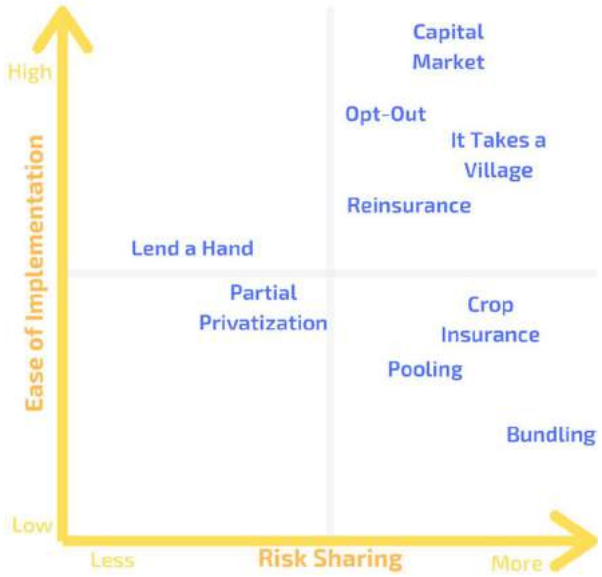


Figure 9 (Friedman, n.d.)

5 Implications of Increased Private Market Involvement

There is a tide in the affairs of men, which taken at the flood, leads on to fortune. Omitted, all the voyage of their life is bound in shallows and in miseries. On such a full sea we are now afloat. And we must take the current when it serves, or lose our ventures. ~ William Shakespeare

Private insurers have made clear their interest to enter more prominently into the flood insurance market. Challenges do exist, however, primarily in the form of regulation, rating and forms development. These will have to be overcome for the private market to grow substantially.

5.1 Challenges for a Successful Private Market

5.1.1 Regulatory Challenges

Currently, the NFIP allows for flood insurance purchased under the mandatory purchase requirement to be purchased through a private insurer, given that the coverage is "at least as broad as" the coverage available through the NFIP (Horn & Webel, 2018). The difficulty in this is that no entity has been assigned the task of evaluating whether specific policies meet this standard, and the criteria to be used in this assessment remain undefined. Two of the proposed congressional bills include provisions to remove this language and instead allow for any private insurance that is in compliance with individual state laws and regulations to be accepted in fulfilling the mandatory purchase requirement (Horn & Webel, 2018).

Another reason that private insurers continue to have limited involvement in assuming flood risk is due to the "non-compete" clause that previously existed in the standard contracts between the NFIP and Write Your Own (WYO) carriers (Horn & Webel, 2018). This clause was recently amended for the 2019 fiscal year to allow WYO carriers to also offer their own flood coverage provided that they ensure it remains entirely separate from their NFIP WYO business. This includes ensuring that all communication regarding the private policies clearly indicates that it is not supported by the NFIP, FEMA, or the Federal Government in any way, and that all data related to the carrier's arrangement with the NFIP not be used to support their non-NFIP flood insurance lines (FEMA, 2018e). In an admitted market, the insurer must also obtain a certificate of authority to write private flood insurance.

Private insurers are also concerned about the uncertainty of state regulation as it relates to flood insurance. Most other insurance markets are regulated at the state level, so as private sector involvement in the flood market continues to grow, it is reasonable to assume that state regulator's involvement in the flood market will grow as well. This will likely add complexity and additional costs to insurers and the uncertainty surrounding it has contributed to the hesitation of private insurers to enter the market. Consumer protections will also vary if private policies are regulated at the state level. The language in private flood policies is not standardized and has not been tested in court the same way as other coverages, such as homeowners, have been. Therefore, there may be a greater variability in the outcome of claims for insurers, as well as for consumers, in the early years of private flood insurance coverage. However, regulation at a state level could provide benefits to the market as well through the development of state-specific insurance solutions that better suit local social and economic conditions (U.S. Department of Homeland Security, 2015).

North Carolina has its own peculiar regulatory challenges. It is a prior approval state, meaning it requires rates to be approved by the North Carolina Department of Insurance (NCDOI) before they can be used. The unique NC Rating Bureau coordinates the rating prior approval process for residential property and other "essential lines of insurance coverage" (namely auto and workers' compensation insurance). By state law, all insurers writing residential property insurance in NC must subscribe to the NC Rating Bureau and pay into it according to their market share in the state. The Rating Bureau proposes and establishes (with the approval of the Commissioner) standard insurance policy forms and rates (known as "base rates"), which are filed on behalf of all licensed NC homeowners insurers. Insurers must go through the Rating Bureau and Commissioner's Office to get rates approved before they can implement rates (pricing) for their insurance policies. Insurers can offer discounts (downward deviating rates), but have not been able to gain approval from the Commissioner to charge rates higher than the base rates. Insurers wishing to challenge the Commissioner's decision can request a rate hearing.

5.1.2 Rating Challenges

In the absence of any regulation that forces private coverage, the private insurance market only underwrites risks that can reasonably be expected to result in a profitable line of business.

Shortcomings in adequate ratemaking are what made flood insurance unprofitable, leading to the initial withdrawal of insurers from this market. Proper ratemaking is easier said than done, and there are a number of challenges that private insurers will have to overcome before beginning to write profitable flood policies.

The subsidy problem is often seen as one of the largest barriers to private sector involvement in flood insurance. Law currently mandates that a portion of the cost of flood insurance for properties in high risk flood areas be subsidized. In order for private insurers to take on a risk, they must charge an "actuarially fair" rate that adequately reflects the risk that they are acquiring. Private insurers also require that their rates include a profitable return on capital as well; this means that even rates that are actuarially sound from an NFIP perspective may still be underpriced from the perspective of private insurers.

Should the NFIP continue to operate and private insurers enter the market as direct competitors, the private market will not be able to compete with the NFIP subsidized rates and will therefore be unable to write policies in those locations. With around 20% of NFIP policies receiving some sort of subsidy, there is a large portion of the market that is automatically unavailable for private insurers to access (FEMA, 2014). However, private companies have already found niches where they believe they will be able to underprice the NFIP. With the total extent of NFIP subsidization not historically tracked, it is difficult to quantify how NFIP and private insurance rates would compare. Milliman and KatRisk attempted to answer this question by looking at the premiums for single family homes in Louisiana, Texas in Florida. Their modeling suggests that 77% of single-family homes in Florida, 69% in Louisiana, and 92% in Texas would pay less under a private policy than under the NFIP; however, 14% in Florida, 21% in Louisiana, and 5% in Texas would pay over twice as much (Horn & Webel, 2018).

Through the Biggert Waters Flood insurance Reform Act of 2012 and the Homeowner Flood Insurance Affordability Act of 2014, FEMA is already actively working to reform their rating approach and move towards a more risk-based pricing structure, although they are still faced with restrictions placed on their annual premium rate increases. The move to risk-based pricing will encourage the growth of private insurer involvement in the primary flood insurance market because they will be able to compete with the NFIP in more areas. This move will lead to higher rates for households in flood prone areas which aligns with the NFIP goals of discouraging building in those places.

An associated issue is that of continuous coverage. Under existing law, if an NFIP policyholder allows their policy to lapse, any subsidy that they received is eliminated immediately. Unless legislation is changed to allow for private insurance to count as continuous coverage, policyholders may be reluctant to purchase private insurance if it meant that they would lose their subsidy should they ever decide to return to NFIP coverage. With NFIP subsidized rates increasing to better reflect risk, this barrier to entry may resolve on its own.

5.1.3 Insurance Form Challenges

For private insurers to successfully participate in the flood insurance market, they must design flood insurance contracts either as an endorsement to the homeowners policy or as a stand-alone flood policy. The decision can have major implications. An endorsement may be the simplest option up front, as it effectively serves to eliminate the flood exclusion from the underlying policy, subject to terms and conditions. The form specifies modifications to the policy's definitions, insured perils, coverage amounts, property not covered, exclusions, and general conditions, and is designed to minimize coverage gaps and overlaps with the underlying policy (much like a Difference-in-Conditions policy achieves in commercial insurance). It may be difficult, however, to design an endorsement that regulators are willing to accept as both properly aligned with the underlying policy and at least as liberal as NFIP coverage. Florida addressed this issue by passing a law allowing "certification" of private flood policies and endorsements, and efforts are under way to expand this paradigm to other states and have it recognized by federal regulators (Florida OIR). Areas of the policy that may prove challenging include deductibles, sublimits on personal property, loss assessment coverage, the loss settlement basis, coinsurance provisions, and cancellation.

A stand-alone flood policy can provide flexibility in form design and eliminate the issue of alignment with an underlying property policy. But stand-alone policies have drawbacks as well. Renewal and cancellation timelines, billing and other issues become more complicated when an insurer adds a stand-alone flood policy to its homeowners offerings.

5.2 Overcoming Private Market Challenges

The key to successfully overcoming the challenges mentioned above is for the private insurance market to share the risk efficiently and in socially appropriate ways – presumably across the standard private market, surplus lines market and involuntary market. In North Carolina, the North Carolina Assembly may be called upon either to relax the reliance on the Rating Bureau for homeowners insurance rating, or to carve out flood insurance to be treated separately from how it makes rates for other homeowner perils.

5.2.1 Proper Ratemaking

Private insurers must satisfactorily determine how they will rate their flood insurance policies. The NFIP relies on the FIRM flood maps produced by FEMA for ratemaking purposes. Since profit making is not part of the NFIP's overall purpose, the maps they use for rating will not translate well to usage by private insurers for rating policies; additionally, it has been established that the NFIP rating structure would not be profitable since the NFIP is heavily in debt[27]; although, some of the debt is attributable to the subsidy problem previously discussed. Quantifying risk is the first step in the ratemaking process. Since insurers lack faith in FEMA's

[27] NFIP current debt is approximately $20.5 Billion after subtracting the $16 billion that was waived after 2017-2018 storms, and $4.2 billion in interest has been paid since Hurricane Katrina in 2005. (FEMA, 2019b)

maps to accurately do this, they first need to come up with an alternative method to evaluate flood risk which will be discussed in section 4.2.3 and the accompanying subsections. Once they are satisfied that have been able to properly assess a property's flood risk, there are a few techniques that have been proposed regarding how insurers could handle pricing flood insurance policies.

5.2.1.1 Multi-Peril Ratemaking

The first rating technique would prove useful if insurers were to offer flood coverage as a part of homeowner's policies, and it involves including flooding as a peril in property insurance multiperil ratemaking. Deconstructing risks by peril is not a unique or new idea and is commonly used in homeowner's insurance rating. Rating by peril is intuitively appealing because the predictors that are useful in predicting one peril may not predict well for others. Current multi-peril rating practice is based on modeling each peril in isolation of the others. However, the problem with rating in this way is that it assumes that the perils are independent although past studies have demonstrated statistically significant dependence among perils (Frees, Meyers, & Cummings, 2012). This can have major implications when discussing flood risk since floods often occur in conjunction with other perils: hurricanes bring flooding and wind, thunderstorms bear lightning and heavy rains. Including the relationships between perils in multi-peril models has the potential to allow insurers to more accurately model true risks and therefore develop adequate premiums that are reflective of that risk. It has been proposed to include the dependency of perils through the usage of copulas in a generalized linear model to create a multivariate framework for pricing (Yang & Shi, 2018). By using this framework on perils that are correlated, the information on one peril will aid in learning about the other perils. It is also important to include the dependence between risks in multi-peril models because risk dependence has important implications for risk aggregation and risk margin analysis (Yang & Shi, 2018). The availability of longitudinal data also makes this model for multi-peril rating appealing to insurers. Longitudinal data is repeated measures of the same subject; in this context, looking at past loss experience for a singular property. This not only allows insurers to incorporate experience rating through repeated observations but allows them to incorporate the claim history not only for the peril being priced but other correlated perils as well.

Although applying a multi-peril model to homeowners insurance is intuitively plausible, not all insurers will want to use this complex model. Pricing by peril requires more efforts on data collection and model building. In the end, customers are charged a single price for homeowners insurance meaning that decomposition by peril may not be necessary or worth the added cost. Additionally, like all complex models, there is the potential that models with extra parameters could lead to overfitting and overall poor prediction. In order to implement this multivariate framework for multi-peril models, extensive past loss data is necessary, and as previously discussed, there is a lack of this data in the private market and obtaining it from FEMA presents its own challenges.

5.2.1.2 Base Premium with Simulated Catastrophe Adjustment

It has also been suggested that standard property insurance ratemaking techniques with the addition of a premium adjustment for long-term catastrophic loss exposure based on expected losses from simulation tools (also known as “cat models”) would work well for flood insurance ratemaking. This rating procedure would easily apply to independent flood insurance products; simulated expected loss could also prove to be a useful addition in multi-peril ratemaking for policies covering a variety of perils including flood. This technique lends itself well to ratemaking for flood risk due to the variety of flood risk that exists and its catastrophic nature. The base premium rate constructed by the insurer would reflect the sustained flood risk that a property faces: property that has never flooded before would have a low base rate while properties that flood regularly from typical rainfall would start with a higher base rate. This rate would then be adjusted based on the results from catastrophic scenario simulations. The simulations would account for the flood risk associated with higher intensity, lower frequency extreme weather events.

While this rating technique seems significantly more straightforward than multi-peril ratemaking, it is not without faults of its own. It is of limited usefulness to products other than standalone flood insurance; it is likely that flood insurance will be sold as an endorsement to or as a covered peril in more comprehensive property insurance coverages. Additionally, insurers face the difficulty of determining how to develop the base rate for a property. With no past claims data available to derive these rates from, insurers would have to construct their own process to evaluate base flood risk which takes time and could be costly. This is made further difficult due to the previously discussed evolving nature of flood risk which insurers may need to account for in the development of a base rate. Furthermore, in order to employ the use of catastrophe models in flood ratemaking, the models have to first be produced as well as tested extensively. While these models exist for and are used in the ratemaking of other insured perils, the development of catastrophe models for flood risk has proved to be difficult. Catastrophe models in general as well as those specific to flood are discussed in more detail in section [XXX].

5.2.1.3 Community Rating

Insurers may also consider setting premiums for flood insurance based on a community rating system. They could copy the system that the NFIP uses where policyholders receive a discount in communities with strong floodplain management systems in place. However, unlike the NFIP, private insurers would be not be able to provide assistance to communities to put these techniques in place. Without assistance, many communities would remain unable to build the necessary infrastructure to manage flood risk and therefore would not be able to receive the community rated premium reduction resulting in flood coverage remaining unaffordable for a large portion of property owners. While this type of community rating works well when an agency like FEMA is in place to support it, it would likely not transfer well to the private market.

The private market could consider applying a community rating system similar to what is often used in health insurance to their flood insurance products. In a health insurance context, community rating refers to a rating system that requires all insureds in the same geographical area to pay the same premiums, regardless of their health status (Community Rating, n.d.).

While community rating of a similar format is not currently used for any property insurance, it may be useful for flood rating. This would involve insurers evaluating the risk for each property in the community to establish an aggregate risk level. The premium for this aggregate risk would then be divided more evenly between all participants with less emphasis on their individual risk level: high-risk properties would pay slightly less than their risk-reflective rate while low-risk properties would pay slightly more. Community rating is beneficial in that it would ensure private flood insurance is still affordable for high-risk individuals.

Although this rating system includes a type of policy subsidy, insurers will not face the same financial risk that the NFIP faces since they will be collecting adequate premiums overall (amounts that in aggregate cover the risk underwritten). It can be argued that a policy rated in this way would be difficult to sell as low-risk individuals do not want to subsidize the rates for high-risk individuals. It is true that individuals likely do not want to subsidize the rates for property owners on the other side of the country, however, they may be more inclined to subsidize the rates for their neighbors. After an intense flooding event, the resilience of a community is greatly impacted by the ability of individuals to rebuild. Lower-risk property owners may be willing to subsidize a portion of their higher-risk neighbors' rates since they arguably benefit from the insurance, both before and after a loss occurs. A lot of this benefit comes in the form of mitigation funding and disaster relief from FEMA; communities that cooperate with FEMA are eligible for flood mitigation grants and disaster relief. Selling policies rated in this way will be difficult as low-risk property owners may have trouble seeing the benefit that they would be receiving.

In order for community rating of flood insurance to work, adequate consumer participation is of utmost importance; this rating system may not be viable unless some variation of a mandatory purchase requirement is in place. Implementation of this rating system would prove difficult as insurers would be required to come up with ways to define or group communities for the rating process as well as develop the tools necessary to evaluate flood risk. It may also be too difficult for individual insurers to gain enough exposure in a singular community to implement this system, and even if they are able to, the risk they would be taking on would be poorly diversified. In order for this rating system to work, extensive collaboration, or even a pooling system, between private insurers is necessary, and with each insurer having their own risk evaluation techniques and individual risk appetite, this seems nearly impossible. While this system would solve the issue of private market flood policies being unaffordable for high-risk properties, its complexities would require the continuation of a governing body, such as the NFIP, to oversee private company collaboration.

5.2.2 Evaluating and Reducing Catastrophic Risk

The frequency and severity of flooding events easily classify it as a catastrophic risk. In order for the private market to be willing to offer flood insurance, they need to be able to ensure that their rates will result in a profitable product. This requires insurers have a complete and detailed understanding of the risk they are taking on so that they are able to develop a rate that accurately reflects this risk in addition to having access to the financial instruments necessary to

manage the risk. Since FEMA's flood maps are not appropriate for use by the private market for this function, private insurers are faced with having to develop their own risk assessment tools. While the creation of applicable flood maps would assist insurers in risk evaluation, due to the complex nature of flood risk, it is universally accepted that the use of catastrophe models is necessary in order to produce and accurate assessment of flood risk. Catastrophe models are currently widely used by insurers for pricing, risk selection and underwriting, loss mitigation activities, reinsurance decision making and overall portfolio management for a variety of catastrophic perils (Clark, 2002).

Reduction of the underlying flood risk is also crucial to overcoming private market challenges. The role of the NFIP in flood hazard mapping and flood mitigation through the Flood Mitigation Assistance program has been an important one. As more states move to do what North Carolina has done with its flood mapping, better risk assessment will make more effective and granular risk mitigation efforts possible. FIRMs are not ideal risk communication tools, and North Carolina has made a commitment to better risk communication, including the dynamic nature of the state's flood risks. Furthermore, the vast majority of federal flood mitigation dollars do not come from the NFIP-funded mitigation programs, so it is not a foregone conclusion that growth in the private sector would undercut federally-backed mitigation.

Greater private sector pricing (presumably not prevented from being risk based) may compel greater risk reduction by communities and homeowners. Flood-resilient communities will require commitments by both the private and the public sectors to a range of mutually reinforcing activities. Valuable risk-reducing information must be accessible to the public sector, and ultimately reach individual property owners in an easily understandable form. Even FEMA is aware of this as in its December 2015 annual report, the Technical Mapping Advisory Committee (TMAC)[28] recommended that "FEMA should transition from identifying the 1-percent-annual-chance floodplain and associated base flood elevation as the basis for insurance rating purposes to a structure-specific flood frequency determination." The private market creates profit incentive to create a public momentum around mitigation and resilience, much in the same way has been accomplished for hurricane wind mitigation in some states.[29]

5.2.3 Reinsurance

Flood is a catastrophic peril, so a robust reinsurance program is paramount. In addition to being able to evaluate the catastrophic nature of flood risk, private insurers need to ensure that there is an adequate appetite in the reinsurance market to assume a portion of the high severity risk that flood presents. The willingness of reinsurers to provide coverage to the NFIP in recent years is promising for the private market. If reinsurers are able to offer coverage to a program

[28] TMAC is a Federal advisory committee created to review and make recommendations to FEMA on matters related to the national flood mapping program (TMAC, 2015).

[29] Florida, South Carolina and Virginia, for instance, have strong building codes coupled with wind mitigation credit programs within their property and insurance markets (Medders et al, 2013).

not focused on making a profit and riddled with adverse selection it can be assumed that they would be inclined to offer reinsurance for flood risk to private insurance companies as well. Reinsurers can take on a more partnered approach than this. A lead reinsurer's risk model can be used by the primary insurer for underwriting and pricing individual exposures, with that reinsurer agreeing to accept the majority of the flood risk. This approach has the advantage of aligning direct pricing and reinsurance pricing incentives and models, and of keeping the new flood program from "polluting" the existing catastrophe reinsurance structure of an incumbent direct insurer writing homeowners and other policies in the same region. But the direct insurer may question its options if the program were to be withdrawn, leaving it with a book of customers (and a regulator) to keep satisfied and a need to find new funding for the catastrophe risk while limiting non-renewals. Additionally, even the most expansive quota-shares have caps on losses from an occurrence, leaving some residual extreme event risk with the direct insurer. A variation on this approach is a partnership among a Managing General Agent (MGA) that acquires and prices customers, a "fronting insurer" that underwrites the direct policy, and a reinsurer (or panel of reinsurers), often organized by the MGA, that benefits the fronting insurer and nearly eliminates its net flood risk. The MGA or insurer must have other strong alliances or capabilities for a successful program, including IT integration with the reinsurer, intermediaries (if multiple or syndicated reinsurers are used), catastrophe analytics and actuarial partners, contract and product development experts, and relationships with state regulators. Whatever the network of providers looks like, the expenses associated with acquisition, servicing, and claims must be properly reflected in the premium. Agent commission rates, MGA operations, vendor expenses, fronting fees, and reinsurance costs must be considered. The final target loss ratios used to "gross up" loss costs from risk models and create premiums must mirror the business plan and capital structure, and may differ across a region.

Capital markets have also become increasingly interested in participating in the insurance industry, which can be specifically seen through the ability of FEMA to administer a catastrophe bond in 2018. Even if private insurers are unable to acquire reinsurance, they also have these alternative risk financing techniques available to them through the capital market. Private insurers should not be worried about the ability to obtain the proper instruments to help them manage high severity flood risk since alternative markets have already proven their interest and ability to assume this risk.

5.2.4 Adequate Consumer Participation

Many private insurers are concerned that there is not sufficient participation by consumers in the flood insurance market which is necessary for them to manage and diversify their risk exposure. Good risk assessment doesn't drive consumer behavior; even if insurers are able to create the necessary tools to accurately evaluate flood risk that does not mean consumers will be willing to purchase their flood insurance products. Even with effective ratemaking, the problem of adverse selection, which led to the creation of the NFIP in the first place, will continue to exist and create a vicious cycle. If only high-risk individuals are buying flood coverage, then rates overall will increase. This in turn decreases the number of individuals who

decide to purchase coverage to where only those with extremely high loss potential are purchasing coverage which then furthers the issue of adverse selection.

The NFIP has always seen increasing the purchase of flood insurance policies as one of their objectives, and it was their motivation behind enacting the mandatory purchase requirement. Even with the mandatory purchase requirement in place, flood insurance participation rates have consistently remained low, although no official studies on compliance have been conducted since 2006 (Horn & Webel, 2018). Nationwide, the purchase rate in SFHAs, the only areas where the mandatory purchase applies to a portion of the population, is only a little over 30%, and outside of SFHAs they are much lower (Kousky et al., 2018). However, as of February 2018, around 2 million households outside of mandatory purchase areas had voluntarily purchased coverage (Kousky et al., 2018). Broad participation is necessary to limit adverse selection and maintain a sufficiently large and diverse risk pool, so many people believe that some form of a mandatory purchase requirement will likely remain in place. All proposed bills require a study to assess the compliance with the current mandatory purchase requirement (Horn & Webel, 2018).

In order to overcome adverse selection and ensure adequate market penetration, the discussion around flood insurance needs to change. It is necessary to shift consumer perception so that flood insurance is no longer seen as an added, unnecessary expense, but as an essential product that could have a substantial impact on financial status and quality of life should a loss event occur. Achieving this would require educating consumers to establish more robust understanding of the risk they inherently face, which for many property owners is likely significantly higher than currently recognized. Flood insurance needs to be seen as a standard property coverage rather than a specialized addition.

5.3 Benefits of Private Sector Involvement

The NFIP currently has very little variance in the types and limits of the coverages they offer compared to what is offered by the private market for similar insurance against non-flood perils. Private companies can compete by exceeding the limits of what the NFIP will cover through offerings such as business interruption insurance, living expenses while property is repaired, basement coverage, coverage for other structures on property, and higher coverage limits. Private companies could also include flood as part of a standard homeowners' policy therefore eliminating the problem of distinguishing between wind and flood damage after intense storms. Furthermore, private companies can streamline the application process and shorten the NFIP's current 30-day waiting period before coverage goes into effect. All of these possibilities benefit consumers by giving them a wider variety of coverage options which allows them to purchase individualized coverage that better meets their needs. With greater market participation and competition, many consumers may be able to find coverage at rates lower than the cost of NFIP coverage.

Since the NFIP will write a flood policy for any property in a participating community, NFIP pricing has become the primary point of comparison for the private market. Where property owners are largely price driven, any insurer that cannot underprice the NFIP will be unable to write policies. Current rating practices by the NFIP, however, result in many properties for which the rate charged by the program does not reflect the risk, creating market distortions and private market opportunities (Kousky et al, 2018). Thus, insurers can find market pockets where they find they can effectively undercut the NFIP pricing. Additionally, FEMA is moving toward more risk-based pricing at a granular property level. As NFIP pricing more closely aligns with risk at a structure level, there may be greater opportunity for the private sector to compete with the NFIP in more areas based on pricing alone.

Competition is good overall for North Carolina property owners, the vast majority of whom would benefit from flood insurance purchase. In the short term, this competition may primarily exist between the NFIP and a handful of private market participants, but in the future a flourishing private market could conceivably handle all but the greatest at-risk properties. A strong private market for flood insurance in North Carolina should result in wide availability and affordability of coverage for virtually all North Carolina property owners.

6 Conclusions

Flood insurance in the U.S. and North Carolina is changing. Private insurers have shown a clear intent to enter the market as alternative coverage providers. Even faced with many obstacles still to overcome, there is no question that they will continue to increase their market share. The NFIP still plays a vital role in the management and mitigation of flood risk, but as a result of increased private flood offerings NFIP policies and focuses are evolving.

Even with all the changes to the market, one thing has remained the same: the vast degree of flood underinsurance. Whether offered through the NFIP or private companies, in order for flood insurance to be successful, the problem of underinsurance has to be addressed. Only an estimated 15% of homeowners in the U.S. carry flood insurance and of those many do not carry sufficient levels of coverage (Insurance Information Institute, 2018). This report reveals that in North Carolina the percentage of homes insured for flood could be as low as 5 percent. Underinsurance directly leads to the problem of adverse selection and was a motivation behind the initial development of the NFIP.

Currently, property owners either perceive that they need flood coverage or they do not. The implementation of the mandatory purchase requirement can be blamed for creating this framework for public perception; a property either lies within a SFHA and therefore needs the mandated coverage or is outside the SFHA with minimal risk, and no coverage is needed. This has led to the extensive underinsurance that currently exists as an estimated three times as many properties lie within 1-in-100-year (1 percent probability) floodplains than is currently indicated by FIRM maps (Adriano, 2018). Property owners need to be made aware of the true

level of risk they face; just because their property has never flooded before doesn't mean it never will, especially with flood risk exposure continually evolving.

The underinsurance of flood risk can have serious financial consequences. As the damage from storms continues to increase, proper insurance coverage is a crucial element in securing the ability of individual property owners as well as communities as a whole to rebuild. Widespread flood insurance is a necessity in order to ensure resilience as communities continue to be faced with extreme flooding events. In order for any progress to be made, the discussion around flood insurance has to change.

APPSTATE R.I.S.E (Risk Initiative for Student Engagement) is a research-teaching-learning collaboration of Appalachian State University students and faculty. Dr. Lorilee Medders, Joseph F. Freeman Distinguished Professor of Insurance, and a select group of students began the initiative in early 2018, with the support of the Brantley Risk & Insurance Center. APPSTATE R.I.S.E conducts multiple projects annually, and as of the time of this publication, is comprised of Dr. Medders and 11 finance, banking & insurance students.

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SIGNIFICANT U.S. FLOOD EVENTS 1978-2019 Available at https://www.fema.gov/significant-flood-events

EVENT	YEAR	# PD LOSSES	AMOUNT PD ($)	AVG PD LOSS
MASSACHUSETTS FLOOD FEB. 1978	Feb-78	2,202	$20,145,418	$9,149
LOUISIANA FLOOD MAY 1978	May-78	7,343	$43,422,439	$5,913
WV, IN, KY, OH FLOODS DEC 1978	Dec-78	690	$3,670,542	$5,320
PA, CT, MA, NJ, NY, RI FLOODS	Jan-79	133	$1,935,294	$14,551
ND, MN FLOODS	Apr-79	1,448	$7,000,387	$4,835
TEXAS FLOOD APRIL 1979	Apr-79	1,954	$20,131,418	$10,303
FLORIDA FLOOD APRIL 1979	Apr-79	1,488	$2,029,163	$1,364
TROPICAL STORM CLAUDETTE	Jul-79	9,664	$147,295,363	$15,242
HURRICANE FREDERIC	Sep-79	2,947	$45,809,311	$15,544
TEXAS FLOOD SEPTEMBER 1979	Sep-79	6,261	$47,085,222	$7,520
NJ, CT & NY FLOODS APRIL 1980	Apr-80	1,474	$4,579,416	$3,107
LOUISIANA FLOOD APRIL 1980	Apr-80	12,831	$86,279,354	$6,724
HURRICANE ALLEN	Aug-80	3,636	$27,454,134	$7,551
TEXAS FLOOD EVENT JUNE 1981	Jun-81	2,143	$13,414,893	$6,260
TEXAS FLOOD AUGUST 1981	Aug-81	2,740	$20,958,042	$7,649
LOUISIANA FLOOD APRIL 1992	Apr-82	3,187	$20,785,522	$6,522
RI, MA, CT FLOODS JUNE 1982	Jun-82	133	$2,004,884	$15,074
THE 'NO-NAME STORM'	Jun-82	2,921	$10,474,435	$3,586
MO, IL FLOODS DECEMBER 1982	Dec-82	2,580	$27,507,398	$10,662
LOUISIANA FLOOD DECEMBER 1982	Dec-82	1,636	$12,917,415	$7,896
LOUISIANA FLOOD APRIL 1983	Apr-83	11,581	$104,833,841	$9,052
ALICIA	Aug-83	10,518	$119,388,681	$11,351

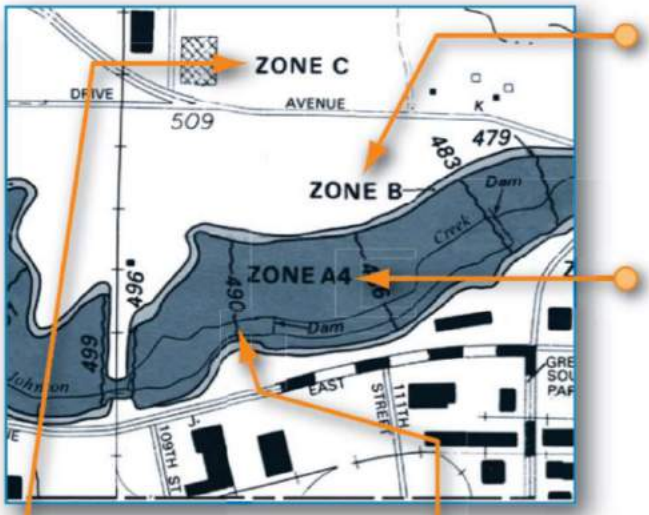
NEW JERSEY FLOOD MARCH 1984	Mar-84	4,096	$22,163,537	$5,411
NEW JERSEY FLOOD APRIL 1984	Apr-84	2,471	$33,300,119	$13,476
KENTUCKY FLOOD MAY 1984	May-84	2,654	$32,623,472	$12,292
ELENA	Aug-85	8,234	$81,322,383	$9,876
GLORIA	Sep-85	6,088	$39,194,422	$6,438
ISABEL OCTOBER 1985	Oct-85	1,612	$5,769,195	$3,579
JUAN	Oct-85	6,187	$90,987,478	$14,706
CALIFORNIA FLOOD FEBRUARY 1986	Feb-86	2,003	$34,838,406	$17,393
LOUISIANA FLOOD APRIL 1988	Apr-88	3,003	$17,124,219	$5,702
TEXAS FLOOD MAY 1989	May-89	2,562	$59,020,120	$23,037
TROPICAL STORM ALLISON 1989	Jun-89	3,127	$39,303,958	$12,569
HURRICANE CHANTEL	Aug-89	2,919	$39,510,677	$13,536
HUGO	Sep-89	12,840	$376,433,739	$29,317
LOUISIANA FLOOD NOVEMBER 1989	Nov-89	4,455	$48,911,213	$10,979
LOUISIANA FLOOD JUNE 1991	Jun-91	1,919	$15,832,141	$8,250
BOB	Aug-91	2,821	$49,707,690	$17,621
HALLOWEEN	Oct-91	9,541	$143,158,312	$15,005
DE, NJ, PR FLOODS JANUARY 1992	Jan-92	3,211	$30,087,521	$9,370
TEXAS FLOOD MARCH 1992	Mar-92	2,353	$50,956,063	$21,656
ANDREW	Aug-92	5,587	$169,113,347	$30,269
NOR'EASTER - 1992	Dec-92	25,142	$346,150,356	$13,768
MARCH STORM	Mar-93	9,840	$212,596,101	$21,605
MIDWEST FLOOD	Jun-93	10,472	$272,819,515	$26,052
TEXAS FLOOD OCTOBER 1994	Oct-94	6,226	$217,628,440	$34,955
LOUISIANA FLOOD	May-95	31,343	$585,071,593	$18,667
OPAL	Oct-95	10,343	$405,527,543	$39,208
NORTHEAST FLOOD - JAN 1996	Jan-96	12,523	$186,623,944	$14,902
NORTHWEST FLOOD	Feb-96	2,329	$61,903,974	$26,580

BERTHA	Jul-96	1,166	$10,388,364	$8,909
FRAN	Sep-96	10,315	$217,843,271	$21,119
HORTENSE	Sep-96	1,382	$20,465,346	$14,808
JOSEPHINE	Oct-96	6,512	$102,604,272	$15,756
NORTHEAST FLOOD - OCT 1996	Oct-96	3,480	$40,837,392	$11,735
CALIFORNIA FLOOD DECEMBER 1996	Dec-96	1,858	$39,699,759	$21,367
SOUTH CENTRAL FLOOD	Feb-97	4,529	$100,469,721	$22,184
UPPER MIDWEST FLOOD	Apr-97	7,398	$160,101,054	$21,641
NOR'EASTER	Feb-98	3,212	$28,011,201	$8,721
HURRICANE BONNIE	Aug-98	2,675	$23,073,621	$8,626
TEXAS FLOOD SEPTEMBER 1998	Sep-98	4,876	$78,402,842	$16,079
LOUISIANA FLOOD SEPTEMBER 1998	Sep-98	5,176	$50,999,758	$9,853
HURRICANE GEORGES (KEYS)	Sep-98	3,437	$43,208,306	$12,572
HURRICANE GEORGES	Sep-98	9,097	$154,169,745	$16,947
HURRICANE GEORGES (PANHANDLE)	Sep-98	1,679	$23,137,642	$13,781
TEXAS FLOOD OCTOBER 1998	Oct-98	3,191	$143,779,364	$45,058
HURRICANE FLOYD	Sep-99	20,439	$462,326,389	$22,620
HURRICANE IRENE FLORIDA 2000	Oct-99	13,682	$117,858,779	$8,614
FLORIDA FLOOD OCTOBER 2000	Oct-00	9,276	$158,283,182	$17,064
TROPICAL STORM ALLISON - 2001	1-Jun	30,671	$1,105,003,344	$36,028
TROPICAL STORM GABRIELLE	1-Sep	2,418	$34,828,580	$14,404
TEXAS FLOOD JULY 2002	2-Jul	1,897	$70,901,720	$37,376
TROPICAL STORM ISADORE	2-Sep	8,470	$114,182,903	$13,481
HURRICANE LILI	2-Oct	2,569	$37,269,589	$14,507
TEXAS FLOOD OCTOBER 2002	2-Oct	3,251	$89,034,696	$27,387
HURRICANE ISABEL	3-Sep	19,938	$500,270,118	$25,091
HURRICANE CHARLEY	4-Aug	2,609	$50,914,481	$19,515
HURRICANE FRANCES	4-Sep	4,966	$153,488,029	$30,908

HURRICANE IVAN	4-Sep	28,154	$1,607,512,533	$57,097
HURRICANE JEANNE	4-Sep	5,380	$128,027,899	$23,797
HURRICANE DENNIS	5-Jul	3,808	$119,867,428	$31,478
HURRICANE KATRINA	5-Aug	166,790	$16,257,744,061	$97,474
HURRICANE RITA	5-Sep	9,354	$466,223,897	$49,842
TROPICAL STORM TAMMY	5-Oct	4,116	$44,773,505	$10,878
HURRICANE WILMA	5-Oct	9,435	$358,146,723	$37,959
PA, NJ, NY FLOODS JUNE 2006	6-Jun	6,427	$229,292,230	$35,676
HURRICANE PAUL	6-Oct	1,507	$37,261,864	$24,726
NOR'EASTER APRIL 2007	7-Apr	8,640	$225,928,476	$26,149
TORRENTIAL RAIN JUNE 2008	8-Jun	3,406	$144,789,258	$42,510
HURRICANE GUSTAV	8-Sep	4,545	$112,566,983	$24,767
HURRICANE IKE	8-Sep	46,701	$2,702,388,727	$57,866
TORRENTIAL RAIN MARCH 2009 TX	9-Mar	3,303	$127,530,808	$38,611
TORRENTIAL RAIN SEPT 2009 GA	9-Sep	2,068	$124,448,580	$60,178
TROPICAL STORM IDA VA	9-Nov	5,671	$102,898,511	$18,145
2010 NOREASTER	10-Mar	10,095	$195,361,623	$19,352
TORRENTIAL RAIN - TN	10-Apr	4,119	$230,583,017	$55,980
TORRENTIAL RAIN - NJ	11-Mar	1,873	$36,428,863	$19,449
MID-SPRING STORMS	11-Apr	4,348	$146,192,748	$33,623
LATE-SPRING STORMS	11-Jun	2,435	$134,795,849	$55,358
HURRICANE IRENE	11-Aug	44,314	$1,345,775,273	$30,369
TROPICAL STORM LEE	11-Sep	9,905	$462,459,225	$46,689
TROPICAL STORM DEBBIE	12-Jun	1,797	$43,021,813	$23,941
HURRICANE ISAAC	12-Aug	12,084	$561,527,299	$46,469
SUPERSTORM SANDY	12-Oct	132,360	$8,804,242,152	$66,517
IL FLOODING - APRIL 2013	13-Apr	3,394	$89,219,304	$26,287

COLORADO FLOODING SEPT 2013	13-Sep	1,740	$69,513,126	$39,950
FLORIDA FLOODING APR 2014	14-Apr	2,145	$111,780,211	$52,112
TEXAS FLOODING MAY JUN 2015	15-May	6,774	$468,799,696	$69,206
SOUTH CAROLINA FLOODING OCT 2015	15-Oct	3,975	$139,808,193	$35,172
2015 EARLY MIDWEST WINTER STORMS	15-Dec	2,257	$99,533,799	$44,100
LATE WINTER SEVERE STORMS	16-Mar	5,318	$283,711,582	$53,349
TORRENTIAL RAIN - TEXAS	16-Apr	7,437	$471,517,374	$63,402
LOUISIANA SEVERE STORMS AND FLOODING	16-Aug	26,976	$2,468,493,541	$91,507
HURRICANE MATTHEW	16-Oct	16,586	$654,394,214	$39,455
HURRICANE IRMA	17-Sep	21,920	$1,054,248,877	$48,095
HURRICANE HARVEY	17-Sep	76,257	$8,908,547,689	$116,823
HURRICANE MARIA	17-Sep	640	$38,050,370	$59,454
HURRICANE FLORENCE	18-Sep	13,754	$648,333,990	$47,138
HURRICANE MICHAEL	18-Oct	3,490	$201,562,277	$57,754

Riverine Flood Hazard Zones



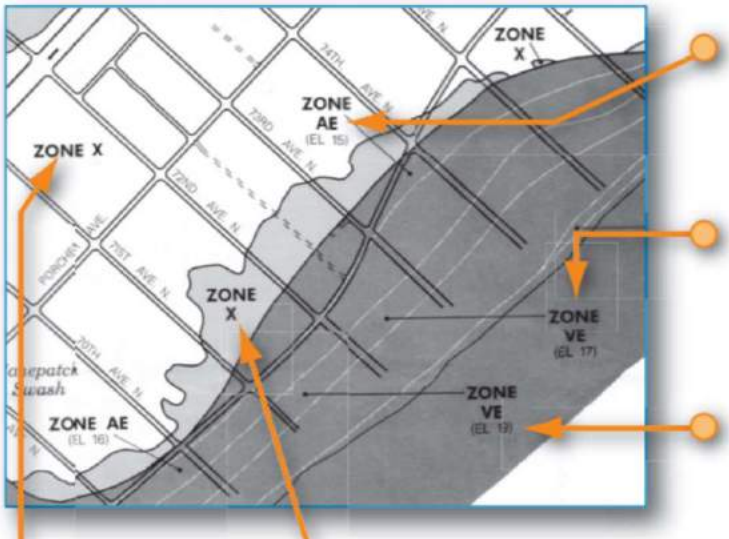
Zone B (or shaded Zone X) is subject to flooding by the 500-year flood (0.2 percent annual chance), and is a moderate risk area.

Zone A, A Zones A1-A30, and **Zone AE** are subject to flooding by the base of the 1percent annual chance (100-year) flood, and are considered high-risk areas.

Zone C (or Zone X) is all other areas, considered low-risk.

Base Flood Elevation (BFE), is the predicted water surface elevation of the base flood at specific locations (in feet above the datum).

Coastal Flood Hazard Zones



Zone A, A Zones A1-A30, and **Zone AE** are subject to flooding by the base or 100-year flood (1percent annual chance), and waves less than 3 feet.

Zone V, V Zones V1-V30, and **Zone VE** are where waves are expected to be 3 feet or more.

Base Flood Elevation (BFE) is the predicted water surface elevation (in feet above datum).

Zone X is all other areas.

Shaded Zone X (or Zone B) is subject to flooding by the 500-year flood (0.2 percent annual chance).

NORTH CAROLINA FLOOD EVENTS - REGION & COUNTY

Mountains

Wilkes	33
Alleghany	17
Ashe	50
Avery	24
Watauga	59
Burke	48
McDowell	22
Caldwell	55
Yancey	19
Mitchell	21
Madison	38
Buncombe	33
Henderson	58
Rutherford	27
Polk	20
Transylvania	47
Haywood	29
Jackson	25
Swain	20
Macon	34
Graham	12
Cherokee	14
Clay	6
	711

Piedmont

Yadkin	16
Alexander	9
Catawba	22
Lincoln	25
Cleveland	14
Gaston	21
Mecklenburg	95
Iredell	18
Davie	10
Rowan	31
Surry	42
Stanly	52
Anson	33
Richmond	17
Montgomery	30
Davidson	39
Forsyth	30
Stokes	11
Rockingham	37
Guilford	61
Randolph	34
Moore	26
Lee	17
Chatham	24
Caswell	24
Person	12
Granville	14
Alamance	27
Vance	8
Orange	21
Durham	45
Wake	88
Franklin	19
Warren	15
Union	64
Cabarrus	55
	1106

Inner Coastal

Gates	11
Bertie	14
Hertford	11
Martin	17
Pitt	24
Lenoir	22
Duplin	19
Sampson	22
Bladen	18
Columbus	22
Robeson	17
Scotland	16
Hoke	16
Harnett	16
Cumberland	39
Johnston	32
Wayne	27
Nash	25
Wilson	22
Greene	14
Edgecomb	30
Halifax	30
Northampton	11
	475

Tidewater

Washington	8
Tyrell	3
Dare	5
Beaufort	21
Hyde	3
Currituck	5
Camden	9
Chowan	4
Carteret	38
Pasquotank	12
Perquimans	6
Craven	31
Pamlico	13
Jones	13
Onslow	35
Pender	40
New Hanover	79
Brunswick	46
	371

NFIP Exposure within North Carolina

Data as of May 31, 2018

Source data available at https://www.fema.gov/media-library/assets/documents/129784

County	Zip Code	No. of Locations	Bldg TIV	Cont TIV	Bldg Lim	Cont Lim	Average Bldg TIV
-	Remainder of NC	278	55,865,823	6,218,501	47,873,500	17,501,400	200,956.20
Alamance	27215	123	33,982,462	3,048,171	23,341,100	6,364,100	276,280.18
Alamance	27217	44	15,369,756	2,064,118	7,148,900	3,610,200	349,312.63
Alamance	27244	23	4,927,826	280,512	4,341,500	780,000	214,253.31
Alamance	27253	55	9,390,461	824,608	9,184,200	2,568,100	170,735.66
Alamance	27258	12	2,392,988	283,985	1,877,600	744,100	199,415.67
Alamance	27302	50	10,182,023	906,570	9,614,500	2,806,500	203,640.47
Alexander	28681	17	5,862,591	789,119	3,123,700	1,528,100	344,858.30
Alleghany	28663	8	1,650,419	172,174	1,237,700	430,000	206,302.34
Alleghany	28675	5	925,221	53,981	752,000	210,000	185,044.18
Anson	28170	5	823,581	94,637	1,075,000	347,200	164,716.18
Ashe	28615	14	3,546,860	166,901	2,930,400	487,000	253,347.11
Ashe	28617	13	2,906,969	190,097	2,707,300	429,300	223,613.02

Ashe	28626	11	2,612,060	238,291	2,344,900	511,500	237,460.03
Ashe	28631	14	2,091,112	93,580	2,218,600	370,500	149,365.15
Ashe	28640	24	7,455,413	740,707	5,838,100	949,600	310,642.19
Ashe	28643	38	6,472,340	597,162	6,090,100	1,373,100	170,324.73
Ashe	28644	5	1,071,634	99,168	1,031,400	304,800	214,326.86
Ashe	28684	23	5,370,854	448,832	5,147,400	1,340,300	233,515.41
Ashe	28694	38	6,787,255	617,568	6,954,500	2,127,900	178,611.98
Avery	28622	20	3,037,308	248,595	2,843,900	772,500	151,865.41
Avery	28646	45	22,013,443	2,484,289	9,588,400	3,402,200	489,187.63
Avery	28657	96	15,818,263	1,592,195	15,342,600	3,779,800	164,773.58
Beaufort	27806	231	52,879,800	4,567,452	37,065,400	7,440,000	228,916.88
Beaufort	27808	388	96,444,503	6,652,147	78,815,000	12,590,900	248,568.31
Beaufort	27810	1,044	220,643,663	15,780,851	167,500,400	20,498,300	211,344.50
Beaufort	27814	100	24,918,424	1,465,854	18,192,400	2,316,100	249,184.24
Beaufort	27817	257	78,729,354	5,828,829	51,175,900	7,962,200	306,339.90
Beaufort	27860	70	11,661,645	540,596	7,837,200	989,200	166,594.93
Beaufort	27865	55	11,731,815	519,190	7,682,800	676,500	213,305.72

Beaufort	27889	2,103	521,561,870	46,954,978	357,793,000	44,639,400	248,008.50
Bertie	27805	16	2,148,694	195,009	1,868,400	665,600	134,293.39
Bertie	27924	25	4,274,067	509,976	3,682,100	1,287,600	170,962.69
Bertie	27957	28	5,123,325	372,578	5,242,800	1,023,700	182,975.90
Bertie	27983	149	44,005,508	4,806,725	18,003,000	6,141,100	295,338.98
Bladen	28320	24	3,413,278	249,223	2,732,900	686,100	142,219.92
Bladen	28337	25	4,788,184	435,417	5,033,100	1,620,000	191,527.34
Bladen	28399	7	1,603,003	130,803	1,437,200	460,000	229,000.48
Bladen	28433	10	1,415,198	171,453	1,409,100	530,100	141,519.79
Bladen	28448	32	4,775,365	241,929	4,176,900	563,500	149,230.16
Brunswick	28420	60	12,469,665	1,184,816	8,563,100	2,548,200	207,827.76
Brunswick	28422	318	84,233,932	7,573,834	63,706,400	18,654,700	264,886.58
Brunswick	28451	881	207,304,352	21,497,580	180,503,100	70,342,500	235,305.73
Brunswick	28461	2,877	873,372,572	132,748,496	708,541,700	217,625,000	303,570.58
Brunswick	28462	2,333	519,418,830	52,359,328	539,085,400	108,153,600	222,639.88
Brunswick	28465	3,352	769,839,369	65,531,318	783,440,500	155,414,900	229,665.68
Brunswick	28467	1,103	273,896,954	25,690,667	246,257,900	80,404,600	248,319.99

Brunswick	28468	1,558	381,981,483	34,651,911	402,411,300	81,406,700	245,174.25
Brunswick	28469	2,343	615,545,235	54,766,538	598,455,500	116,455,900	262,716.70
Brunswick	28470	401	92,247,542	9,265,973	87,816,300	25,031,000	230,043.75
Brunswick	28479	126	32,130,980	3,340,026	25,806,700	9,761,800	255,007.78
Buncombe	28701	8	1,752,543	162,223	1,356,900	355,100	219,067.91
Buncombe	28704	40	15,322,560	1,422,714	8,631,600	2,979,400	383,064.00
Buncombe	28709	39	10,628,013	1,230,004	6,212,400	1,662,700	272,513.16
Buncombe	28711	79	16,095,105	1,667,189	15,457,500	5,097,500	203,735.51
Buncombe	28715	62	18,804,807	1,888,576	12,131,800	3,915,400	303,303.35
Buncombe	28730	19	5,403,961	456,562	4,145,000	1,010,000	284,418.99
Buncombe	28748	11	2,219,935	251,664	2,137,800	688,000	201,812.23
Buncombe	28778	82	38,156,876	4,282,623	15,682,800	5,570,700	465,327.76
Buncombe	28787	56	14,464,533	1,480,280	10,574,100	2,843,000	258,295.23
Buncombe	28801	74	19,817,426	15,097,242	16,885,200	6,432,400	267,803.06
Buncombe	28803	195	80,261,813	8,548,073	48,678,600	16,397,900	411,599.04
Buncombe	28804	125	48,518,098	4,059,322	25,738,200	10,057,300	388,144.78
Buncombe	28805	119	33,461,355	2,949,974	28,679,400	8,027,600	281,187.86

Buncombe	28806	92	21,194,722	1,956,992	19,660,700	4,828,800	230,377.41
Burke	28612	5	1,110,810	89,787	727,100	125,500	222,162.07
Burke	28655	75	20,966,694	1,840,250	16,666,300	4,295,400	279,555.92
Burke	28690	6	3,897,727	710,363	983,000	230,000	649,621.12
Cabarrus	28025	67	19,678,857	1,920,699	13,230,900	4,206,100	293,714.29
Cabarrus	28027	138	66,375,996	5,571,368	31,198,700	11,617,700	480,985.48
Cabarrus	28075	152	49,661,860	4,650,208	31,117,900	9,092,800	326,722.77
Cabarrus	28081	39	12,208,616	1,157,542	7,173,600	2,045,100	313,041.43
Cabarrus	28083	42	9,751,888	1,102,130	7,003,800	3,248,700	232,187.82
Cabarrus	28107	11	3,883,343	395,951	2,047,100	637,400	353,031.14
Caldwell	28611	14	1,982,997	185,957	2,139,300	514,200	141,642.61
Caldwell	28630	15	5,061,358	462,213	2,881,700	808,400	337,423.90
Caldwell	28638	7	10,089,757	1,338,801	1,711,000	1,178,000	1,441,393.82
Caldwell	28645	147	86,764,497	10,588,848	26,454,500	6,423,500	590,234.67
Camden	27921	441	97,443,471	5,730,358	92,513,900	14,797,200	220,960.25
Camden	27974	158	29,687,100	1,395,888	27,408,900	2,726,800	187,893.04
Camden	27976	235	50,068,312	2,708,713	48,162,100	6,937,700	213,056.65

Carteret	28511	64	11,867,789	1,352,695	11,750,000	3,597,600	185,434.20
Carteret	28512	2,212	986,422,071	50,861,166	865,271,000	121,048,800	445,941.26
Carteret	28516	2,235	560,609,618	44,942,371	472,793,400	98,956,900	250,832.04
Carteret	28520	65	10,471,591	1,046,416	9,674,000	2,045,800	161,101.39
Carteret	28524	119	21,104,306	2,192,087	16,632,800	2,804,900	177,347.11
Carteret	28528	92	18,567,984	1,455,105	16,138,800	3,403,100	201,825.91
Carteret	28531	254	55,723,336	5,117,840	50,132,800	10,782,100	219,383.21
Carteret	28553	136	23,664,489	2,032,711	21,755,800	3,500,300	174,003.60
Carteret	28557	1,353	409,583,495	37,454,283	344,796,900	87,447,300	302,722.46
Carteret	28570	749	184,392,489	17,591,925	154,974,300	47,446,000	246,184.90
Carteret	28577	110	20,041,702	1,757,701	20,131,500	3,936,500	182,197.29
Carteret	28579	182	33,939,527	2,765,508	29,770,300	5,009,700	186,480.92
Carteret	28581	60	10,427,224	1,017,230	7,249,800	1,325,000	173,787.07
Carteret	28582	44	11,456,213	1,000,914	9,236,500	2,689,400	260,368.48
Carteret	28584	770	204,901,656	18,190,571	166,721,800	46,183,000	266,106.05
Carteret	28594	2,047	615,155,463	50,224,991	566,638,200	128,656,300	300,515.61
Catawba	28601	112	28,395,939	2,692,807	22,776,200	6,696,100	253,535.17

Catawba	28602	18	4,677,681	516,899	2,985,300	1,223,000	259,871.18
Catawba	28609	15	2,533,086	282,965	1,834,300	650,300	168,872.39
Catawba	28610	23	4,022,238	373,269	3,242,200	714,900	174,879.90
Catawba	28613	30	5,498,754	516,000	5,296,900	1,753,500	183,291.81
Catawba	28650	12	39,452,444	5,893,382	2,511,500	1,749,000	3,287,703.65
Catawba	28658	26	5,341,576	447,925	4,247,100	1,480,600	205,445.24
Catawba	28673	21	7,676,074	786,996	4,770,000	1,680,800	365,527.31
Catawba	28682	10	3,301,061	290,494	2,450,000	689,000	330,106.06
Chatham	27312	55	14,480,287	1,470,702	11,150,700	3,935,300	263,277.95
Chatham	27344	20	4,384,042	451,583	2,932,100	710,500	219,202.12
Cherokee	28901	23	6,358,856	522,101	4,418,900	1,581,700	276,472.01
Cherokee	28905	11	3,353,998	147,315	1,564,000	300,000	304,908.87
Cherokee	28906	110	22,297,125	1,703,463	21,320,000	5,394,700	202,701.13
Chowan	27932	377	124,406,301	11,249,234	94,510,400	22,262,600	329,990.19
Chowan	27980	14	3,580,589	328,681	2,732,500	822,400	255,756.39
Clay	28902	8	1,610,614	143,945	1,624,000	447,000	201,326.81
Clay	28904	117	28,501,090	2,171,332	24,526,400	5,357,500	243,599.06

Clay	28909	6	1,127,613	82,584	1,233,900	270,600	187,935.56
Cleveland	28086	11	2,056,890	221,587	1,806,000	702,000	186,989.98
Cleveland	28150	29	10,577,800	719,194	5,791,400	2,016,800	364,751.73
Cleveland	28152	13	2,253,710	188,776	2,303,000	720,000	173,362.31
Columbus	28423	5	987,553	84,495	806,200	166,300	197,510.67
Columbus	28431	13	1,719,817	192,999	2,340,000	884,700	132,293.62
Columbus	28432	5	568,185	27,382	558,000	41,000	113,637.04
Columbus	28436	13	2,326,737	214,950	2,461,600	738,100	178,979.74
Columbus	28439	19	2,347,234	169,445	2,352,400	428,100	123,538.63
Columbus	28442	16	2,505,704	260,691	2,683,800	844,000	156,606.49
Columbus	28450	135	25,214,110	1,699,530	25,113,700	4,575,900	186,771.19
Columbus	28455	6	1,142,524	94,077	941,300	207,200	190,420.68
Columbus	28456	13	2,106,905	247,222	2,676,900	1,690,000	162,069.63
Columbus	28463	23	3,621,655	238,308	3,041,000	813,300	157,463.28
Columbus	28472	114	16,096,905	1,540,855	13,563,100	4,493,600	141,200.92
Craven	28523	12	2,194,614	244,536	2,083,500	700,000	182,884.47
Craven	28526	11	1,630,071	181,410	1,840,000	735,000	148,188.26

Craven	28527	5	1,086,749	77,608	938,500	240,000	217,349.86
Craven	28532	450	82,267,767	8,059,552	88,338,900	27,415,900	182,817.26
Craven	28560	1,953	461,552,779	33,845,128	425,915,000	84,557,400	236,330.15
Craven	28562	1,597	351,512,989	29,415,422	332,342,600	88,473,500	220,108.32
Craven	28586	120	19,309,063	1,456,478	18,235,700	4,405,300	160,908.86
Cumberland	28301	192	87,002,977	9,142,594	38,676,600	11,488,500	453,140.51
Cumberland	28303	170	43,733,091	4,424,281	34,280,600	11,976,700	257,253.47
Cumberland	28304	153	29,958,726	2,852,167	27,763,700	9,251,900	195,808.67
Cumberland	28305	59	12,671,120	1,520,110	8,853,900	3,410,500	214,764.74
Cumberland	28306	200	44,308,342	4,562,356	37,891,600	14,396,300	221,541.71
Cumberland	28311	164	38,831,532	4,266,446	34,291,800	12,318,100	236,777.63
Cumberland	28312	150	48,932,893	5,592,425	29,701,100	11,995,500	326,219.29
Cumberland	28314	255	53,786,228	5,024,447	45,027,100	13,772,000	210,926.38
Cumberland	28348	148	34,705,473	3,721,285	28,017,800	10,785,600	234,496.44
Cumberland	28356	22	4,765,169	503,259	4,283,500	1,494,000	216,598.59
Cumberland	28391	18	4,392,340	442,283	3,338,100	1,239,900	244,018.88
Cumberland	28395	8	2,002,981	145,598	1,725,000	490,000	250,372.67

Currituck	27916	42	10,461,482	982,833	8,010,700	2,340,600	249,082.90
Currituck	27917	45	8,209,332	548,543	7,269,100	998,300	182,429.61
Currituck	27923	74	38,063,681	3,925,334	14,578,500	3,332,200	514,374.06
Currituck	27927	2,821	1,079,777,485	117,631,889	698,443,400	199,727,600	382,764.09
Currituck	27929	255	64,359,770	4,843,200	55,467,500	9,998,700	252,391.26
Currituck	27939	197	37,347,591	3,236,409	31,465,500	6,503,700	189,581.68
Currituck	27941	130	35,714,614	3,083,013	28,680,200	5,890,200	274,727.80
Currituck	27947	57	13,130,355	1,204,239	10,205,700	2,445,500	230,357.10
Currituck	27950	174	40,669,656	3,031,662	35,038,500	6,398,500	233,733.66
Currituck	27956	7	1,569,222	42,932	1,164,800	160,000	224,174.59
Currituck	27958	994	315,033,131	20,370,348	206,087,300	45,216,700	316,934.74
Currituck	27964	96	23,053,841	1,783,252	20,535,300	3,615,000	240,144.18
Currituck	27965	16	2,959,099	358,270	2,779,600	642,700	184,943.71
Currituck	27966	67	20,696,686	1,793,296	16,040,000	3,102,500	308,905.76
Currituck	27973	103	24,168,572	1,570,038	20,125,900	2,937,000	234,646.33
Dare	27915	1,319	287,739,592	32,468,664	298,917,600	48,931,200	218,149.80
Dare	27920	455	99,187,967	10,704,761	98,447,900	18,654,300	217,995.53

Dare	27936	794	161,850,265	17,009,624	169,731,300	26,166,500	203,841.64
Dare	27943	717	166,573,848	14,935,402	175,477,700	30,046,500	232,320.57
Dare	27948	5,024	1,307,305,553	110,283,286	1,183,709,200	185,926,100	260,212.09
Dare	27949	4,229	1,331,145,904	132,950,495	1,040,336,300	234,131,700	314,766.12
Dare	27953	140	27,573,227	1,963,288	22,925,400	3,554,500	196,951.62
Dare	27954	1,439	543,700,785	33,619,862	401,353,000	56,473,400	377,832.37
Dare	27959	3,327	987,558,512	104,747,598	824,855,500	161,160,700	296,831.53
Dare	27972	519	121,537,370	13,534,682	117,324,800	20,331,000	234,176.05
Dare	27978	95	17,314,210	1,746,144	14,909,500	2,496,700	182,254.84
Dare	27981	284	55,587,493	3,674,982	50,309,200	5,617,400	195,730.61
Dare	27982	769	211,155,512	21,710,748	185,147,500	32,838,800	274,584.54
Davidson	27239	6	1,842,651	201,113	1,060,000	420,000	307,108.53
Davidson	27292	123	35,396,272	3,537,844	21,596,900	6,264,200	287,774.57
Davidson	27295	27	10,309,812	702,837	4,930,500	1,266,000	381,844.90
Davidson	27360	78	45,811,827	6,669,590	15,553,500	5,620,100	587,331.12
Davie	27006	61	25,531,965	2,220,407	13,366,600	3,578,900	418,556.80
Davie	27028	12	4,444,292	491,418	2,600,000	876,500	370,357.68

Duplin	28349	15	54,236,411	10,964,553	2,664,500	1,284,500	3,615,760.76
Duplin	28398	12	1,918,155	236,504	1,975,000	790,000	159,846.22
Duplin	28453	5	2,415,525	253,437	1,100,000	500,000	483,105.08
Duplin	28464	5	624,557	63,111	876,400	340,000	124,911.34
Duplin	28466	255	61,409,555	6,513,410	48,539,200	18,847,400	240,821.78
Duplin	28518	39	7,461,979	824,174	6,914,300	2,558,500	191,332.79
Duplin	28521	19	3,111,589	324,159	3,068,100	1,135,100	163,767.86
Duplin	28572	7	1,159,193	136,541	977,500	385,100	165,598.95
Durham	27503	5	1,455,078	120,378	975,400	255,100	291,015.54
Durham	27701	53	8,805,363	1,599,342	7,327,500	1,872,100	166,138.92
Durham	27703	174	60,543,206	3,337,595	33,870,500	9,772,200	347,949.46
Durham	27704	232	32,638,312	3,006,857	35,160,100	8,683,100	140,682.38
Durham	27705	220	74,046,649	4,178,002	46,204,800	10,993,600	336,575.68
Durham	27707	255	61,935,923	4,983,882	48,135,000	11,790,000	242,885.97
Durham	27709	7	16,815,546	4,030,817	2,538,200	513,500	2,402,220.92
Durham	27712	80	18,524,193	1,813,295	15,255,900	4,516,700	231,552.41
Durham	27713	265	150,306,957	18,726,738	63,080,500	16,156,300	567,196.06

Edgecombe	27801	331	47,923,145	4,727,670	45,792,500	10,789,500	144,782.92
Edgecombe	27852	19	3,771,357	336,185	3,907,900	1,126,000	198,492.45
Edgecombe	27864	25	4,829,872	495,505	2,620,100	949,000	193,194.88
Edgecombe	27886	462	159,846,406	20,160,809	72,637,300	26,208,100	345,987.89
Forsyth	27012	78	25,707,527	2,292,646	16,506,300	5,111,000	329,583.68
Forsyth	27023	21	6,632,121	709,988	4,620,000	1,748,000	315,815.29
Forsyth	27040	7	1,889,483	219,256	1,550,000	620,000	269,926.13
Forsyth	27101	33	9,069,526	628,517	8,059,100	2,034,600	274,834.13
Forsyth	27103	74	13,315,657	1,271,472	13,247,800	3,950,500	179,941.31
Forsyth	27104	98	35,863,457	3,836,037	21,051,300	5,691,700	365,953.64
Forsyth	27105	69	30,064,232	706,972	12,554,400	2,053,600	435,713.50
Forsyth	27106	149	41,375,937	4,349,230	31,064,000	10,026,000	277,690.85
Forsyth	27107	23	9,402,292	489,577	4,236,100	1,346,000	408,795.31
Forsyth	27127	60	34,289,545	3,395,545	14,331,400	4,158,500	571,492.42
Forsyth	27284	68	19,226,365	1,931,927	13,709,700	4,770,300	282,740.65
Franklin	27525	7	1,643,687	172,456	1,550,000	620,000	234,812.39
Franklin	27549	37	7,764,339	676,452	6,425,500	1,770,600	209,847.01

Franklin	27596	20	4,133,506	404,099	3,389,800	1,215,000	206,675.30
Gaston	28012	48	13,373,372	1,144,783	9,955,300	3,041,500	278,611.92
Gaston	28032	18	4,133,622	248,808	3,132,800	660,300	229,645.66
Gaston	28034	14	2,092,468	158,144	1,648,700	390,000	149,462.01
Gaston	28052	53	6,961,802	486,466	7,476,900	1,704,400	131,354.76
Gaston	28054	67	16,033,996	768,084	11,697,900	2,236,300	239,313.37
Gaston	28056	49	11,946,709	1,066,743	9,779,700	3,223,000	243,810.38
Gaston	28098	5	1,263,906	132,609	1,059,500	342,500	252,781.16
Gaston	28101	5	11,280,888	1,945,551	1,505,600	1,102,200	2,256,177.66
Gaston	28120	65	18,018,965	989,642	12,503,400	2,927,600	277,214.85
Gaston	28164	15	5,319,824	502,917	3,720,000	1,288,000	354,654.93
Gates	27926	7	1,727,940	187,571	1,600,000	640,000	246,848.62
Gates	27935	22	3,629,091	280,479	3,024,600	848,200	164,958.67
Gates	27937	11	2,032,385	209,454	2,083,100	790,000	184,762.26
Gates	27938	23	7,904,526	525,794	6,014,800	1,234,000	343,675.06
Gates	27946	8	2,200,426	164,024	1,824,200	351,900	275,053.25
Gates	27979	7	1,249,108	136,016	776,000	264,000	178,443.97

Graham	28702	5	903,430	92,612	741,600	270,000	180,686.00
Graham	28771	42	7,246,709	328,945	6,322,300	778,700	172,540.70
Granville	27509	8	10,978,669	1,194,533	1,980,000	443,300	1,372,333.58
Granville	27522	11	2,858,706	313,250	1,980,000	792,000	259,882.39
Granville	27565	9	2,023,650	207,707	1,688,000	482,100	224,850.01
Granville	27581	5	975,307	105,879	888,000	370,000	195,061.35
Greene	28538	11	1,739,047	167,418	1,536,300	484,900	158,095.20
Greene	28580	55	8,545,661	954,163	9,307,100	3,927,000	155,375.66
Guilford	27235	6	2,158,426	261,066	1,350,000	440,000	359,737.74
Guilford	27249	26	5,222,508	297,683	4,491,900	1,095,500	200,865.68
Guilford	27260	35	9,898,955	559,730	7,252,100	1,945,100	282,827.28
Guilford	27262	74	32,046,720	2,681,555	15,198,800	3,601,700	433,063.79
Guilford	27265	123	27,227,730	2,322,805	21,689,500	5,614,500	221,363.66
Guilford	27282	32	9,362,350	752,146	7,234,400	1,890,600	292,573.44
Guilford	27301	9	2,111,630	205,152	1,617,500	595,000	234,625.56
Guilford	27313	5	1,240,922	130,198	1,200,000	480,000	248,184.48
Guilford	27358	16	5,689,510	612,488	3,200,000	1,280,000	355,594.39

Guilford	27377	12	2,860,041	301,585	2,307,700	900,000	238,336.75
Guilford	27401	41	16,523,207	343,692	8,334,500	1,554,000	403,005.06
Guilford	27403	33	11,350,087	1,038,758	4,825,700	1,360,800	343,942.03
Guilford	27405	62	54,636,469	8,170,204	12,977,000	3,716,500	881,233.37
Guilford	27406	119	42,979,211	4,463,451	30,488,000	8,554,200	361,169.84
Guilford	27407	97	19,265,709	1,394,538	17,865,100	3,394,800	198,615.56
Guilford	27408	91	93,136,517	3,541,805	28,854,000	4,539,200	1,023,478.21
Guilford	27409	33	22,334,483	844,315	6,720,200	1,442,900	676,802.52
Guilford	27410	113	35,043,682	5,893,704	23,387,000	8,584,700	310,121.08
Guilford	27455	41	12,950,789	1,354,001	9,003,800	3,159,300	315,872.91
Halifax	27839	7	1,049,646	124,879	1,250,000	500,000	149,949.44
Halifax	27843	6	1,021,045	122,015	1,175,000	470,000	170,174.10
Halifax	27850	31	8,930,947	1,017,175	6,788,700	2,661,500	288,095.05
Halifax	27870	88	16,044,086	1,206,130	16,642,400	4,483,700	182,319.16
Halifax	27874	6	579,062	69,548	955,000	382,000	96,510.26
Halifax	27890	8	3,099,677	356,240	1,581,900	890,000	387,459.64
Harnett	27501	22	6,890,740	734,039	4,560,800	1,988,000	313,215.45

Harnett	27505	5	901,852	95,543	780,000	312,000	180,370.42
Harnett	27546	46	10,873,762	1,078,007	7,912,000	2,895,800	236,386.12
Harnett	28323	14	2,729,745	240,353	1,732,000	660,000	194,981.76
Harnett	28326	38	9,657,687	1,048,397	6,370,000	2,532,100	254,149.67
Harnett	28334	83	16,818,495	1,454,861	13,969,600	3,016,800	202,632.47
Harnett	28339	34	7,301,828	656,522	6,441,600	1,876,800	214,759.65
Harnett	28390	62	11,719,435	1,404,386	9,995,600	4,239,400	189,023.14
Haywood	28716	129	21,706,742	1,669,222	21,155,000	5,851,900	168,269.32
Haywood	28721	69	18,545,929	2,688,054	10,554,700	2,210,300	268,781.58
Haywood	28751	80	21,432,023	1,774,209	19,964,700	4,278,600	267,900.29
Haywood	28785	66	12,810,696	1,060,904	9,533,000	3,085,400	194,101.46
Haywood	28786	338	76,420,710	5,586,204	50,356,000	11,858,000	226,096.78
Henderson	28729	11	2,751,042	291,604	2,592,000	984,100	250,094.75
Henderson	28731	31	6,993,368	708,732	6,820,000	2,210,000	225,592.52
Henderson	28732	66	54,867,334	1,443,757	14,998,700	3,793,900	831,323.24
Henderson	28739	95	31,871,487	1,882,015	22,920,700	5,259,000	335,489.34
Henderson	28742	7	1,781,527	128,798	1,530,000	387,000	254,503.84

Henderson	28759	8	2,302,254	201,402	1,832,600	508,000	287,781.81
Henderson	28790	11	2,535,938	237,081	1,712,000	436,300	230,539.83
Henderson	28791	58	15,998,452	1,191,034	14,132,900	3,415,400	275,835.38
Henderson	28792	95	27,037,700	2,461,671	19,539,600	6,550,300	284,607.37
Hertford	27818	11	2,136,450	174,392	1,975,900	630,900	194,222.75
Hertford	27855	9	1,452,349	170,151	1,681,400	647,500	161,372.06
Hertford	27910	55	84,037,334	14,686,740	9,294,800	4,031,300	1,527,951.52
Hertford	27942	8	1,065,284	107,596	868,900	181,300	133,160.45
Hertford	27986	10	1,647,182	171,931	1,661,300	572,900	164,718.16
Hoke	28376	110	23,222,726	2,459,445	19,584,100	7,633,900	211,115.69
Hyde	27824	164	25,971,162	1,499,636	17,568,300	2,327,200	158,360.74
Hyde	27826	80	12,397,830	279,079	7,575,100	272,600	154,972.87
Hyde	27875	92	12,529,315	811,119	8,900,500	897,900	136,188.21
Hyde	27885	181	38,617,636	2,792,810	24,709,900	5,662,900	213,357.10
Hyde	27960	655	155,227,903	12,982,273	150,965,400	19,732,800	236,989.17
Iredell	28115	26	9,254,523	873,297	5,079,600	1,914,000	355,943.19
Iredell	28117	77	37,990,297	4,179,532	16,717,400	6,668,700	493,380.48

Iredell	28166	6	13,813,804	1,484,682	1,525,000	910,000	2,302,300.63
Iredell	28625	17	42,621,235	2,640,934	4,650,900	1,063,200	2,507,131.46
Iredell	28677	26	6,918,345	933,433	4,430,200	1,442,100	266,090.19
Jackson	28717	15	7,692,988	954,688	3,800,000	1,370,000	512,865.85
Jackson	28723	70	12,272,116	971,981	11,453,600	3,137,500	175,315.95
Jackson	28736	10	2,944,841	281,349	2,260,000	780,000	294,484.09
Jackson	28774	37	27,102,145	3,161,580	8,540,800	3,343,300	732,490.40
Jackson	28779	127	29,110,635	2,518,554	24,149,000	6,423,600	229,217.60
Jackson	28783	19	2,923,919	226,259	1,893,200	672,100	153,890.45
Jackson	28789	36	15,479,097	1,119,201	7,503,700	1,500,100	429,974.93
Johnston	27504	21	4,492,485	874,051	3,559,000	1,555,800	213,927.85
Johnston	27520	66	107,537,725	1,758,945	15,745,800	4,542,800	1,629,359.47
Johnston	27524	49	12,110,898	1,018,968	7,863,000	2,120,800	247,161.19
Johnston	27527	62	25,077,082	2,616,570	12,847,000	5,058,000	404,469.07
Johnston	27542	20	3,828,304	431,888	3,432,700	1,165,800	191,415.22
Johnston	27569	30	4,628,118	484,095	3,573,800	877,100	154,270.59
Johnston	27576	34	6,416,481	687,564	5,909,200	2,225,700	188,720.04

Johnston	27577	137	31,296,339	2,458,055	24,781,800	6,539,300	228,440.43
Jones	28573	49	10,246,548	972,712	10,448,600	3,179,500	209,113.22
Jones	28585	58	10,434,898	989,363	10,816,800	2,920,000	179,912.03
Lee	27330	63	14,522,306	1,050,272	13,863,300	3,390,900	230,512.79
Lee	27332	129	33,411,625	2,839,196	26,609,900	7,522,400	259,004.84
Lenoir	28501	198	33,574,240	2,736,381	34,705,600	6,665,300	169,566.87
Lenoir	28504	194	70,306,867	6,727,013	37,957,600	13,989,600	362,406.53
Lenoir	28551	46	8,001,484	841,446	7,385,700	2,756,300	173,945.30
Lincoln	28037	55	18,577,477	1,928,296	11,539,000	4,334,000	337,772.31
Lincoln	28092	28	11,064,269	1,273,330	4,476,500	1,646,000	395,152.47
Mc Dowell	28752	55	10,421,062	874,225	9,396,100	3,016,700	189,473.85
Mc Dowell	28761	38	8,129,853	691,961	7,681,700	1,466,000	213,943.49
Mc Dowell	28762	32	6,515,657	404,339	6,034,100	1,251,500	203,614.27
Macon	28734	88	17,924,253	1,620,605	16,347,600	4,862,900	203,684.69
Macon	28741	62	16,513,111	1,868,135	14,115,800	5,004,300	266,340.51
Macon	28763	23	3,657,788	311,119	4,179,000	1,161,000	159,034.26
Madison	28743	13	2,751,273	193,179	2,741,200	963,000	211,636.38

Madison	28753	56	22,875,833	3,752,581	11,288,800	3,091,900	408,497.02
Madison	28754	19	3,442,509	264,491	3,299,300	689,000	181,184.69
Martin	27871	12	1,657,112	200,631	1,755,000	635,000	138,092.63
Martin	27892	69	9,281,017	871,260	10,334,100	2,861,000	134,507.50
Mecklenburg	28031	127	55,623,371	5,640,518	27,322,800	9,992,600	437,979.30
Mecklenburg	28036	54	30,241,555	2,982,890	12,605,000	4,233,200	560,028.80
Mecklenburg	28078	144	50,684,491	5,212,540	31,003,600	10,844,100	351,975.63
Mecklenburg	28105	104	30,916,029	3,251,826	21,374,000	8,503,400	297,269.51
Mecklenburg	28134	60	36,437,249	3,929,533	15,186,600	5,582,500	607,287.49
Mecklenburg	28202	15	21,183,215	849,549	17,118,500	592,800	1,412,214.32
Mecklenburg	28203	53	18,922,849	2,379,467	13,813,000	5,988,600	357,034.88
Mecklenburg	28204	25	6,988,205	745,043	4,722,000	1,713,500	279,528.21
Mecklenburg	28205	203	50,721,380	6,075,917	34,530,900	6,969,800	249,859.02
Mecklenburg	28206	21	8,295,354	1,762,509	5,051,800	2,077,000	395,016.85
Mecklenburg	28207	182	90,336,937	6,633,754	43,769,100	10,665,400	496,356.80
Mecklenburg	28208	40	22,292,059	1,989,515	10,948,000	2,845,300	557,301.49
Mecklenburg	28209	236	75,360,205	4,716,444	62,633,100	10,664,800	319,322.90

Mecklenburg	28210	216	70,614,723	5,783,828	48,361,000	11,896,100	326,920.01
Mecklenburg	28211	186	78,770,233	7,908,245	43,296,400	12,262,600	423,495.88
Mecklenburg	28212	67	6,716,558	1,228,309	8,004,900	2,405,600	100,247.13
Mecklenburg	28213	67	14,072,360	1,653,642	12,168,000	4,140,300	210,035.22
Mecklenburg	28214	130	26,330,908	2,363,203	24,498,900	6,525,900	202,545.45
Mecklenburg	28215	123	20,147,211	1,737,346	24,967,000	4,286,000	163,798.46
Mecklenburg	28216	97	25,102,585	2,044,023	15,591,700	5,426,400	258,789.54
Mecklenburg	28217	74	33,654,909	4,390,967	15,385,300	3,817,100	454,796.06
Mecklenburg	28226	271	117,570,376	12,460,109	62,704,200	19,013,000	433,839.03
Mecklenburg	28227	77	18,092,152	1,976,681	14,619,800	5,368,900	234,963.01
Mecklenburg	28262	52	24,726,619	2,294,205	11,983,200	5,218,700	475,511.90
Mecklenburg	28269	89	34,505,463	3,584,655	18,340,800	7,060,100	387,701.83
Mecklenburg	28270	85	30,556,575	3,153,466	19,452,900	6,530,000	359,489.11
Mecklenburg	28273	108	69,793,890	7,787,128	26,210,900	10,608,000	646,239.72
Mecklenburg	28277	217	90,069,363	9,000,891	49,105,900	16,818,800	415,066.19
Mecklenburg	28278	69	31,013,091	2,004,353	20,851,900	4,747,200	449,465.08
Mitchell	28705	27	4,044,629	364,292	5,443,800	1,271,000	149,801.07

Mitchell	28777	5	2,664,898	31,896	849,600	40,800	532,979.52
Montgomery	27306	5	959,950	65,586	608,800	180,000	191,990.03
Montgomery	27371	9	2,275,154	229,275	1,475,000	580,000	252,794.92
Moore	27376	24	8,207,610	820,261	5,591,000	2,202,000	341,983.76
Moore	28315	30	6,877,552	648,638	6,243,800	1,394,900	229,251.72
Moore	28327	42	10,771,790	922,352	8,086,000	2,388,300	256,471.19
Moore	28374	122	41,941,697	3,971,949	26,201,000	8,538,700	343,784.40
Moore	28387	55	14,702,756	1,685,847	9,830,000	4,644,700	267,322.84
Moore	28394	245	56,669,543	3,217,299	50,206,900	7,728,800	231,304.26
Nash	27803	240	51,497,239	3,997,627	46,397,500	11,617,500	214,571.83
Nash	27804	441	152,621,231	12,505,409	96,521,100	30,594,100	346,079.89
Nash	27809	15	3,288,098	253,146	2,849,400	745,800	219,206.55
Nash	27856	55	10,105,625	1,519,325	10,014,000	3,807,600	183,738.64
Nash	27891	6	783,083	71,351	644,500	261,000	130,513.86
New Hanover	28401	231	145,586,739	14,051,895	66,224,500	19,197,100	630,245.62
New Hanover	28403	720	221,799,783	22,619,734	167,532,200	51,195,600	308,055.25
New Hanover	28405	706	241,655,765	24,739,195	156,379,600	57,169,000	342,288.62

New Hanover	28409	1,995	623,613,108	55,862,586	481,953,600	142,696,900	312,588.02
New Hanover	28411	1,773	534,477,376	54,738,220	413,061,600	143,153,400	301,453.68
New Hanover	28412	1,294	324,559,830	33,033,156	278,552,400	86,394,300	250,819.03
New Hanover	28428	2,085	697,508,431	33,550,936	636,121,300	75,670,300	334,536.42
New Hanover	28429	92	17,382,052	2,544,874	17,262,100	6,341,600	188,935.35
New Hanover	28449	668	218,654,845	16,613,785	198,189,000	48,707,200	327,327.61
New Hanover	28480	1,604	630,875,584	36,799,922	593,351,200	80,144,400	393,313.96
Northampton	27831	6	1,140,224	129,448	1,125,000	450,000	190,037.35
Northampton	27842	10	2,076,610	252,986	1,670,000	683,000	207,661.00
Northampton	27845	6	757,653	65,980	1,069,700	275,200	126,275.47
Northampton	27869	14	1,329,368	103,685	1,273,500	415,000	94,954.86
Onslow	28445	3,297	749,931,058	64,530,857	751,369,200	128,607,100	227,458.62
Onslow	28454	36	6,415,679	661,267	5,530,800	1,864,100	178,213.30
Onslow	28460	1,581	387,630,165	32,209,711	373,563,800	69,550,400	245,180.37
Onslow	28539	294	70,493,873	5,962,004	59,077,100	19,332,100	239,775.08
Onslow	28540	515	97,438,481	9,879,990	100,494,400	36,493,700	189,200.93
Onslow	28544	24	3,628,210	412,617	3,906,600	1,468,800	151,175.40

Onslow	28546	438	94,353,937	9,963,376	86,054,800	34,954,000	215,419.95
Onslow	28555	28	4,749,352	491,888	4,945,400	1,724,700	169,619.73
Onslow	28574	99	17,501,916	1,712,658	18,929,200	6,945,100	176,787.03
Orange	27243	5	1,281,432	134,448	1,250,000	500,000	256,286.49
Orange	27278	55	14,258,070	1,662,344	11,752,500	3,998,000	259,237.63
Orange	27510	77	15,313,122	1,267,658	15,793,300	4,023,400	198,871.71
Orange	27514	218	101,293,352	6,464,653	74,930,500	12,357,900	464,648.40
Orange	27516	104	39,221,385	3,910,661	23,337,000	7,732,400	377,128.70
Orange	27517	200	87,520,981	7,073,297	42,177,100	13,305,200	437,604.91
Pamlico	28510	168	36,437,231	3,137,705	35,038,800	8,029,300	216,888.28
Pamlico	28515	240	40,077,671	3,215,259	37,836,800	7,365,000	166,990.30
Pamlico	28529	48	9,280,950	649,114	8,037,500	1,192,800	193,353.12
Pamlico	28537	40	4,389,071	336,623	4,801,800	819,700	109,726.77
Pamlico	28552	42	4,913,422	332,591	4,472,800	662,500	116,986.23
Pamlico	28556	294	61,926,732	5,039,298	57,509,900	10,948,600	210,635.14
Pamlico	28571	1,020	235,967,115	19,443,312	231,275,100	51,751,900	231,340.31
Pamlico	28587	71	10,881,359	1,002,555	11,473,400	1,919,200	153,258.58

Pasquotank	27909	2,637	641,918,070	39,006,830	484,732,800	78,850,900	243,427.41
Pender	28421	21	3,536,876	288,231	2,992,600	741,100	168,422.65
Pender	28425	299	57,675,706	5,172,437	50,891,100	13,582,200	192,895.34
Pender	28435	57	9,710,492	711,583	8,831,300	1,931,900	170,359.52
Pender	28443	907	250,339,403	24,530,438	197,889,500	65,760,400	276,008.16
Pender	28457	103	20,514,871	1,933,749	18,943,200	6,331,700	199,173.51
Pender	28478	32	4,459,223	2,058,863	4,829,100	1,425,500	139,350.72
Perquimans	27919	9	1,634,655	113,719	1,425,100	295,000	181,628.34
Perquimans	27944	698	163,787,971	12,050,305	146,434,500	34,014,800	234,653.25
Person	27572	6	1,143,154	131,062	1,030,000	296,800	190,525.67
Person	27573	11	3,402,412	324,745	2,706,700	879,000	309,310.15
Person	27583	6	1,309,629	116,105	1,198,900	380,000	218,271.58
Pitt	27812	15	2,169,381	178,494	1,884,500	373,300	144,625.38
Pitt	27828	88	18,447,741	1,991,558	17,320,600	6,300,700	209,633.42
Pitt	27834	683	392,360,202	112,367,662	116,020,200	39,357,100	574,465.89
Pitt	27837	48	8,998,782	863,952	8,024,100	2,457,600	187,474.63
Pitt	27858	465	86,856,739	6,691,734	88,870,700	16,966,800	186,788.69

Pitt	27884	17	2,595,775	213,926	2,402,300	625,300	152,692.63
Pitt	28513	52	8,956,902	1,016,485	8,837,700	3,214,200	172,248.11
Pitt	28530	137	92,255,703	13,189,073	22,246,000	6,201,000	673,399.29
Pitt	28590	283	63,915,729	6,025,958	59,719,800	19,178,000	225,850.63
Polk	28722	11	3,131,483	356,865	2,195,000	672,000	284,680.28
Polk	28756	5	1,000,454	82,255	1,086,000	300,000	200,090.81
Polk	28773	18	3,560,755	230,305	3,591,800	682,800	197,819.70
Polk	28782	37	7,242,342	754,641	7,085,600	2,327,100	195,738.96
Randolph	27203	47	6,689,731	354,018	6,818,100	710,100	142,334.71
Randolph	27205	12	2,782,996	316,246	2,335,000	942,000	231,916.36
Randolph	27263	44	7,383,248	496,016	5,790,500	847,400	167,801.09
Randolph	27298	8	1,383,826	157,149	1,436,300	488,300	172,978.20
Randolph	27316	5	885,157	69,786	902,500	435,600	177,031.45
Randolph	27317	11	2,132,757	110,456	1,682,000	380,000	193,887.03
Randolph	27370	10	2,667,689	186,346	2,056,500	472,000	266,768.93
Richmond	28379	39	14,969,631	926,398	7,931,300	3,498,600	383,836.70
Robeson	28340	9	1,313,338	129,021	1,230,100	448,600	145,926.46

Robeson	28357	14	2,725,353	265,217	2,789,000	1,008,000	194,668.07
Robeson	28358	518	104,036,752	10,753,125	85,512,100	20,116,500	200,843.15
Robeson	28360	167	37,588,375	2,403,755	28,598,600	5,031,600	225,080.09
Robeson	28364	61	10,269,792	703,676	7,632,300	1,762,700	168,357.24
Robeson	28369	5	944,523	76,147	831,900	212,000	188,904.53
Robeson	28371	36	7,020,659	754,327	6,348,100	2,419,000	195,018.29
Robeson	28372	30	4,720,481	213,296	3,933,300	308,300	157,349.36
Robeson	28377	10	1,627,627	156,622	1,627,900	590,000	162,762.71
Robeson	28383	55	7,592,564	296,143	6,472,300	792,500	138,046.63
Robeson	28384	18	4,326,802	451,283	3,027,500	1,050,000	240,377.88
Rockingham	27025	9	1,668,308	279,385	1,612,900	1,172,900	185,367.53
Rockingham	27048	5	1,170,022	129,438	1,030,000	362,000	234,004.37
Rockingham	27288	30	4,134,495	259,967	3,967,700	798,800	137,816.51
Rockingham	27320	29	7,349,180	212,256	5,550,000	524,500	253,419.99
Rowan	28023	8	2,010,007	195,530	1,634,000	570,000	251,250.85
Rowan	28138	7	1,595,228	178,627	1,186,300	460,000	227,889.75
Rowan	28144	85	23,795,476	1,875,562	16,904,300	6,561,600	279,946.78

Rowan	28146	78	17,233,787	1,424,562	15,444,400	3,902,800	220,945.98
Rowan	28147	16	3,598,548	303,809	3,265,700	1,048,000	224,909.28
Rutherford	28043	8	1,899,352	142,956	1,519,100	350,800	237,418.99
Rutherford	28139	26	6,163,343	528,093	4,969,900	1,552,100	237,051.64
Rutherford	28746	83	93,044,133	9,457,610	18,993,600	3,802,600	1,121,013.65
Sampson	28318	8	1,733,918	187,906	1,725,000	690,000	216,739.73
Sampson	28328	41	8,516,424	927,581	8,534,200	2,791,500	207,717.66
Sampson	28382	5	1,007,900	95,841	590,000	232,000	201,579.92
Sampson	28441	7	1,433,136	142,400	1,442,000	505,000	204,733.70
Sampson	28444	21	3,324,947	289,174	3,321,300	827,000	158,330.80
Sampson	28447	20	3,608,079	304,209	3,319,800	800,000	180,403.95
Scotland	28351	5	947,957	92,897	941,900	328,200	189,591.41
Scotland	28352	29	6,019,444	628,201	5,832,300	2,372,000	207,567.05
Stanly	28001	38	22,183,336	923,941	6,818,100	2,262,800	583,772.00
Stanly	28127	17	4,790,516	554,491	3,600,000	1,340,000	281,795.08
Stanly	28128	7	1,536,753	162,093	1,701,000	530,000	219,536.21
Stanly	28137	6	863,992	63,540	730,900	240,000	143,998.63

Stokes	27021	12	2,028,953	196,150	2,388,400	845,100	169,079.38
Stokes	27053	5	874,572	113,744	990,000	370,000	174,914.39
Surry	27030	38	35,393,111	5,595,401	9,016,500	3,574,900	931,397.65
Surry	28621	8	4,945,524	828,120	940,400	600,000	618,190.48
Swain	28713	79	13,754,452	882,477	14,468,100	2,817,800	174,106.98
Swain	28719	44	93,855,739	10,858,851	7,638,300	1,692,300	2,133,084.97
Transylvania	28712	152	36,800,089	3,222,931	31,212,300	9,407,900	242,105.85
Transylvania	28718	5	806,675	105,661	1,099,600	407,600	161,335.08
Transylvania	28747	25	6,111,878	690,353	5,680,000	2,132,000	244,475.10
Transylvania	28768	45	11,599,996	1,201,603	9,022,000	2,539,100	257,777.70
Transylvania	28772	17	7,359,788	1,147,752	2,769,400	924,000	432,928.72
Tyrrell	27925	533	92,994,985	5,245,756	77,720,200	9,940,200	174,474.64
Union	28079	96	23,467,361	1,991,997	21,366,000	5,841,000	244,451.68
Union	28103	8	6,381,124	4,566,731	1,305,900	800,000	797,640.53
Union	28104	105	34,757,752	3,607,018	22,238,400	8,375,900	331,026.21
Union	28110	73	17,813,066	1,937,338	15,456,400	4,876,600	244,014.61
Union	28112	17	4,265,011	432,011	3,432,900	1,250,000	250,883.03

Union	28173	155	60,673,431	5,544,189	36,317,000	11,802,300	391,441.49
Union	28174	10	1,275,414	140,510	1,318,100	467,000	127,541.44
Vance	27536	10	2,283,462	232,918	1,600,100	595,000	228,346.19
Vance	27537	14	3,724,675	312,941	2,896,000	800,000	266,048.21
Wake	27502	76	23,198,893	2,379,634	15,864,500	5,698,200	305,248.59
Wake	27511	150	56,591,602	4,123,472	31,720,300	10,223,800	377,277.35
Wake	27513	120	43,536,530	4,692,452	25,062,200	9,646,900	362,804.42
Wake	27518	174	83,899,856	7,559,351	43,003,300	13,726,300	482,183.08
Wake	27519	215	75,392,533	7,427,291	48,059,200	16,873,900	350,662.94
Wake	27523	32	16,879,629	1,656,844	7,690,000	2,430,000	527,488.41
Wake	27526	115	24,527,459	2,580,862	21,772,400	8,216,200	213,282.25
Wake	27529	122	27,652,334	2,798,229	24,810,300	7,723,400	226,658.48
Wake	27539	55	21,681,908	2,057,381	12,011,600	4,421,000	394,216.52
Wake	27540	72	22,548,317	2,409,024	15,920,000	6,523,300	313,171.07
Wake	27545	43	10,412,086	1,293,868	8,198,700	3,170,100	242,141.54
Wake	27560	80	35,602,786	2,654,493	23,541,100	4,926,000	445,034.82
Wake	27571	8	2,057,362	218,746	1,680,000	672,000	257,170.20

Wake	27587	156	65,855,829	5,525,167	41,153,600	11,703,200	422,152.75
Wake	27591	40	10,592,298	891,503	8,408,400	2,680,000	264,807.46
Wake	27592	14	3,457,707	382,261	2,570,000	1,028,000	246,979.05
Wake	27597	51	10,297,067	763,252	8,148,600	2,241,300	201,903.28
Wake	27601	15	3,225,173	341,681	3,933,700	770,300	215,011.50
Wake	27603	84	24,368,725	3,718,592	17,421,100	7,851,500	290,103.86
Wake	27604	213	47,496,315	3,196,905	44,323,700	9,890,500	222,987.40
Wake	27605	6	9,544,077	1,410,257	1,530,000	812,000	1,590,679.56
Wake	27606	81	25,715,857	2,629,308	21,222,800	6,083,000	317,479.72
Wake	27607	44	11,226,535	6,512,491	8,531,600	3,669,600	255,148.52
Wake	27608	180	72,544,760	4,520,513	60,159,200	8,068,300	403,026.44
Wake	27609	297	102,584,929	7,190,712	74,740,900	18,871,600	345,403.80
Wake	27610	170	29,399,594	2,623,636	36,227,500	8,489,300	172,938.79
Wake	27612	148	147,932,000	18,255,855	34,121,300	14,345,700	999,540.54
Wake	27613	103	35,183,513	3,748,771	21,540,000	8,446,000	341,587.50
Wake	27614	139	58,791,578	6,052,656	31,720,100	11,581,900	422,960.99
Wake	27615	181	57,635,954	6,055,512	39,685,000	12,825,100	318,430.68

Wake	27616	102	21,751,428	2,184,982	19,787,600	7,114,300	213,249.30
Wake	27617	58	33,125,087	1,910,535	15,085,000	3,642,500	571,122.19
Warren	27551	6	1,524,575	134,790	1,300,000	420,000	254,095.82
Washington	27928	37	4,939,136	246,958	4,232,600	637,900	133,490.17
Washington	27962	87	17,943,485	1,512,197	17,146,500	4,962,300	206,246.95
Washington	27970	122	21,865,427	1,717,650	23,274,600	5,149,500	179,224.81
Watauga	28604	142	31,287,113	3,317,883	30,426,400	10,361,900	220,331.78
Watauga	28605	67	16,938,329	1,710,408	15,228,600	4,823,400	252,810.87
Watauga	28607	263	96,564,479	5,875,545	69,734,400	12,835,400	367,165.32
Watauga	28618	13	2,210,964	200,932	2,208,500	678,000	170,074.13
Watauga	28679	22	3,854,199	407,275	4,319,500	1,410,200	175,190.87
Watauga	28692	19	3,175,260	246,624	3,201,700	659,500	167,118.93
Watauga	28698	13	1,757,937	173,799	1,797,900	470,000	135,225.90
Wayne	27530	561	118,540,850	19,123,951	83,290,700	28,287,200	211,302.76
Wayne	27534	285	111,055,521	7,468,442	59,630,500	17,945,300	389,668.49
Wayne	27863	34	5,777,795	622,285	5,524,300	2,004,000	169,935.14
Wayne	28333	24	6,651,783	491,198	4,611,900	1,518,700	277,157.62

Wayne	28365	19	3,729,254	268,404	3,672,000	837,000	196,276.51
Wayne	28578	31	4,327,465	357,121	4,430,800	1,096,900	139,595.63
Wilkes	28624	7	619,252	28,258	1,043,800	150,000	88,464.58
Wilkes	28659	20	6,752,508	383,153	5,171,300	850,100	337,625.42
Wilkes	28697	24	18,658,964	2,163,302	6,228,800	3,772,000	777,456.82
Wilson	27822	21	3,918,343	431,406	3,390,000	1,221,300	186,587.75
Wilson	27851	12	2,040,532	398,457	2,277,400	1,058,700	170,044.36
Wilson	27883	16	2,388,551	260,019	2,380,800	837,300	149,284.41
Wilson	27893	287	53,859,123	6,323,029	48,411,100	17,207,300	187,662.45
Wilson	27896	223	53,161,704	4,255,425	42,226,200	11,128,400	238,393.29
Yancey	28714	115	20,805,844	1,650,854	20,672,300	5,828,500	180,920.39
State Total		115,557	32,941,877,479	3,073,586,805	25,986,927,500	6,021,516,200	

NFIP Exposure Report
Data as of May 31, 2018
All Lines of Business

Values represent NFIP exposure after applying ACV and Co-Insurance factors

Values and Limits in $Millions

Storm Surge Control Totals	Occupancy Type	Description	RecordCount	Building Value	Content Value	Building Limit	Content Limit
RMS RiskLink v17							
	1	Single-Family	107,957	26,646	2,504	22,077	5,712
	2	Multi-Family	4,373	1,312	71	1,207	107
	37	General Commercial	6,068	4,448	548	1,681	591
	42	Apartments/Condominiums	1,373	2,364	10	2,090	16
	43	Residential	948	140	19	101	42
AIR Touchstone v5.0							
	301	General Residential	1,153	705	75	236	95
	302	Permanent Dwelling - Single-Family	106,748	25,924	2,428	21,829	5,614
	303	Permanent Dwelling - Multi-Family	5,320	1,451	90	1,309	149
	306	Apartments/Condominiums	1,373	2,364	10	2,090	16
	311	General Commercial	6,067	4,448	548	1,681	590

Inland Flood Control Totals	Occupancy Type	Description	RecordCount	Building Value	Content Value	Building Limit	Content Limit
AIR Touchstone v5.0							
	301	General Residential	1,153	705	75	236	95
	302	Permanent Dwelling - Single-Family	106,748	25,924	2,428	21,829	5,614
	303	Permanent Dwelling - Multi-Family	5,320	1,451	90	1,309	149
	306	Apartments/Condominiums	1,373	2,364	10	2,090	16
	311	General Commercial	6,067	4,448	548	1,681	590

Source data available at https://www.fema.gov/media-library/assets/documents/129784

NFIP Storm Surge Analysis Report

Data as of May 31, 2018

All Lines of Business

Values represent NFIP exposure after applying ACV and Co-Insurance factors

Gross AAL and Exposure by County for NC Counties in Top 100 Ranked by Gross AAL

Storm Surge	County	Locations	Building Value	Contents Value	Building Limit	Contents Limit	Gross AAL	U.S. Rank
RMS RiskLink v17								
	NEW HANOVER	11,694	4,069,080,201	341,661,599	3,147,289,800	766,702,300	7,718,636	35
	CRAVEN	4,246	1,207,354,112	97,714,940	887,325,800	215,702,100	4,695,438	45
	BRUNSWICK	15,907	4,179,575,095	438,759,297	3,785,582,700	950,911,400	3,140,389	58
	PENDER	4,510	1,044,369,572	96,108,641	1,003,832,800	222,021,000	2,937,757	61
	DARE	19,118	5,150,541,804	477,860,086	4,618,089,600	834,148,700	2,540,076	65
	CARTERET	10,194	3,143,858,239	231,508,517	2,754,095,900	563,124,100	2,092,996	73
	BEAUFORT	4,074	826,473,116	59,811,966	710,045,200	94,146,600	2,058,094	76
	ONSLOW	3,947	890,718,580	88,763,620	836,508,100	225,059,700	1,816,784	79
	PAMLICO	1,975	440,444,844	36,255,809	400,878,600	87,424,600	924,735	96
AIR Touchstone v5.0 (values & limits in 000s)								
	NEW HANOVER	11,778	4,092,975	343,834	3,166,695	772,796	7,180	41
	BRUNSWICK	15,899	4,177,416	438,526	3,783,633	950,073	6,662	42
	DARE	19,095	5,142,138	476,929	4,612,340	832,583	4,614	52
	ONSLOW	6,505	1,436,288	135,329	1,443,760	318,767	4,157	55
	CARTERET	10,469	3,213,521	238,880	2,810,866	582,625	3,003	64
	HYDE	1,146	232,856	17,316	207,296	28,405	1,052	91
	PAMLICO	1,966	437,857	36,122	399,106	87,030	998	94
	CURRITUCK	5,178	1,778,721	173,897	1,184,545	303,009	745	100

Source data available at https://www.fema.gov/media-library/assets/documents/129784

NFIP Exposure Report
Data as of May 31, 2018
All Lines of Business

Storm Surge Control Totals	Occupancy Type	Description	RecordCount	Building Value	Content Value	Building Limit	Content Limit
RMS RiskLink v17							
	1	Single-Family	107,957	26,646	2,504	22,077	5,712
	2	Multi-Family	4,373	1,312	71	1,207	107
	37	General Commercial	6,068	4,448	548	1,681	591
	42	Apartments/Condominiums	1,373	2,364	10	2,090	16
	43	Residential	948	140	19	101	42
AIR Touchstone v5.0							
	301	General Residential	1,153	705	75	236	95
	302	Permanent Dwelling - Single-Family	106,748	25,924	2,428	21,829	5,614
	303	Permanent Dwelling - Multi-Family	5,320	1,451	90	1,309	149
	306	Apartments/Condominiums	1,373	2,364	10	2,090	16
	311	General Commercial	6,067	4,448	548	1,681	590
Inland Flood Control Totals	**Occupancy Type**	**Description**	**RecordCount**	**Building Value**	**Content Value**	**Building Limit**	**Content Limit**
AIR Touchstone v5.0							
	301	General Residential	1,153	705	75	236	95
	302	Permanent Dwelling - Single-Family	106,748	25,924	2,428	21,829	5,614
	303	Permanent Dwelling - Multi-Family	5,320	1,451	90	1,309	149
	306	Apartments/Condominiums	1,373	2,364	10	2,090	16
	311	General Commercial	6,067	4,448	548	1,681	590

Values represent NFIP exposure after applying ACV and Co-Insurance factors
Values and Limits in $Millions

Source data available at https://www.fema.gov/media-library/assets/documents/129784

NFIP Storm Surge Analysis Report

Data as of May 31, 2018

All Lines of Business

Values represent NFIP exposure after applying ACV and Coinsuranc

Gross AAL and Exposure by County for NC Counties in Top 100 Ranked by Gross AAL

Storm Surge	County	Locations	Building Value	Contents Value	Building Limit	Contents Limit	Gross AAL	U.S. Rank
RMS RiskLink v17								
	NEW HANOVER	11,694	4,069,080,201	341,661,599	3,147,289,800	766,702,300	7,718,636	35
	CRAVEN	4,246	1,207,354,112	97,714,940	887,325,800	215,702,100	4,695,438	45
	BRUNSWICK	15,907	4,179,575,095	438,759,297	3,785,582,700	950,911,400	3,140,389	58
	PENDER	4,510	1,044,369,572	96,108,641	1,003,832,800	222,021,000	2,937,757	61
	DARE	19,118	5,150,541,804	477,860,086	4,618,089,600	834,148,700	2,540,076	65
	CARTERET	10,194	3,143,858,239	231,508,517	2,754,095,900	563,124,100	2,092,996	73
	BEAUFORT	4,074	826,473,116	59,811,966	710,045,200	94,146,600	2,058,094	76
	ONSLOW	3,947	890,718,580	88,763,620	836,508,100	225,059,700	1,816,784	79
	PAMLICO	1,975	440,444,844	36,255,809	400,878,600	87,424,600	924,735	96
AIR Touchstone v5.0								
(values & limits in 000s)	NEW HANOVER	11,778	4,092,975	343,834	3,166,695	772,796	7,180	41
	BRUNSWICK	15,899	4,177,416	438,526	3,783,633	950,073	6,662	42
	DARE	19,095	5,142,138	476,929	4,612,340	832,583	4,614	52
	ONSLOW	6,505	1,436,288	135,329	1,443,760	318,767	4,157	55
	CARTERET	10,469	3,213,521	238,880	2,810,866	582,625	3,003	64
	HYDE	1,146	232,856	17,316	207,296	28,405	1,052	91
	PAMLICO	1,966	437,857	36,122	399,106	87,030	998	94
	CURRITUCK	5,178	1,778,721	173,897	1,184,545	303,009	745	100

Source data available at https://www.fema.gov/media-library/assets/documents/129784

Companies and Subsidiaries Participating in National Flood Insurance Program Write-Your-Own Program as of March 2019

1. **Allstate Insurance Company**
    a. Allstate New jersey Insurance Company
2. **American Capital Assurance Corporation**
3. **American Commerce Insurance Company**
    a. Citation Insurance Company
    b. Commerce Insurance Company
    c. Commerce West Insurance Company
    d. Mapfre Insurance Company
    e. Mapfre Insurance Company of New York
4. **American Family Mutual Insurance Company**
    a. American Family Insurance Company
5. **American National Property and Casualty Company**
6. **American Strategic Insurance Corporation**
    a. ACA Home Insurance Corporation
    b. ASI Assurance Corporation
    c. ASI Lloyds
    d. ASI Preferred Insurance Corporation
    e. ASI Select Insurance Corporation
7. **American Traditions Insurance Company**
8. **Assurant, DBA: American Bankers Insurance Company of Florida**
9. **Auto Club South Insurance Company**
10. **Auto-Owners Insurance Company**
    a. Owners Insurance Company
11. **Baldwin Mutual Insurance Company**
12. **Bankers Insurance Group, DBA: First Community Insurance Company**
    a. Bankers Insurance Company
    b. Bankers Specialty Insurance Company
13. **Capitol Preferred Insurance Company**
14. **Centauri Specialty Insurance Company**
15. **Cooperativa de Seguros Multiples de Puerto Rico**
16. **Cornerstone National Insurance Company**
17. **CSAA Insurance Exchange**
    a. ACA Insurance Company
    b. Western United Insurance Company
18. **Everett Cash Mutual Insurance Company**
19. **Farm Family Casualty Insurance Company**
20. **Farmers Insurance Group/DBA Fire Insurance Exchange**
    a. Civic Property & Casualty Company
    b. Farmers Insurance Company
    c. Farmers Insurance Company of Arizona
    d. Farmers Insurance Company of Idaho
    e. Farmers Insurance Company of Oregon
    f. Farmers Insurance Company of Washington
    g. Farmers Insurance Exchange
    h. Farmers Insurance of Columbus
    i. Farmers New Century Insurance Company
    j. Foremost Insurance Company of Grand Rapids
    k. Michigan Illinois Farmers Insurance Company
    l. Mid-Century Insurance Company
    m. Texas Farmers Insurance Company
    n. Truck Insurance Exchange
21. **FedNat Insurance Company**
22. **First American Property & Casualty Insurance Company**
23. **First Insurance Company of Hawaii**
24. **First Protective Insurance Company**
25. **Florida Family Insurance Company**
26. **Gulfstream Property and Casualty Insurance Company**
27. **Hartford Fire Insurance Company**
    a. Hartford Fire Insurance Company of the Midwest
28. **Hartford Underwriters Insurance Company**
29. **Homesite Insurance Company**
    a. Homesite Indemnity Company
    b. Homesite Insurance Company of California
    c. Homesite Insurance Company of Florida
    d. Homesite Insurance Company of Georgia
    e. Homesite Insurance Company of Illinois

f. Homesite Insurance Company of New York
g. Homesite Insurance Company of the Midwest
h. Homesite Lloyd's of Texas

30. **Integrand Assurance Company**
31. **Island Insurance Company**
32. **Liberty Mutual Fire Insurance Company**
33. **Mapfre PRAICO Insurance Company**
34. **Metropolitan Property & Casualty Insurance Company**
    a. Metropolitan Direct Property & Casualty Insurance Company
35. **Multinational Insurance Company**
36. **National General Insurance Company**
    a. Imperial Fire & Casualty Insurance Company
    b. Integon Casualty Insurance Company
    c. Integon General Insurance Company
    d. Integon Indemnity Corporation
    e. Integon National Insurance Company
    f. Integon Preferred Insurance Company
    g. MIC General Insurance Corporation
    h. National General Assurance Company
    i. National General Insurance Company
    j. National General Insurance Online, Inc.
    k. New South Insurance Company
37. **NGM Insurance Company**
    a. Main Street America Assurance Company
    b. Old Dominion Insurance Company
38. **Occidental Fire & Casualty Company of North Carolina**
39. **Pacific Indemnity Insurance Company**
40. **Philadelphia Contributionship Insurance Company**
    a. Germantown Insurance Company
41. **Philadelphia Indemnity Insurance Company**
42. **Pilgrim Insurance Company**
    a. High Point Preferred Insurance Company
    b. Mount Washington Assurance Corporation
    c. Palisades Property & Casualty Insurance Company
    d. Plymouth Rock Assurance Corporation
43. **Prepared Insurance Company**
44. **Privilege Underwriters Reciprocal Exchange**
45. **QBE Insurance Corporation**
46. **Safepoint Insurance Company elective Insurance Company of America**
    a. Selective Casualty Insurance Company
    b. Selective Fire & Casualty Insurance Company
    c. Selective Insurance Company of New England
    d. Selective Insurance Company of New York
    e. Selective Insurance Company of South Carolina
    f. Selective Insurance Company of the Southeast
47. **Southern Farm Bureau Casualty Insurance Company**
    a. Florida Farm Bureau General Insurance Company
    b. Georgia Farm Bureau Mutual Insurance Company
    c. Kentucky Farm Bureau Mutual Insurance Company
    d. Louisiana Farm Bureau Casualty Insurance Company
    e. Mississippi Farm Bureau Mutual Insurance Company
    f. North Carolina Farm Bureau Mutual Insurance Company
    g. South Carolina Farm Bureau Mutual Insurance Company
    h. Virginia Farm Bureau Mutual Insurance Company
48. **Southern Fidelity Insurance Company**
49. **Union Mutual Fire Insurance Company**
50. **United Property & Casualty Insurance Company**
51. **United Surety & Indemnity Company**
52. **Universal Insurance Company (PR)**
53. **Universal Insurance Company of North America**
54. **Universal North America Insurance Company**
55. **USAA General Indemnity Company**
56. **Westfield Insurance Company**
57. **White Pine Insurance Company**
58. **Windsor-Mount Joy Mutual Insurance Company**

59. Wright National Flood Insurance Company

2019

Allied World Insurance Company
Antares (Lloyd's Synd. No. 1274 AUL)
Apollo (Lloyd's Synd. No. 1969 APL)
Ariel Re (Lloyd's Synd. No. 1910 ARE)
Ascot (Lloyd's Synd. No. 1414 ASC)
AXIS Reinsurance Co
Brit (Lloyd's Synd. No. 2987 BRT)
Canopius (Lloyd's Synd. No. 4444 CNP)
Chaucer (Lloyd's Synd. No. 1084 CSL)
Faraday (Lloyd's Synd. No. 0435 FDY)
Hannover Ruck SE
Hiscox (Lloyd's Synd. No. 0033 HIS)
Liberty Mutual Insurance Company
Liberty Specialty Services Ltd. Paris o/b/o (Lloyd's Synd. No. 4472 LIB)
Markel Global Reinsurance Co
MS Amlin (Lloyd's Synd. No. 2001 AML)
Munich Reinsurance America, Inc.
Navigators US
Renaissance (Lloyd's Synd. No. 1458 RNR)
Renaissance Reinsurance U.S. Inc.
SCOR Reinsurance Company
Swiss Reinsurance America Corporation
The Cincinnati Insurance Co
Transatlantic Re o/b/o General Reinsurance Corporation
Transatlantic Reinsurance Company
Validus Americas o/b/o Validus Reinsurance (Switzerland) Ltd.
XL Catlin (Lloyd's Synd. No. 2003 XLC)
XL Reinsurance America, Inc.

2018

Allied World Insurance Company
Amlin (Lloyd's Synd. No. 2001 AML)
Apollo (Lloyd's Synd. No. 1969 APL)
Ariel (Lloyd's Synd. No. 1910 ARE)
Ascot (Lloyd's Synd. No. 1414 ASC)
AXIS Reinsurance Co US
Brit (Lloyd's Synd. No. 2987 BRT)
Canopius (Lloyd's Synd. No. 4444 CNP)
Chaucer (Lloyd's Synd. No. 1084 CSL)
Faraday (Lloyd's Synd. No. 0435 FDY)
General Reinsurance Corporation
Hannover Ruck SE
Hiscox (Lloyd's Synd. No. 0033 HIS)
Liberty Mutual Insurance Company
Liberty Specialty Services Ltd. Paris o/b/o (Lloyd's Synd. No. 4472 LIB)
Managing Agency Partners (Lloyd's Synd. No. 2791 MAP)
Markel Global Reins Co
Munich Reinsurance America, Inc.
QBE Reinsurance Corporation
Renaissance (Lloyd's Synd. No. 1458 RNR)
Renaissance Reinsurance U.S. Inc.
SCOR Reinsurance Company
Swiss Re Underwriters Agency, Inc. o/b/o Swiss Reinsurance America Corporation
The Cincinnati Insurance Co
Transatlantic Reinsurance Company
Validus Reinsurance (Switzerland) Ltd.
XL Catlin (Lloyd's Synd. No. 2003 XLC)
XL Reinsurance America, Inc.

2017

Amlin (Lloyd's Synd. No. 2001)
Ascot (Lloyd's Synd. No. 1414)
Axis Reinsurance Company U.S.
Brit (Lloyd's Synd. No. 2987)
Everest Reinsurance Company
Faraday (Lloyd's Synd. No. 0435)
General Reinsurance Company
Hannover Ruck SE
Hiscox (Lloyd's Synd. No. 0033)
Liberty Mutual Insurance Company
Liberty Specialty Markets (Lloyd's Synd. No. 4472)
Market Global Reinsurance Company
Munich Reinsurance America Inc.
National Indemnity (U.S.)
Partner Reinsurance Company of the U.S.
QBE Reinsurance Corporation
Renaissance Re (Lloyd's Synd. No. 1458)
Renaissance Reinsurance U.S. Inc.
SCOR Reinsurance Company
Sompo Canopius (Lloyd's Synd. No. 4444)
Swiss Reinsurance America Corporation
Transatlantic Reinsurance Company
Validus Reinsurance (Switzerland) Ltd.
XL Catlin (Lloyd's Synd. No. 2003)
XL Reinsurance America Inc.