Vulnerability to coastal storms in New York City neighborhoods

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THE TRUST FOR PUBLIC LAND

Cover: Clark Wallace

Foreword

The extreme devastation wrought on New York City's waterfront communities by Superstorm Sandy followed significant damage inflicted by Hurricane Irene just a year earlier. These events have created heartbreaking images of the storm's devastating impact on people's lives, and illustrated the vulnerability of New York City's homes, businesses, transportation networks, sewer systems, power grid, and natural resources in its low-lying areas. More events like this are likely to occur. Based on the effects of sea level rise projections alone, what is now a 1-in-100 year flood is anticipated to occur five times as often by the 2050s.[1,2] Through this partnership, The Trust for Public Land, the City of New York ("the City"), Columbia University's Center for Climate Systems Research ("Columbia CCSR"), and the Consortium for Climate Risk in the Urban Northeast (CCRUN)—including CCRUN-affiliated researchers from Columbia University and Drexel University—joined together to research, plan, and create protective green infrastructure along the City's waterfront. This new green infrastructure, ranging from natural systems like wetlands to new waterfront parks that integrate creative storm protection features, will help absorb the brunt of sea level rise and storms to protect New Yorkers for generations to come.

The Trust for Public Land's Climate-Smart Cities[TM] initiative helps cities mitigate and adapt to climate change through conservation and design along four strategies:

> **CONNECT:** creating better bicycle and pedestrian networks helps people ditch driving, reducing carbon emissions and improving health.

> **COOL:** increasing green space such as parks, tree canopies, and gardens helps to cool the urban landscape, reducing the health impacts of heat waves for everyone, particularly older adults, low-income households, and other vulnerable residents.

> **ABSORB:** replacing pavement with permeable surfaces or swales helps to filter and absorb rainfall, reducing water treatment costs and preventing pollution.

> **PROTECT:** placing well-designed parks and green space where they can act as natural buffers to rising seas and storm surges protects surrounding neighborhoods while providing opportunities for people to get outdoors.

With support from the National Oceanographic and Atmospheric Administration, The Trust for Public Land's Climate-Smart Cities program commissioned research from Columbia University to assess the physical and social impact green infrastructure has on communities.

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[1] Based on the high estimate for sea level rise.
[2] New York City Panel on Climate Change, 2013: Climate Risk Information 2013: Observations, Climate Change projections, and Maps. C. Rosenzweig and W. Solecki (Editors), NPCC2. Prepared for use by the City of New York Special Initiative on Climate Change.

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REPORT
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1. Introduction

Adaptation and management of climate risks have been gaining urgency among a wide range of decision makers. Climate services have been responding to the growing need with an impressive increase in climate information available for decision-making. Less available has been guidance on who is vulnerable to climate risks and what are the causes of that vulnerability that decision makers can use to design strategies that build resilience of populations to climate. Determinants of vulnerability that need to be addressed in order to build resilience are likely to be different for different climate risks. For example, floods and wind are a major threat to property and infrastructure even though they may also threaten lives. Heat waves primarily threaten health. Changing seasons impact a variety of other economic outcomes. Progress on adaptation requires addressing specific vulnerabilities presented by different climate risks.

The densely populated, large urban centers on the northeastern coast of the United States are exposed to several different risks from climate variability and climate change. Coastal flooding due to storms is one high priority for city governments (see for example The City of NYC 2011). The concern increased sharply after Hurricane Sandy killed 117 people in the northeastern US (CDC 5/24/2013), and caused an estimated $19 billion in damages in New York City (NYC) alone (Bloomberg 2012). While hurricane Sandy was the highest flood in NYC history (Orton et al submitted), storm tides that impact populations are not unusual in the region, and increased damage from flooding related to storm surges is among the most certain impacts of climate change (Frumhoff et al. 2007). The extreme floods associated with events that currently are projected to happen once in a hundred years will become 30-year flood events by 2080 under central estimates of sea level rise (Horton et al 2015).

The NYC government has been at the forefront of engaging with climate scientists to understand the city's vulnerability to climate risks in general, and to coastal storms in particular, and to develop strategies to build resilience. Efforts to address the increasing flood risk from coastal storms are primarily focused on engineered structures. NYC developed a $20 billion plan for coastal adaptation under the Special Initiative on Rebuilding and Resilience (City of New York 2013). Many projects are underway, but densely populated sections of the coastline will remain unprotected in NYC and elsewhere, and even those that receive protections will have a residual risk of flooding (Orton et al. 2015b, National Research Council 2014).

This study seeks to complement existing efforts by advancing resilience through means other than engineering. We identify factors that are associated with vulnerability to coastal flooding driven by storms in urban neighborhoods based on evidence from the recovery from hurricane Sandy in NYC. The objective is to identify vulnerable populations and guide the design of interventions to build resilience to coastal storms in urban communities. The study will demonstrate factors that have already led to greater resilience as well as sources of vulnerability to provide examples of what communities and government can do to better prepare for future storms.

We follow Susan Cutter's definition of vulnerability of place as a combination of exposure to hazard, susceptibility to loss due to the hazard, and ability to recover from the loss (Cutter et al 2009). By resilience, we mean ability to adapt to withstand the impacts of future hazards, storms in the case of this study, and recover from future losses.

This study analyzes determinants of vulnerability to coastal flooding based on the recovery from hurricane Sandy in two neighborhoods in NYC: the Rockaways and the southeastern shore of Staten Island. The two locations bore the brunt of hurricane Sandy, experiencing very similar intensity of the storm. The two neighborhoods have rather different socio-economic and institutional landscapes, presenting a comparison that has the potential to illuminate different aspects of resilience and vulnerability. Both neighborhoods are still recovering from the storm. We adopt a mixed method approach, combining evidence from in-depth interviews of community leaders, people involved in the recovery, and residents with data from surveys of residents in the two neighborhoods.

Summary of results

The evidence from the post-Sandy recovery suggests that middle-income homeowners are the most vulnerable to flooding from coastal storms. This evidence is contrary to the common assumption in the literature on social vulnerability that low-income populations are most vulnerable to climate risks, and it illustrates the importance of documenting vulnerabilities that are specific to each climate risk and to context in order to inform policy decisions. The main loss caused by the storm was damage to people's homes. The people who were hardest hit are those who owned those properties and who either lost the investment in the home or had to spend considerable resources on rebuilding it. Rebuilding was the component of recovery for which there was least assistance available. Middle-income homeowners have spent a considerable part of their savings on rebuilding and are less resilient to future storms than they were before Sandy.

Different parts of the population had different vulnerabilities to the storm and were most vulnerable at different points during the recovery. The lower income populations experienced more difficulties with access to food immediately after the storm. However, considerable assistance became available quickly and people recovered.

A significant source of vulnerability after hurricane Sandy was lack of awareness about the flooding risk and lack of access to information. Access to information rarely plays a part in analyses of vulnerability, yet it should be an important consideration in identifying vulnerable populations and designing strategies for reducing vulnerability. Poor understanding of storm forecasts led to most people deciding against evacuation despite an order to evacuate issued by the NYC Mayor's Office. After the storm, information about how to clean out a flooded home, and about resources available to support the recovery was not easily available. Lack of knowledge about future flood risks is one factor that resulted in missed opportunities to improve resilience during rebuilding.

Another source of vulnerability that needs to be taken into account in building resilience to coastal flooding consists of institutions present in a neighborhood. Volunteer networks,

community groups, and non-profit, non-governmental organizations (NGOs) carried out much of the work of recovery after the storm. Neighborhoods that had stronger organizations before the storm were more resilient. For example, more help with rebuilding was available in Staten Island than in the Rockaways because there were strong NGOs on Staten Island that could undertake the work of rebuilding, while that capacity was absent in the Rockaways. Volunteer networks, community groups, and NGOs played a major role in the recovery in both neighborhoods but these critical institutions were stronger in Staten Island than in the Rockaways, speeding the recovery in that neighborhood. The main constraints that these organizations faced were insufficient resources. The rebuilding work in Staten Island ground to a halt when many homes still needed assistance because the non-profits depleted their funding.

The organizations that facilitated the recovery and contributed to resilience built communication channels needed to collect information about needs in the neighborhoods, and they had the command structures, the agility, and the manpower that enabled them to respond to those needs quickly and on a scale commensurate with the extent of Sandy's impacts. These were for the most part, but not exclusively, volunteer networks, community groups and NGOs. The organizations that respondents considered less effective acted based on their own plans for what assistance should be delivered and how.

This study contributes to the existing literature evidence that can guide the analysis of social vulnerability to coastal storms. The literature on social vulnerability for the most part considers vulnerability to all climate risks to be determined by individual characteristics such as income, education, gender, and ethnicity, as well as geographical variables, using these variables to construct a social vulnerability index (see for example Cutter et al 2003). We point out that the relationship between each of the variables commonly encountered in social vulnerability indices and vulnerability is likely to differ for different climate risks. We elaborate the important role of additional factors, primarily knowledge, information, social networks, and institutions in determining vulnerability to flooding from coastal storms. We also demonstrate that understanding the process which leads to vulnerability is essential for guiding strategies to build resilience.

The directions for building resilience that emerge from the preliminary findings share the common theme of involving communities that are particularly exposed to coastal storms (and climate risks more generally) in preparing themselves for storms and in establishing a structure to support the recovery. The theme that communities are critical to building resilience appears in a growing literature (Klinenberg 2013; Sampson 2003; Klinenberg 1999). Aldrich (2010) states, "I call for a re-orientation of disaster preparedness and recovery programs at all levels away from the standard fixes focused on physical infrastructure towards ones targeting social infrastructure." Much of the vulnerability and resilience to hurricane Sandy has its roots in lack of awareness of flooding risk from coastal storms in the study neighborhoods, and in social networks and organizations that responded to the storm.

2. Context

Hurricane Sandy caused the most damage within the US on the New Jersey coast and in NYC when it landed just north of Atlantic City, NJ. The Rockaways and the southeastern shore of Staten Island, which together form the southern and eastern coast of NYC, were the two hardest hit neighborhoods in NYC.

The Rockaways is a long, thin, flat peninsula that forms a barrier beach in the Atlantic Ocean, off the southern coast of Queens. We selected three sections along the length of the Rockaways for the study in order to represent the socio-economic diversity of the peninsula. The western area stretches from Beach 149th to Beach 116th streets and from the bay to the Atlantic Ocean. The residential population in this area is mainly middle to upper-middle income and predominantly white, with the majority of residential structures being single-family homes. The middle area stretches from Beach 115th to Beach 69th streets, and the entire width of the peninsula. The area has a mixed income population and is diverse ethnically. The housing stock consists of single-family homes as well as small and large apartment buildings. Several high-rise apartment buildings managed by the New York Community Housing Agency (NYCHA) are in this area. Residents of NYCHA buildings tend to be low-income. The area is much more commercial than the western area, including a large supermarket. The eastern area, from Beach 68th to Beach 35th streets, is predominantly low-income and non-white. The area has mostly single-family homes, but it does have a number of apartment buildings managed by NYCHA. Many residents of the single-family homes are renters rather than owners. Businesses are sparse in the area. A number of streets in this area have large pools of standing water even after a moderate rainfall.

The Rockaways reach further west and east than do the areas included in our study. However, the three areas represent the main variation in socio-economic and natural conditions across the peninsula. The section further east from our study area was less affected by the storm. The one severely affected area that is not represented in the study is a small, private community of middle-income single-family homeowners at the western-most tip of the peninsula, Breezy Point. All services in Breezy Point are privately managed and access is restricted. A fairly high proportion of homes are vacation homes. Sandy devastated Breezy Point perhaps more than other areas of the peninsula, with very high flood levels and about 130 homes destroyed and another 50 damaged by a massive fire sparked by floodwaters coming in contact with electric equipment.

The study area in Staten Island comprises the southeastern coastal neighborhoods of Arrochar, South Beach, Midland Beach, New Dorp Beach, and Oakwood Beach, which are north of the Great Kills Park, and Butler Manor and Tottenville south of Great Kills. We selected the neighborhoods for the study by examining the extent of the flooding on the USGS Hurricane Sandy Storm Tide Mapper. We included blocks that were shown as being flooded on the mapper. We did not include neighborhoods lying between Great Kills Park and Butler Manor because the coastline elevation rises quickly in this area, resulting in relatively minor flooding. The study area is flat and low-lying, with significant stretches of wetland, especially in Midland Beach.

The neighborhoods are mainly residential with some public infrastructure such as schools and hospitals. The income and ethnic composition of the study area changes somewhat from northeast to southwest but is generally much more homogenous than the Rockaways. Most of the area is low to middle income and mostly white, with incomes and percentage of white population increasing as one heads southeast. The hardest-hit area, Midland Beach, is primarily a white, working-class neighborhood. One of the respondents reports "Midland Beach, South Beach, Oakwood Beach, New Dorp Beach, these areas are more moderate incomes and a higher density level of housing. That was the main areas that got hit, and plus the houses weren't as strong, not as well built; the damage was higher." The quotation is comparing these neighborhoods to the neighborhoods of Butler Manor and Tottenville further south, which are wealthier.

3. Data collection and methodology

3.1 Interviews

Interviews began in the Rockaways less than two months after the storm (December 2012), at which point the team interviewed 16 residents and volunteers who were providing assistance. About one year later, the study team made contact with new interview respondents by sending an email about the study through an email listserv belonging to a local community leader in the Rockaways. We interviewed residents and community leaders who responded to that email, and then used snowball sampling, asking respondents to provide names of additional residents, community leaders, and others involved in the recovery effort. We conducted semi-structured interviews in person or over the phone, covering the same broad set of issues for each respondent.

We completed 40 interviews in the Rockaways, including residents, community leaders, and individuals providing relief and recovery assistance to residents. We completed 17 of these interviews in December 2012 and January 2013, and another 23 in 2014. The community leaders and individuals active in providing relief and recovery assistance included both residents of the Rockaways and non-residents. We also attended various recovery meetings in the Rockaways, including meetings of the Long Term Recovery Group, and we include material from the meetings in the study.

The study team selected interview respondents on Staten Island by identifying organizations that were active in the relief and recovery effort after Sandy. We interviewed people who played significant roles in those efforts. We then selected additional individuals using the snowball approach as in the Rockaways, asking our interviewees to suggest whom we should interview and asking in particular to introduce us to residents who may not have been actively involved in the relief and recovery.

The team interviewed 17 people in Staten Island and conducted less structured conversations with another 7 people. The group of interviewees includes 11 relief and recovery organization leaders who are very knowledgeable not only about their own experience as Staten Island residents but also about the post-Sandy events on Staten

Island in general and about the experiences of many residents. It also includes 6 residents. We conducted the additional 7 conversations with residents.

3.2 Household surveys

The study team conducted household surveys in both neighborhoods, with a random sample of 250 households in each neighborhood. In the Rockaways, we sampled households from each of the three sections of the peninsula described in section 2: west, middle, and east. In Staten Island, we sampled separately from the neighborhoods north of Great Kills Park, and from the two neighborhoods south of the park, which are Butler Manor and Tottenville. We allocated the number of sampled households north and south of Great Kills Park proportionally to the total number of households from which we drew the sample in each region.

The team used a list of residential addresses available from data maintained by New York City. We eliminated all apartment building taller than 10 floors from the list. Many of the residential buildings taller than 10 floors in our study areas would have been NYCHA residences. Identification of the vulnerability issues in these residences is outside of the scope of this study, largely because we could not allocate the number of sampling units to these building that would have been required.

In the Rockaways, we sampled from all residential addresses, excluding apartment buildings taller than 10 floors, located between Beach 149th Street and Beach 35th Street. The entire peninsula was flooded, therefore no special effort was required to sample from flooded areas. In Staten Island, we selected addresses located within the flooded area shown on the USGS Hurricane Sandy Storm Tide Mapper, and we sampled from those addresses.

We interviewed households who are permanent residents. This condition restricted eligibility for the survey only in the Rockaways, where some residences are vacation homes. We only interviewed residents who lived in the Rockaways or in the flooded section of Staten Island during hurricane Sandy, though they may have lived at a different address during the storm. In each of these households, we spoke to the person or one of the people who pay the mortgage or the rent and who are otherwise responsible for household finances.

We conducted the surveys 2 – 3 years after the storm, starting in the Rockaways in September 2014, and ending on Staten Island in February 2016. We encountered a substantial number of abandoned properties and residences in which people had moved out and the current residents did not live in the area during the storm. We replaced each of these residences with another randomly chosen address.

The final sample consists of 151 addresses in the Rockaways and 141 addresses in Staten Island, yielding a response rate of 60% in the Rockaways and 56% in Staten Island. The interviewers returned to sampled households repeatedly in order to ensure as high a response rate as possible. However, a number of people did not want to discuss the storm,

which was a very traumatic event. The response rate is substantial but it does allow for selection bias in our results, since the households who responded to the survey may be systematically different from households who did not respond.

3.3 Methodology

The study team transcribed the interviews. We coded the transcribed text to locate various categories of information important to the study, and we analyzed the coded text using Nvivo. All statistics provided in the report regarding the number of respondents who made a given point or the number of references to a given point are based on 40 interviews in the Rockaways and 17 interviews on Staten Island. We used the material from the additional 7 conversations in Staten Island to elaborate and add examples, but the conversations were not included in the statistics.

We compared the means of a number of variables that capture losses from the storm and recovery outcomes between renters, homeowners in the same income categories as the renters, and homeowners in higher income categories. We verified the results of the comparison of means with regressions that test whether home ownership and several other household characteristics affect recovery outcomes, controlling for damage to the home. We conducted the comparison of means and ran regressions for the following dependent variables: how much money respondents spent on the recovery out of their own pockets, how much financial assistance they received, whether their savings declined from before Sandy to the time of the survey, by what percentage their savings declined, whether they incurred debt to finance the expenses of the recovery, whether they were displaced from their homes, for how long they were displaced, whether they experienced problems with access to food and for how long, whether they experienced problems with access to health care and for how long, how long they had mold in their homes, how long they did not have a functioning boiler and hot water heater, how long they did not have electricity, whether their homes are back to the same condition they were in before Sandy or better, how long it took for homes to return to that condition, whether anyone in the respondent's household lost their job as a result of Sandy, how long it took to regain jobs, whether the household received assistance with food, whether it received assistance with health care, whether it received assistance with clearing out the home, and whether it received assistance with rebuilding (for homeowners only).

The independent variables in all regressions are: whether or not the respondent owns their home (except in regressions that are only relevant for homeowners), whether people over 65 live in the home, whether people under 18 live in the home, household size, whether the respondent lives with a partner, whether the highest education level of the men in the household is a BA or above, whether the highest education level of the women in the household is a BA or above, whether there is no adult male in the household, whether the annual household income is between $35,000 and $100,000, whether the annual household income is above $100,000, whether the home suffered more than a minimal amount of damage in the storm, and whether the home suffered severe damage in the storm. In some regressions that included only observations from the Rockaways we also included the variable whether the household head and his/her partner, if s/he lives with a

partner, are both white or not. We could not include this variable for regressions on observations from Staten Island, because there were too few observations in which the household head was not white in Staten Island.

The categories of damage had the following specific definitions in the survey. **Not affected**: There were no impacts to the home that required repair; the home may have lost electricity or running water, but nothing required repair. **Minorly affected**: The home could be lived in, and the structure required minor repairs, or required treatment of mold, or replacement or repair of utilities such as the boiler or hot water heater. **Affected**: The structure required major repairs but was safe for living in; the house may have been unsafe to live in because of mold, but not because of structural issues. People may have stayed in the house or not. **Majorly affected**: The structure became unsafe and could not be lived in but it could be repaired. **Destroyed**: The home could not be repaired; it had to be torn down and rebuilt. Whether or not the home suffered more than minimal damage is a binary variable that takes the value 1 if the respondent experienced damage in the third category, affected. Whether or not the home had severe damage takes the value 1 if the respondent experienced damages in one of the last two categories.

We ran OLS regressions for continuous dependent variables, and logit regressions for binary dependent variables. Any outcomes that we do not mention in the results sections below did not have any statistically significant results in the regressions.

4. Exposure to hurricane Sandy and damage from the storm

The two elements of vulnerability that are constant across the Rockaways and Staten Island are exposure to hurricane Sandy, and coastal storms more generally, and the range of damages that the storm inflicted. Hurricane Sandy brought the highest storm tide in NYC history, and most of the damage in both neighborhoods was due to flooding driven by storm surge. Exposure to storm surge is more or less uniform along the southeastern shore of Staten Island and the coast of the Rockaways. The coast experienced approximately a 9.2-foot storm surge.[1] In the Rockaways, residents report only one other storm in living memory when the "ocean met the bay," meaning that the peninsula was under water across its entire width. In Staten Island, the water overran large swathes of the flat portions of the southeastern coast. In both neighborhoods, the ocean waters roared in as a rapid storm surge, leaving little time to get out of the way for anyone who was not in a safe place.

The Rockaways and Staten Island suffered similar ranges of damage, with extensive damages to residential homes and other built and natural infrastructure. One of the respondents on Staten Island reports, " … there were 12,000 homes that were tagged by the Building Department.[2] Almost 1,000 of those had to be completely demolished." In the Rockaways, in addition to homes destroyed by flooding, almost 200 homes were

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[1] The storm surge is the water level above the average daily low tide level minus the tide.
[2] Homes that were destroyed or heavily damaged were "tagged" with different color tags by the NYC Building Department to indicate the level of damage and whether the structure was safe to live in.

either completely destroyed or damaged by fires triggered by flooded electric circuits. The boardwalk in the Rockaways was entirely uprooted, floated down the streets and slammed into homes. In both neighborhoods sand and mud were piled up in the streets. Residents describe a scene reminiscent of a war zone. People lost the contents of whatever parts of their homes were flooded. Figure 1 illustrates that respondents to our survey in both neighborhoods report similar levels of flooding in their homes. Figure 2 shows the extent of damage reported by survey respondents in the two neighborhoods.
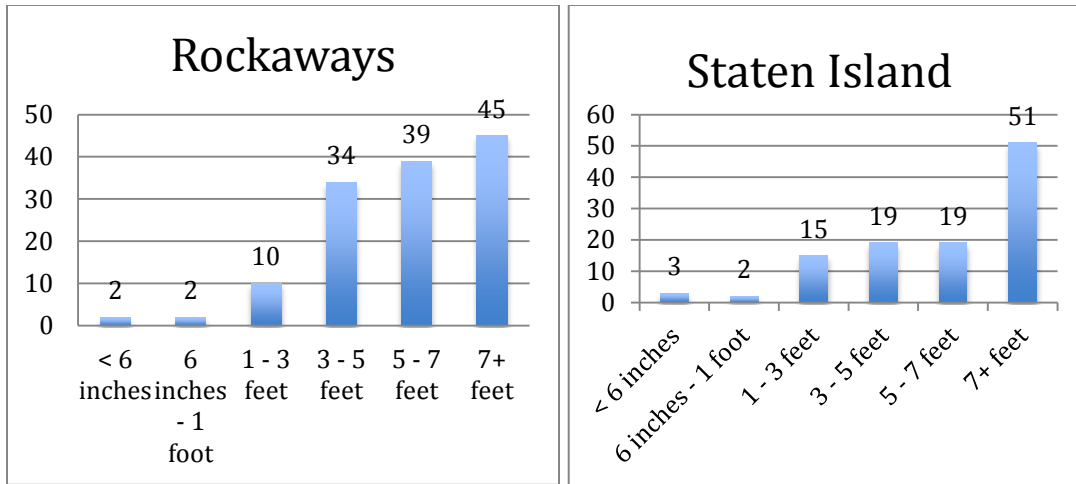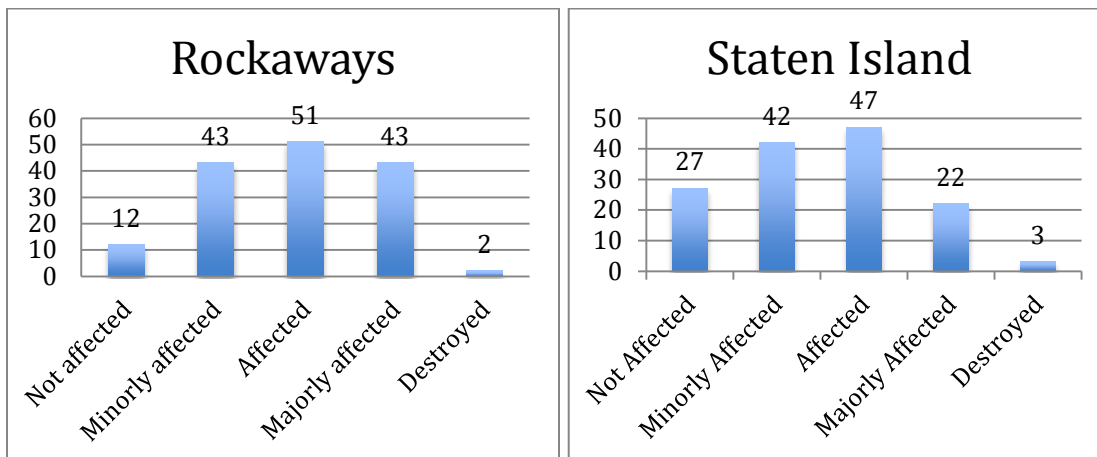
Figure 1: Height of floodwaters inside the homes.

Figure 2: Damage to homes.

Not affected: There were no impacts to the home that required repair. The home may have lost electricity or running water, but nothing required repair. **Minorly affected**: The home could be lived in, and the structure required minor repairs, or required treatment of mold, or replacement or repair of utilities such as the boiler or hot water heater. **Affected**: The structure required major repairs but was safe for living in. The house may have been unsafe to live in because of mold, but not because of structural issues. People may have stayed in the house or not. **Majorly affected**: The structure became unsafe and could not be lived in but it could be repaired. **Destroyed**: The home could not be repaired. It had to be torn down and rebuilt.

There were some differences in impacts of the storm in the two neighborhoods that reflect partly the differences in pre-existing conditions and partly differences in geography. The most striking difference is that 23 of the 43 deaths due to Sandy in NYC occurred on Staten Island. Twenty-two of these occurred on the south shore, and all but 3 of these occurred in the working class neighborhoods in the middle section of the shore (Yates 2013). Eleven of the deaths occurred within a square mile covering the borders of Midland Beach, Ocean Breeze, and Dongan Hills, adjacent to Father Capodanno Boulevard. The boulevard forms a berm, and the storm surge that gathered behind the berm rushed into the neighborhood at great speed once the water reached the top of the berm. The speed of the water may have contributed to the likelihood of drowning in this area (Schuerman 2/25/13). Three deaths occurred on one block of Fox Beach Avenue in Oakwood Beach. Three respondents report that they suspect the death count is higher than 23, if you include the people whose deaths were not reported, and those who died in the weeks and months following the storm from illnesses and events like heart attacks, that were likely related to the stress of post storm recovery. Six people died in the Rockaways during the storm, but residents offered reports of deaths in the days and weeks after the storm that are similar to the reports from Staten Island.

The Rockaways suffered more crippling disruptions to transportation after the storm than did Staten Island. Parts of the peninsula could be reached only by boat after the storm. The only subway line that serves the peninsula remained closed for 7 months. Limited bus service was restored within a week, but bus drivers were afraid to drive on the dark and damaged streets after dark. Residents were also afraid to go out on the dark streets after sunset. The great majority of cars were carried away by the floodwaters. Fewer cars were lost in Staten Island because some residents were able to move their cars to higher ground before the storm. Higher ground was not available in most of the Rockaways.

Geography also resulted in worse emergency services after the storm in the Rockaways. Local police stations and fire departments had many of their emergency response vehicles washed out and were therefore operating under a significantly diminished capacity. The police set up some mobile command stations, but due to lack of phone services there was no way to call these stations so if you had an emergency you had to get to them on foot.

Residents of both neighborhoods did not have access to basic services for several weeks. Electricity outage lasted for about 3 weeks in Midland Beach on Staten Island, and people did not have gas for 2 to 3 weeks. In the Rockaways, some residents report electricity outages lasting over a month. There was no access to the Internet or wireless phone service for weeks after the storm in the Rockaways, and for about 2 weeks on Staten Island.

Many local businesses such as grocery stores, pharmacies, banks, restaurants, and laundromats in both neighborhoods closed after the storm. Many of these never reopened, and the ones that did took several months to return. Again geography and pre-existing lack of services resulted in greater scarcity of access to food and health care in the Rockaways, where all food stores east of Beach 35th Street closed and remained closed for weeks, and it was months before the first supermarket re-opened. Pharmacies and

health clinics were closed on a peninsula that only had one hospital, at the very eastern end, even before the storm. The only existing hospital was overwhelmed.

Residents in both neighborhoods also suffered a variety of health impacts. Perhaps the most pervasive health issue was mold. In flooded homes mold was growing rapidly, within hours, posing a danger to health for all residents, not only the more sensitive groups. The problem was exacerbated by lack of information and misinformation regarding proper treatment of mold, including the distribution of inappropriate supplies. In addition, respondents reported that insurance companies were instructing them to leave everything in the home untouched until a claim adjuster. Residents who waited for adjusters, often weeks, faced mold issues that became exceedingly difficult to manage.

Water pipes burst and sewers overflowed. Conditions were extremely unsanitary for the individuals who had not evacuated, with floodwaters contaminated with sewage, oil, and all manner of debris. One respondent's mother was hospitalized and nearly died of sepsis of the blood from coming into contact with floodwater in Midland Beach. Some respondents were unable to access medications, which was a serious problem for those with chronic diseases such diabetes, HIV/Aids, etc. There were many reports of increased illnesses and deaths in the months following the storm particularly for people who were already sick and elderly. Another health impact was related to the physical exertion and stress of the recovery process, particularly for those rebuilding their homes.[3]

Fifteen of the 23 respondents whom we interviewed in the Rockaways in 2014, and 11 out of the 17 respondents in Staten Island discuss psychological and emotional impacts related to the storm, the stress of recovery, and/or exacerbation of pre-existing mental health and substance abuse issues.[4] In addition to psychological impacts from the storm and from lack of support for recovery,[5] individuals who suffered from mental health issues prior to Sandy were also those whose recovery needs often went unmet.[6]

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[3] One respondent reports: "It affected my health. Here I'm down here working 12, 13 hours, I'm forgetting to drink water, forgetting to eat, not showering, getting up the next morning and doing it again. I was so burnt out I could barely get out of bed."

[4] One of the residents and community leaders report: "One of the biggest issues on Staten Island through the storm has been mental health. So many people, they're displaced, they have financial problems, they are stressed out, not living in their home, their children are going to different schools, they have to commute to their office from somewhere else …"

[5] Another resident and community leader dealing with homeless populations reports: "My boss was perceptive in the days after the storm. She was thinking about how important it would be to help people get recovered and home quickly because the longer people suffer from not being home or not feeling fully recovered, or fully whole in a mental health sort of way, you know substance abuse always sky rockets after a disaster, the more homeless clients we would have to serve later on down the road…"

[6] A resident and community leader reports: "Some of the people that - a lot of the homes that we and the organizations on Staten Island have rebuilt, like through friends and families and neighbors helping neighbors are okay, but cases that we are coming across now are all people that have serious mental health issues... They didn't have the proper support. They didn't have the proper knowledge. You know some people don't know how to navigate FEMA's [Federal Emergency Management Agency] website. Some people didn't get FEMA. Some people aren't savvy enough to go through their insurance policy or if the insurance company says no they are not savvy enough to fight with them about it."

5. The process of recovery

In this section we analyze the residents' ability to recover from the losses suffered. We also examine how the recovery has shaped resilience to future storms. The losses suffered and the recovery depended on residents' access to information before and after the storm, residents' own resources, social networks, and assistance from a variety of sources. The main types of sources that offered assistance were people's social networks (neighbors, family, and friends), community groups, volunteers, NGOs, private for-profits such as employer groups, and various levels of government.

The recovery evolved through several stages. People first lacked basic necessities such as food, water, accommodations, clothing, household supplies, access to medical care, funding for all these needs, and basic services such as electricity and gas. They were also concerned with clearing the debris out of their flooded homes. Over several months the availability of basic goods and services returned to normal. Gradually, the need for clearing out evolved into a need for rebuilding. Throughout the process, people needed information: about where to get goods and services that they needed, how to handle flooded homes and especially mold, how to get help with rebuilding, and how to finance it all. We organize the discussion of the recovery around the factors that determined vulnerability during each of these main stages.

5.1 Own resources and other individual characteristics

For all respondents, the major source of loss from the storm was the home, including the structure and belongings. Homeowners were a particularly vulnerable population in several ways. First, most residents of the study areas range from low to upper middle income, with most households concentrated in the lower-middle to middle income range. For lower-middle and middle-income homeowners, the home represents their major investment and accounts for most of their assets. The damage to the home was a severe impact on the households' wealth. At the same time, despite the widely spread perception that assistance was focused on homeowners, homeowners in the study neighborhoods received relatively little assistance compared to the damage they suffered.

As almost all of the individuals whom we interviewed said, homeowners depleted their own resources in order to rebuild their homes. A considerable amount of assistance was available in the Rockaways and in Staten Island with food, clothing, household items including cleaning supplies, clearing out flooded homes, and to some extent health care. Relatively limited assistance was available with rebuilding homes and, while most affected residents received some financial assistance, the amount of financial assistance was small relative to the needs of rebuilding. Households who were renting their homes were not responsible for the expenses of repairing and rebuilding the home.

Table 1 shows several measures of damage and of the amount of money that respondents spent on the recovery from Sandy, separately for households who rent their homes and

homeowners in two different income categories based on our survey data. All renter households are in income categories up to an annual household income of $100,000. We compare these households to homeowners in the same income range. We include separately homeowner households whose annual incomes are higher than $100,000. The households in the higher income category are not the very rich. The majority of them have annual incomes below $150,000. Only 20 households in the sample from the Rockaways and 10 households in the sample from Staten Island have annual incomes over $150,000 and only 1 household has an annual income over $500,000.

Table 1: Damage and expenditures on the recovery for homeowners and renters.

Variable	Mean value for renters	Mean value for low to middle income homeowners	Mean value for higher income homeowners	P value - renters vs low to middle income homeowners	P value - lower to higher income homeowners
Level of flooding in the home (feet)	4	6	6	.0007***	.74
Households with no or minimal damage (%)	51	37	41	.06***	.63
Households with greater damage (%)	15	36	39	.0012***	.64
Households with severe damage (%)	34	27	20	.18	.14
Own money spent on the recovery ($)	3,375	32,922	29,762	.0000***	.36
Total financial assistance ($)	3,752	8,594	13,235	.0002***	.05**
Total amount received from insurance ($)	1,556	31,343	40,867	.0000***	.09*
Sum of own money spent, financial assistance, and insurance ($)	8,940	71,698	83,892	.0000***	.1792

Comparisons between means that are statistically significant at the 1% level are denoted with ***, significant at the 5% level are denoted with **, and 10% level with *.
Low to middle income homeowners are in the same income categories as renters.

The table illustrates that homeowners in the same income categories as renters paid far more out of their own pockets to recover from the storm than did renters. This is perhaps the most indicative comparison for the assessment of economic vulnerability. The amount paid out of pocket for the recovery expenses is the amount over and above any insurance payment that residents received and any financial assistance that they received beyond

insurance. It does not even include subsidized loans such as those from the Small Business Administration (SBA), though it does include regular loans. In other words, this amount is the money that residents paid to cover the expenses of recovery out of their own income and savings that was never reimbursed from any source of assistance.

The total of the money paid out of pocket, the insurance, and the assistance is a rough estimate of the total cost of the recovery. The difference between these totals illustrates how much larger were the losses sustained by homeowners than were the losses sustained by renters, holding income roughly constant, and assessed 2 -3 years into the recovery, by which time respondents had sustained most of their expenses and received most if not all of any possible assistance.

The renters may have been more impacted than homeowners with respect to loss of home if they could not find another permanent place to live that they could afford. Everyone in our sample now has a permanent place to live and the renters were not displaced any longer on average than were the homeowners. However, we do not have the ability to track households who are no longer at a residential address in the study neighborhoods. We do not know how many households, both renters and homeowners, who were displaced by the storm did not return to the neighborhood and are still in temporary housing or are homeless. As a Furman Center (2013) study points out, the affordable housing stock in NYC is limited and low-income residents who were displaced are more likely to have had difficulties with finding a new home.

Other losses that people experienced from the storm included difficulty with access to food and health care, difficulty with care for young, elderly, disabled, or sick household members, and loss of personal belongings. A higher percentage of renters faced difficulties with access to food and these difficulties continued about 2.5 months longer for renters than for homeowners.

In general, income did not correlate with recovery outcomes in either neighborhood. We regress a number of outcomes such as the amount of own money paid for recovery expenses, the length of time that respondents were displaced from their homes, how long it took before respondents' homes were back to their pre-Sandy condition, how long respondents had problems with access to food, what was the value of all financial assistance received, and others on demographic and socio-economic household characteristics, on the amount of damage that the home suffered in the storm, and on the height of floodwaters inside the home. Respondents' income is not statistically significant in any of these regressions. The likely reason is that homeowners were more vulnerable than the lower income renters, and the range of incomes among homeowners is not sufficiently wide in these neighborhoods for income to make a difference that is statistically significant in regressions. Most homeowners are in a fairly tight middle-income range of annual incomes, from $50,000 to $150,000.

Other individual characteristics played rather different roles in the Rockaways than in Staten Island, except that respondents who live with a partner in general experienced better outcomes in both neighborhoods than did respondents who are single or do not live

with their partner. In the Rockaways, the characteristic that stands out in regressions based on survey data is the presence of health issues, in particular whether anyone in the household had mobility issues or had a chronic health condition before the storm. Households in which health issues were present were more likely to be displaced from their homes longer, to have had issues with mold in their homes longer, were more likely to encounter problems with health care after the storm, were more likely to experience job loss as a result of the storm, and waited longer to have a functioning boiler and hot water heater.

Households with children under 18 experienced worse outcomes. They spent more money on the recovery out of their own pockets, were displaced from their homes longer, were more likely to encounter issues with health care, and had mold issues in their home longer. However, their homes were more likely to be in as good or better condition at the time of the survey as before Sandy. One the other hand, larger households were less likely to have homes that were in as good or better condition and, if they did, then they had waited longer for their homes to return to the pre-Sandy condition. Also larger households were more likely to be in debt as a result of the expenses of the recovery, and they were more likely to have seen their incomes decrease in the period from before the storm to the time of the survey. Larger households were less likely to have been displaced from their homes and were displaced for shorter periods of time, but the reason may be that they could not afford to leave their flooded homes and therefore endured the unsafe conditions caused by floodwaters longer. Finally, households in which some or all residents were over the age of 65 were more likely to be in debt as a result of the expenses of the recovery, and they were more likely to have encountered problems with access to health care after the storm.

The patterns described above for the Rockaways do not characterize Staten Island except that in Staten Island also households in which some or all residents were over the age of 65 were more likely to be in debt as a result of the expenses of the recovery. Otherwise, the only variables that were correlated with significantly worse outcomes in Staten Island were the depth of the floodwaters in the home and the extent of the damage to the home. The flood and damage variables did not correlate with many outcomes in a statistically significant way in the Rockaways.

5.2 Access to information

Both before and after the storm, access to information had a significant influence on people's vulnerability and the recovery. Information that was needed in order to decide whether or not to evacuate affected people's exposure to the storm. Information about how to clean out the house after the storm, what to do about mold, where and how to get assistance that people needed, and information about eligibility criteria and application procedures for various programs was critical to the process of recovery. Awareness of future flood risk affected whether or not homes were rebuilt to be more resilient to future storms.

Information before the storm

Prior to the storm, the NYC government issued an evacuation order and disseminated information about evacuation zones. Respondents in both neighborhoods report that most people did not heed the evacuation order. The disregard for the evacuation order resulted in many death on Staten Island. Respondents identify the following reasons why they and others that they know did not evacuate:

o   Hurricane Irene had been much less severe than warnings that were issued at the time. Many people evacuated and they felt that they did so unnecessarily. Based on that experience, people felt that the city government was "crying wolf" in issuing the Sandy evacuation order.[7]

o   The information about the storm was not explained properly. People did not understand what a storm surge is and what impacts it could have.[8]

o   Several residents report that they wanted to stay to protect their homes and to begin pumping out water and dealing with impacts immediately.[9]

o   Several residents indicate that they and their neighbors did not evacuate because there were no shelters and no safe accommodations for their pets.

o   Another reported reason for not evacuating is that people did not know whether they live in an area, which is required to evacuate, and where the shelters are located.[10] The City ordered the evacuation of zone A, a designated flood zone. Some people did not know whether they live in zone A.

The fact that many people did not evacuate because prior warnings to evacuate were followed by storms that did not require an evacuation underlines the need for better education about the interpretation of weather predictions and storm warnings. People are interpreting predictions in a deterministic way. A forecast for some probability of heavy damage associated with a storm is not faulty if the heavy damage does not occur. Populations who are at risk of coastal storms need to understand the major elements of a storm warning such as statements about the storm surge. Finally, respondents expressed reluctance to follow evacuation warnings that do not explain clearly why people should evacuate.

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[7] A respondent from Midland Beach sums up many people's sentiments in the following way: "We went through Irene, and here's part of the problem - with Irene, we had intense rain. Mandatory evacuation. Big thing, the mayor is out there, 'You've gotta get out for your safety and blah, blah, blah'. They cried wolf, that's why so many people died in Sandy. Because he [the Mayor] kept crying wolf. One inch of snow – oh! Let's make it an emergency."

[8] Respondent from Midland Beach: "… the administration… they treat people like they're bunch of kids, and did not explain the consequences of a surge. What is a surge? When they say a tidal surge, people are imagining - people don't have the technical knowledge… people thought… 'Well, if there's an extra high tide, it's going to be an extra couple of feet of high tide. Some of the water may come over from the beach, and there'll be some water in the streets."

[9] One respondent reports: "I stayed on the second floor, because for Irene I evacuated, and it was a dud. We lost power for a short period of time. I had moved out with my three cats, and it was a dud. So I figured let me say here and do what I can to save what I have... It was in fact a good decision because I spent every minute up until just about the water crashing through the door moving things and saving things."

[10] A respondent reports: "The other thing too is the reason we didn't evacuate is because none of us knew where … zone A was, it was the first time we had ever heard the words 'Zone A' mentioned. We stayed in our homes, because where else were we going to go?"

Many people who considered evacuating did not have an evacuation plan in place. They did not have enough time after the evacuation order to gather the information and make decisions about where to go, how to get there, what to take, and how to secure what they could not take.

Information after the storm

After the storm, information about how to clean out the house, what to do about mold, where and how to get assistance, eligibility criteria and application procedures for various programs was not easily available in one place. In the absence of electricity and phone service, access to information was a problem. In the Rockaways and in Staten Island, volunteers, community groups, and non-profits were the main source of information. Figure 3 shows the different sources of assistance with information in the two neighborhoods.

Figure 3: Sources from which respondents received information.
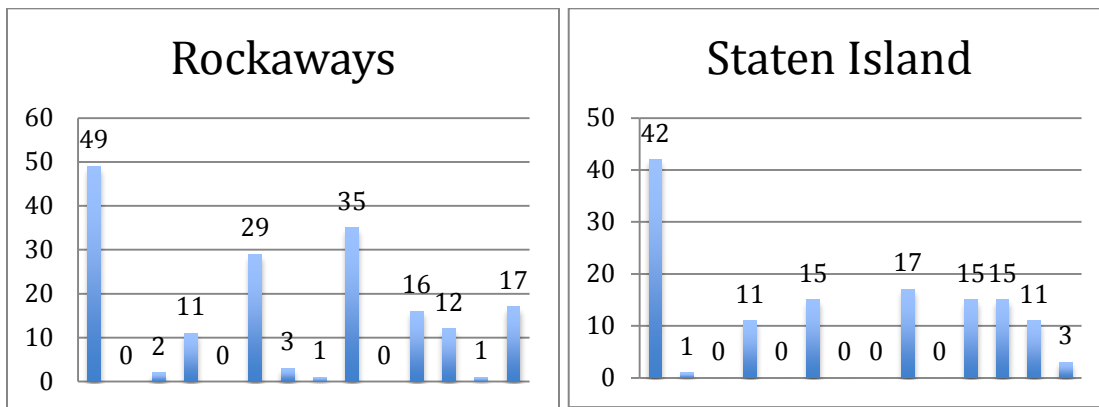
The bars in both figures represent the following. (1) Social networks: family, friends, neighbors. (2) Private for profit includes employer groups. (3) Utilities: electric company, gas, telephone. (4) City agency. (5) NY state agency. (6) Federal agency. (7) Public emergency services: fire department, police, National Guard. (8) Medical services. (9) Non-profit: community groups, volunteers, NGOs. (10) Case manager. (11) Disaster recovery center. (12) Media: television, radio, newspaper. (13) Unknown source. (14) Other. Numbers over the bars report the number of respondents in that category.

In both neighborhoods, respondents praised disaster recovery centers, which remained the best sources of information while they were open. These were grassroots hubs that were formed by residents and volunteers following the storm, run by pre-existing non-profit and community organizations. These hubs were set up as one-stop-shops, where storm victims could charge electronics, pick up donations of various kinds, and/or gift cards to shop at local stores, and to get referrals from national and local voluntary and government agencies that could provide specific kinds of assistance according to respondents' needs. Examples of available information were: information from the Department of Housing and Urban Development on how to make a chemical solution to do mold mitigation yourself, information from utility companies on how to care for and dispose of electrical appliances affected by water, information from Verizon on what to

do with cellular phone equipment, where to obtain food stamps, information from insurance companies and legal teams, and a 4-page list of agencies that provide assistance from the Federal Emergency Management Agency (FEMA). In some hubs, representatives of city recovery programs were also stationed, in particular Build it Back and Rapid Repairs, as well as FEMA and legal services. However, these hubs were not easily accessible to everyone.

For those who could not access the disaster recovery centers easily, information about how to manage the recovery, including how to clean out flooded homes, how to deal with mold, how to rebuild, and how to navigate the available assistance remained an obstacle to recovery. Misleading information was a problem. Insurance companies were advising residents not to gut out their homes after the storm, but rather to leave everything in place so claims adjusters could properly assess the damage. Claims adjusters took anywhere from one week to many weeks to come. However, when wet walls, floors and belongings are left in place, mold spreads rapidly and has serious health consequences as well as quickly eroding the extent to which the structure can be salvaged. Many respondents expressed anger at this advice. There were reports across the Rockaways that many people ignored the advice of insurance companies and immediately began to gut out their homes based on local knowledge and experience with flooding and mold issues.

Many respondents report that the Red Cross was distributing information about mold together with mold remediation kits. However responses are mixed about the reliability of the information provided. Some respondents noted that these kits were not the kind needed to address the mold problem, and they created a false sense of security in the homes where they were used. In particular, the masks included in the kits were reported to be the wrong type; they would not protect people from breathing in mold.

One emergent non-profit in the Rockaways filled the gap highlighted by many residents in terms of reliable information on what to do about mold. The non-profit engaged with the City University of New York School of Public Health and occupational safety experts from Long Island University and Rutgers University, and people from the Occupational Health and Safety Administration (OSHA) to learn about proper procedures for addressing mold. They then informed other organizations that were working on gutting and rebuilding in the Rockaways about the standards and provided the information to residents in addition to applying the standards in their own work.

Information about residents' needs and access to legal advice after the storm seemed to be better organized in Staten Island than in the Rockaways. Organizations that were providing assistance required information about what help people needed and where. In Staten Island, the smaller and the more decentralized NGOs and volunteer groups began to use social media almost immediately to connect people who wanted to donate or organize as volunteers. One respondent mentioned that Occupy Sandy had a Facebook page up and running by the night of the storm. This remained a crucial tool throughout the recovery process. Social media provided avenues for communication in that it allowed volunteers to coordinate quickly, donors to learn about what was useful to donate, and victims to share their needs and link up with volunteers. Five respondents in

Staten Island mentioned Facebook as an effective way to connect with volunteers and match donors with victims as well as recovery organizations. Three respondents mentioned Twitter. One respondent mentioned You Tube. Three respondents mentioned social media in general. All mentions of the various forms of social media were positive.

Respondents in the Rockaways do not mention social media but rather word-of-mouth as a significant source of information. Several respondents reported hearing about the disaster recovery hubs, or learning of opportunities for recovery assistance through word of mouth. Word of mouth also helped volunteers with Occupy Sandy, who were not from the Rockaways, identify areas and houses where people needed assistance; "In apartment buildings, getting back to my earlier point of finding these homebound people, everyone in the apartment building knows who those people are. I mean, they know – if you live on a floor, you know who the elderly on your floor are, you know who is sick or might need medication. That was very useful information."

Affected residents were poorly prepared to apply for assistance in both neighborhoods. Residents needed information about how to properly file insurance claims, where to go to submit claims, where and how to report their losses to FEMA, and how to register for public rebuilding projects. Despite efforts to have representatives from public organizations such as FEMA, Rapid Repair, and Build It Back, as well as legal service representatives such as Staten Island Legal Services, at the emergency relief hubs, respondents complained that the paperwork was overwhelming and unclear. Respondents describe information from these public programs as being difficult to navigate and/or overwhelming. Furthermore, the applications required documents that many people had lost in the flood.

In Staten Island, Staten Island Legal Services continued to play a role in disseminating information as needs evolved in the long run. After people began filing insurance and FEMA claims, people needed further information and assistance on how to appeal claims and how to navigate the changing flood insurance rates and home elevation process. There has not been a well-organized source of legal assistance in the Rockaways.

The recovery is still ongoing in both neighborhoods. Rebuilding of homes in particular has been moving very slowly, and people continue to need access to information. Improving communication remains a priority for the Long Term Recovery Organization in Staten Island and the Long Term Recovery Coalition in order to provide the assistance that residents still need, and in order to build communication channels that will provide information more effectively before and after future storms. The Long Term Recovery Organization in the Rockaways has not been effective.

5.3 Types of assistance

All interview respondents and survey results agree that affected residents' social networks, as well as local community groups, volunteers, and NGOs provided the major part of the relief and recovery assistance. Thus a major part of the recovery depended on the effectiveness of voluntary efforts. The second most frequently used source of help

consisted of federal programs, primarily FEMA. Affected residents who receive regular support from the Special Supplemental Program for Women, Infants, and Children (WIC) or the Supplemental Nutrition Assistance Program (SNAP) also received automatic supplements to their allowances after hurricane Sandy in order to facilitate access to food. The Small Business Administration provided loans. The NYC government established two programs to help affected residents. Rapid Repair offered free small repairs such as replacing hot water heaters and boilers and repairing electrical equipment, which could help people to return to their homes. Build It Back was supposed to address the more long-term needs of rebuilding. Finally, many respondents mentioned their employers as valuable sources of assistance.

In general, people received help from sources different than the ones from which they sought help. In the Rockaways especially, people tended to seek help from government agencies, particularly NYC and federal, whereas they received most help from social networks, community groups, and NGOs. The pattern is similar in Staten Island, but, interestingly, more people sought help from community groups and NGOs as well as from social networks than in the Rockaways. This finding partly reflects the fact that Staten Island had bigger, better established, and stronger NGOs before the storm than did the Rockaways. We will discuss the difference that these NGOs made when comparing the recovery in Staten Island and in the Rockaways below. Figure 4 shows from whom respondents to our survey sought help in each neighborhood. We will report from whom they received help in the sections below.

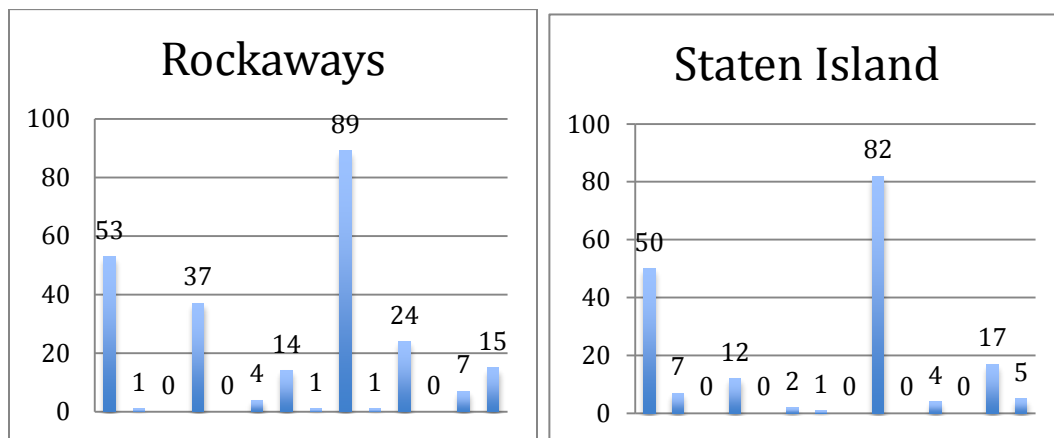Figure 4: Sources from which respondents sought help after hurricane Sandy.
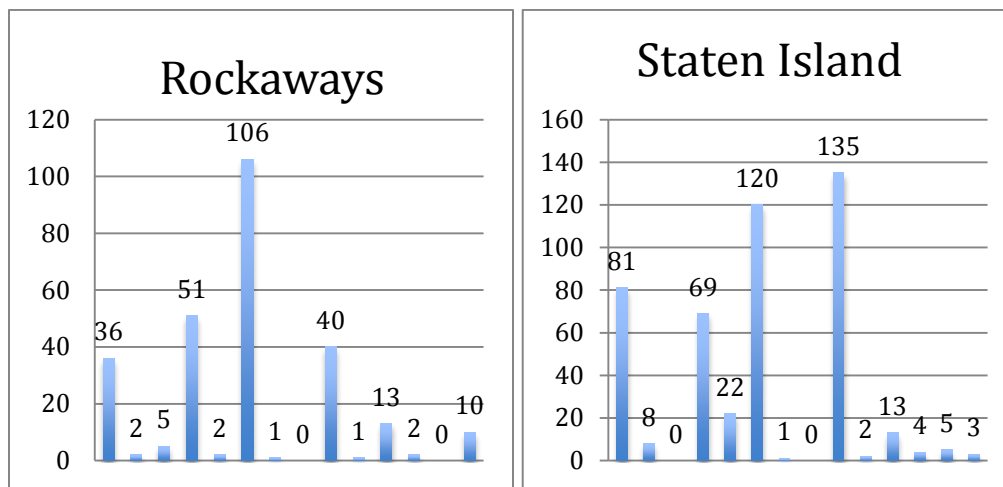
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Addressing basic needs

According to interviewees and survey results, the need for assistance with basic necessities such as food, health care, clothing and household supplies remained for months. The assistance came almost entirely from social networks, community groups, volunteers, and NGOs. Almost everyone who needed help with food, health care, or household necessities received it in both neighborhoods. Almost everyone needed help with access to food in the Rockaways according to survey responses. Fewer survey respondents report needing help with food on Staten Island, but on Staten Island people were less willing to rely on help of any kind in general than in the Rockaways. A much smaller percentage of people needed help with health care in both neighborhoods.

Figure 5 shows who provided help with food in the Rockaways and in Staten Island. Food was the most prevalent need in the days and weeks after the storm, when grocery stores and restaurants remained closed while lack of electricity impeded residents' ability to store food. People lost cars in the storm and public transportation was severely curtailed, especially in the Rockaways, so it was difficult to get to businesses that were farther away and remained open.

Figure 5: Sources from which respondents received assistance with food.

The bars in both figures represent the following. (1) Social networks: family, friends, neighbors. (2) Private for profit includes employer groups. (3) Utilities: electric company, gas, telephone. (4) City agency. (5) NY state agency. (6) Federal agency. (7) Public emergency services: fire department, police, National Guard. (8) Medical services. (9) Non-profit: community groups, volunteers, NGOs. (10) Case manager. (11) Disaster recovery center. (12) Media: television, radio, newspaper. (13) Unknown source. (14) Other. Numbers over the bars report the number of respondents in that category.

Assistance with food, water, and other basic necessities consisted of 2 components: 1) donations of food, clothing, and other items, and (2) Disaster Recovery Centers (other terms used interchangeably are community distribution centers, relief centers, or disaster hubs) that distributed donations and provided a range of information that residents needed after the storm. Eight of the 17 Staten Island interview respondents volunteered in (1 respondent) or initiated and/or ran a grassroots disaster recovery center (7 respondents).

Respondents noted a great deal of private aid being the first and most effective source of basic necessities immediately following Sandy. Private donations of food, clothing, and basic household items arrived from both local and national sources. Seven out of 17

interviewees on Staten Island made specific note of Aiman Youssef, a Staten Island resident who lost his home and set up a small relief hub called Half Table Man that was providing for people's basic needs. Another eight respondents on Staten Island mention that Occupy Sandy was the first on the scene with the basic items that people needed in the immediate aftermath of the storm.

Donations of basic necessities came from local and national volunteer groups and individual volunteers, local community groups, grassroots organizations started by residents after the storm, churches, NGOs, private companies, employers/employer groups, friends, family, and colleagues. Donations that were coming in during the days and weeks after the storm included: food, water, clothing, personal hygiene items, cleaning supplies, medicine and medical supplies, batteries, generators, and toys for kids.[11] Thirty interview respondents speak about donations; 25 respondents speak about donations positively, while 5 speak negatively. The positive comments reflect residents' positive experiences with volunteers from near and far who sent and/or brought donations from all over the country.

The negative comments about donations were related to the expectation that more donations would have been provided by big voluntary agencies – specifically the Red Cross. Respondents indicated that they expected more assistance from the Red Cross, and that the donations that they did receive from the Red Cross were poor quality and arrived too late. Three respondents also noted that many donations were not useful, especially clothes and wrong kind of clothes in particular. Clothing donations created a logistical challenge for storage and sorting. There were too many clothes; there were clothes that were in such poor condition that they were not usable, and clothing that was simply not suitable, for example designer clothes, including sequined tank tops.

There were also donations to local non-profits to help organizations serve post-Sandy needs of the local population. For example, in the Rockaways an out-of-state volunteer fire department donated fire trucks to the Broad Channel Volunteer Fire Department and Long Island Jewish Hospital donated an ambulance. A local mental health non-profit donated 2 computers with information and resources about post-traumatic stress disorder and general mental health that community members could use for free to You Are Not Alone (YANA), a non-profit group that serves Far Rockaway. YANA, Doctors of the World, and Occupy Sandy received medical supplies to run their medical unit in Rockaway Park. Doctors and nurses volunteered their time.

The second component of assistance with basic needs was distribution. Disaster recovery centers sprang up in storm-affected neighborhoods following the storm, set up in local churches and community centers, where volunteers worked to receive, sort, and distribute

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[11] A resident of Midland Beach reports: "Sandy Hope was another organization I dealt with, and they actually, for the first two years after Sandy, actually made Easter baskets, school back packs, Christmas presents… because with all this going on, who had time to think about Christmas shopping? … And I mean they came with beautiful toys and gifts for them [children] for the holidays, it was amazing."

donations such as food, clothing and basic needs items. These locations also provided heat/hot water, charging facilities, and access to information. Many respondents highlight the role of churches in providing and coordinating the distribution of donations, as well as providing spaces for community distribution centers. Several community leaders and all those who volunteered with Occupy Sandy note that the space provided by churches was absolutely critical to the immediate response effort.

Respondents in Staten Island note that Occupy Sandy in particular ran effective disaster recovery centers and addressed people's needs. The first reason that interview respondents noted for the effectiveness of Occupy Sandy was the organization's ability to integrate the assistance effort. Most people had many related needs. Instead of having to go to different places to address each need at a time when getting around was difficult and residents were overwhelmed with trying to secure food, water, medications all while cleaning out flooded homes, people could access all the assistance that they needed in one location thanks to the hubs organized by Occupy Sandy. One of the interview respondents who was running a local NGO that was assisting people described the Occupy Sandy hubs in the following way: "Now the benefit of the Occupy Sandy involvement, which was why we ended up shifting our presence there, was that it had turned into a really central hub for all kinds of help. They were giving out food, they were giving out tools, they were passing out cleaning supplies, and a lot of this was Occupy Sandy because they had this huge, tremendously successful fund-raising and volunteer recruiting effort. So they had tons of volunteers to help just with unskilled work of mucking out homes and things. Also it was becoming a hub for the volunteer nursing services to help people with health or mental health problems. It was Guyon Rescue, which was another homegrown recovery organization that just sprang up to do muck-outs and then later rebuild. The Siller Foundation, which is another Staten Island group – it was all intersecting in that Occupy Sandy hub, which was tremendously beneficial. For example, if a client came in to talk to legal services about their insurance problem and, you know there was a lot of breaking down, there was a lot of crying, sorry it's emotional to even remember it, but we could get a nurse there right away to help. Or, for example a client who just needed a stove because their stove got wiped out, we could talk to the rebuild donation groups and … get this woman a stove... Or mold, mold was a great example because there were all these volunteer groups like Yellow Boots and the LISC [Local Initiatives Support Corporation] mold remediation program. So when we discovered, if a client came to talk with us about FEMA benefits or insurance or mortgage problems, and it became clear that they were living in a house full of mold, we could get them a mold remediation team on the phone right away... And it worked the other way too. I got so many calls from all of those volunteer organizations saying 'we're at this house, and we discovered this is going on, I think this person needs to talk to you' and then they would. It was really the way I think legal services ought to work in general, not just in a disaster... It was so integrated and I think ten times more effective because it was integrated. Also, eventually St. Margaret Mary's got FEMA to come to the center there, so FEMA and the SBA had people there at the same time that we had our clinics, so if somebody came in with a problem we could walk over to the FEMA side or the SBA side and … figure out how to correct it. It was really great."

The second, related reason to which respondents attributed the effectiveness of Occupy Sandy on Staten Island was its use of social media, for example Facebook and Twitter, and cell phone text loops to constantly update online information about storm affected areas where donations and volunteers were needed in the days and weeks after the storm. Occupy Sandy developed a tremendous communication network that allowed tens of thousands of volunteers to respond quickly and directly to needs communicated by residents of areas affected by the storm (USDHS, FEMA).[12]

The third reason reported by interviewees why Occupy Sandy was so effective was the organization's ability to raise money. Its creative use of the internet and social media played a critical role in fund raising. Occupy Sandy used crowd sourcing software and the Amazon wedding registry to raise money and collect necessary donations. They also provided money directly to the community and funded local grassroots organizations to undertake recovery work. They provided $100,000 in seed funding for the Staten Island Long Term Recovery Organization (LTRO).[13] The media attention related to the Occupy Wall Street movement helped Occupy Sandy in its fund raising efforts.

In the Rockaways, Occupy Sandy operated the large hubs in the eastern section of the peninsula, which is considerably lower-income than the western section. The organization had little to no presence west of Beach 116th Street, where hubs were operated by local volunteer groups. Occupy Sandy set up distribution hubs at YANA, St. Gertrude church, St. Camillus church, and a central operations hub set up at the Church of St. Jacoby in Sunset Park that received, sorted, and stored donations. Occupy Sandy also conducted needs assessments, particularly in tall apartment buildings, mainly housing operated by the New York City Housing Authority (NYCHA), and other

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[12] According to one respondent: "Occupy Sandy formed the night of the storm just on Facebook… and there was no current online information, from what I heard from our volunteers, there was no information online that was kept up to date except for ours. So if anybody wanted to know what was going on they would go onto our twitter or our Facebook… and we had teams in Brooklyn just updating everything, and people like me out here updating those teams through text loops. So we got all the volunteers, because there was nowhere else to go for information. DHS [Department of Homeland Security] (USDHS, FEMA) came out with a report on us that said we did 60,000 volunteers, which is kind of amazing and completely dwarfs the Red Cross. And that was because we kept our information up-to-the-minute… that was a combination of cell phone text loops and internet and Twitter, etc….. super effective… the teams out in Brooklyn … quickly set up in a church in Sunset Park and it turned into like the Costco of donations … So that is how information flowed, from teams on the ground, back to Brooklyn, and out to the world, and vice versa… lack of internet wasn't an issue … people who were working relief, they got around it using text loops … And every night, everyone on the ground would send emails to Occupy Sandy and then localized list serves - there's one for Staten Island, there's one for the Rockaways, there is one for Manhattan, so the whole point was to gather information on people who were doing great stuff on the ground so we could support them."

[13] According to one interviewee: "[we benefitted from] a lot of luck because Occupy Sandy was getting the media attention, and that media attention along with some innovative ways of fundraising, like we had an Amazon wedding registry where people could purchase generators, and Hi VAC suits, and you know Bleach Cascade for mold remediation, everything that we needed… hammers and saws ... We also used crowd-funding software to raise $1 million in donations… At first, for several months we gave things directly to the community, and then we also funded grassroots organizations that still exist and have worked on people's homes … have done the manual labor."

buildings where it was difficult for residents to leave, and delivered donations to those buildings.

Fourteen respondents in the eastern part of the Rockaways talk about Occupy Sandy. Nine of these respondents speak about Occupy Sandy positively, and 5 speak about it negatively. Respondents report that the disaster recovery centers were extremely useful. Respondents also praise Occupy Sandy for: their focus on hard to reach, underserved populations, such as people living in NYCHA buildings in Far Rockaway; their capacity to sort, store, and distribute donations and manage thousands of volunteers; and their needs assessment and an internal communication system that effectively matched donations with needs on the ground. The communication system in the Rockaways relied on Verizon pay as you go phones, purchased for coordinators of Occupy Sandy hubs.[14] In addition to their effective use of communications, Occupy Sandy was reportedly able to mobilize an extremely large number of volunteers very quickly, with many arriving the night of the storm. One volunteer with Occupy Sandy reported that he heard of the opportunity for volunteering because he was part of the Occupy Wall St. listservs, and was already part of the "disaster management community" and received the message through those networks, which responded in very large numbers.

Negative comments about Occupy Sandy relate to both challenges they faced and critiques of how they operated. The lack of hierarchy and organizational structure that characterized Occupy Sandy made it agile and able to respond to and change with evolving disaster relief needs on the ground. However, two respondents report that it also created a challenge for interacting and collaborating with other organizations, like FEMA, since there was no defined leadership. Some respondents also reported conflict between groups, and specifically mistrust and anger towards Occupy Sandy for taking over relief efforts in some areas.

Some of the challenges that the disaster recovery centers in general faced included lack of capacity to sort the volume of donations coming in, and disorganized distribution of donations reported at some sites, as well as abuse by individuals coming in from non-storm affected areas to take advantage of free donations.

Almost all respondents spoke positively of the small local grassroots organizations that showed up quickly and provided assistance that met specific needs. Larger volunteer organizations that were more centralized and less agile than Occupy Sandy received mixed reviews because the aid they provided was not as timely, nor was it typically specific to individual needs. For example, in Staten Island, the Red Cross was mentioned by 12 respondents for a total of 29 references, 20 of which were negative (coming from seven respondents), three of which were mixed (coming from three respondents), and six of which were positive (coming from five respondents). In the Rockaways, twenty-three respondents mentioned the Red Cross, 9 positively and 16 negatively. Among the positive comments about the Red Cross, respondents report that they distributed information on mold, products for mold remediation, cleaning products, food, emergency

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[14] Verizon had brought in portable cellular towers and so only Verizon phones were working well.

kits (including personal items and toiletries), provided support with health care, financial support, blankets, and heaters. Most of the respondents who praised the Red Cross were based in Breezy Point. Respondents in other parts of the peninsula complained of a lack of Red Cross presence (Far Rockaway, Rockaway Park, Belle Harbor, Broad Channel, and one from Breezy Point). In addition respondents mentioned that Red Cross donations did not match needs on the ground, the food was unappetizing, took a long time to arrive, and appeared at unpredictable times and therefore could not be relied upon.

By contrast, on Staten Island smaller volunteer organizations such as Guyon Rescue, Half Table Man, The Siller Foundation, Yellow Boots, and various church organizations were mentioned by twelve respondents for a total of 78 references. Only two of these references were negative and one was mixed, while the rest were positive. The pattern was similar in the Rockaways. Furthermore, the smaller and more agile organizations such as Guyon Rescue and Half Table Man, similarly to Occupy Sandy, harnessed positive media attention and social media in creative ways to gather large volumes of private support and match it directly with people in need. Six respondents on Staten Island mentioned social media as crucial to their success.

Social networks also played a major role in meeting basic needs in the weeks after the storm, especially social networks from outside the affected neighborhoods. Many respondents reported that they did not receive donations of clothing or household items from their local social networks because those people were also busy recovering from the storm. The help came in other forms, according to one resident of Midland Beach: "I guess because everybody was dealing with their own stuff, it wasn't the community helping each other. The only thing that we were all helping each other is like, 'I'll run to the McDonald's up the block today,' it was like one day I would buy everybody McDonald's, because we were all in our houses working, and my neighbor would buy pizza one day and everybody would eat pizza, so we would help each other that way."

Clearing out and rebuilding

The main impact of the storm was damage to the infrastructure of the neighborhoods and people's homes. Only 12 out of 151 respondents in the Rockaways and 27 out of 141 respondents on Staten Island report no damage to the home as a result of Sandy (see Figure 2 in section 4). The home may have lost electricity, but it did not require any repairs. All remaining respondents needed to clear debris from the flood and repair or rebuild. The first wave of repairs involved regaining electricity, heat, and working plumbing. Clearing out, commonly referred to as mucking out in the areas affected by hurricane Sandy, consisted of removing wet sand and mud washed into homes, removing all flooded belongings, ripping out wet walls and floors, and treating the house to kill mold. The floodwaters were a mix of seawater and sewage brought up by the flood, therefore anything that was flooded posed a health risk. Anything that was wet also invited mold to grow and mold remained a major health risk after the storm, in some places even until today. Next, focus shifted to more permanent rebuilding and repairing, which are ongoing. The most severely damaged homes had to be demolished.

Assistance with clearing out came mainly from social networks, community groups, volunteers, and non-profits. Figure 6 presents the sources of assistance in both neighborhoods. Most people who required assistance with clearing out received it. Unlike in the case of food and health care, a slightly larger percentage of respondents received help with clearing out on Staten Island than in the Rockaways. However, assistance was available in both places.
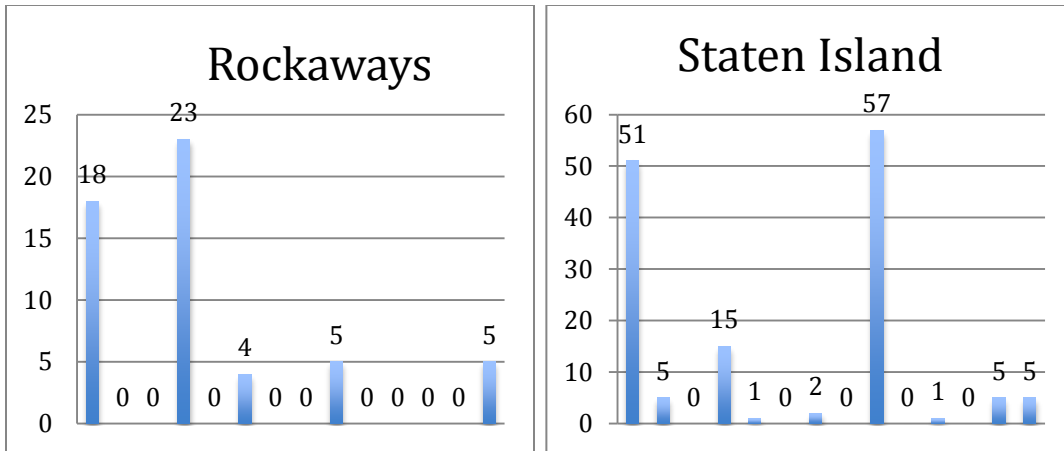
Figure 6: Sources of assistance that respondents received with clearing out flooded homes.
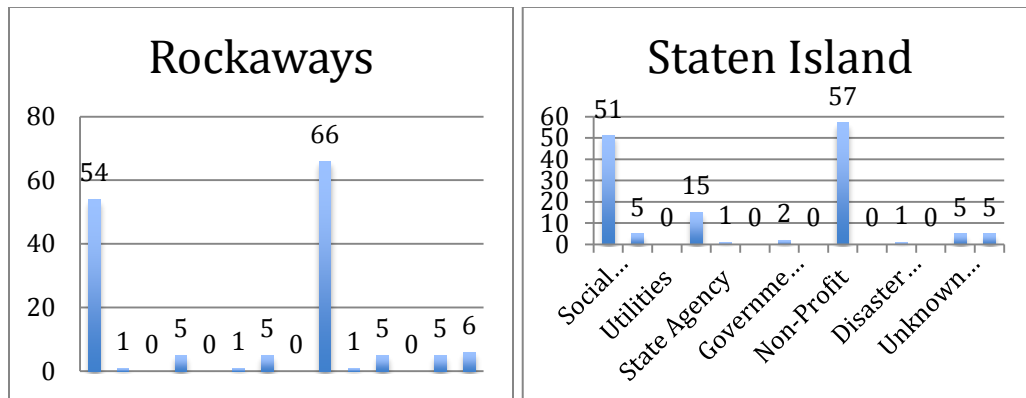
The bars in both figures represent the following. (1) Social networks: family, friends, neighbors. (2) Private for profit includes employer groups. (3) Utilities: electric company, gas, telephone. (4) City agency. (5) NY state agency. (6) Federal agency. (7) Public emergency services: fire department, police, National Guard. (8) Medical services. (9) Non-profit: community groups, volunteers, NGOs. (10) Case manager. (11) Disaster recovery center. (12) Media: television, radio, newspaper. (13) Unknown source. (14) Other. Numbers over the bars report the number of respondents in that category.

The substantial difference between the Rockaways and Staten Island took the form of assistance with rebuilding damaged homes. Less help was available with rebuilding homes than with any other stage of the recovery in both neighborhoods. At the same time, rebuilding was the most difficult and expensive task associated with the recovery, requiring specialized skills, regulatory approval, and funding. In the Rockaways 59% of respondents did not get any help with rebuilding, while on Staten Island 38% of respondents did not get any help with rebuilding. The difference between the two numbers is statistically significant. The difference is due to the role of social networks and NGOs on Staten Island. Social networks provided much more help with rebuilding on Staten Island than in the Rockaways. Also, Staten Island had bigger, stronger NGOs than did the Rockaways before the storm, and these NGOs were able to take on the task of rebuilding homes after the storm. NGOs played a very small role in rebuilding in the Rockaways. Figure 7 reports sources of assistance with rebuilding.

Figure 7: Sources of assistance that people received with rebuilding.

Rockaways: 18, 23, 0, 0, 0, 4, 0, 0, 5, 0, 0, 0, 0, 5

Staten Island: 51, 5, 0, 15, 1, 0, 2, 0, 57, 0, 1, 0, 5, 5

The bars in both figures represent the following. (1) Social networks: family, friends, neighbors. (2) Private for profit includes employer groups. (3) Utilities: electric company, gas, telephone. (4) City agency. (5) NY state agency. (6) Federal agency. (7) Public emergency services: fire department, police, National Guard. (8) Medical services. (9) Non-profit: community groups, volunteers, NGOs. (10) Case manager. (11) Disaster recovery center. (12) Media: television, radio, newspaper. (13) Unknown source. (14) Other. Numbers over the bars report the number of respondents in that category.

One interviewee on Staten Island describes in detail the clearing out and rebuilding phase of the recovery: "So, step one was relief centers … we kept them opened for almost a year, as we completely cleared up the short-term needs. But then … it rapidly goes into housing. People's homes were destroyed; they couldn't live there. One of our other responses was we bought 15 trailers and set them up in Connecticut, I forget the town, and we took families whose homes were completely destroyed and set them up there for a little over a year while their homes were being fixed. Additionally, on Staten Island there were so many homes that needed to be mucked out… We have a tremendous volunteer network, which we're able to tap into … over the next six months we probably mucked out 800 homes in total… Mold brings us into the next step… we started a mold team in Staten Island, and we started a mold team in Brooklyn, Gerritsen Beach. These were people who had been hired; they were on our staff for about a year… So now your house is mucked out, we've done a mold job, and the mold job would take let's say about a week to go in there with these scrubbers and we had this cleaner they call Shock Wave, they use it in hospitals, basically it kills everything. You put it on the wood, scrub it down, seal off the area you're in - you know the people who work in there have all the masks and the suits on and stuff – clean it all up, and then turn the heaters on and the fans and get the wood bone dry. Then you do a test and the wood would be like clean enough, you know hospital level clean… And then once it's dry, now you can seal the walls and start the rebuilding process… There were some people who were quickly getting everything done, got their muck out done right away, their mold job done right away, they're starting to rebuild. But there's other people who, you know after the storm they headed to their cousin's house and basically forgot about their house for a couple of months, so … we're still dealing with people..."

The local NGOs that were mainly involved in clearing out, repairing, and rebuilding homes on Staten Island were the Stephen Siller Foundation, which was already based in Staten Island and had experience in disaster relief as well as home construction; Guyon

Rescue, a grassroots organization that was formed two days after the storm and was among the first groups to organize crews to begin clearing out homes; Yellow Boots, and a number of church groups. Ten respondents on Staten Island discuss the role of the Siller Foundation. All but two of the mentions were positive. The two negative comments reported that people were denied building materials because the Siller Foundation does not provide materials to homeowners but instead sends volunteers with materials to do the work. Five respondents praise the work of Guyon Rescue, and this NGO does not receive any negative mentions. Three respondents have positive comments about Yellow Boots, which also does not earn any negative comments, and 4 respondents evaluate positively the work of religious groups such as the Mennonite Disaster Service, which also do not receive any negative comments.

One interviewee describes the role of his NGO in the process: "We had two teams on Staten Island, one in Brooklyn. On Staten Island we completed 600 mold jobs and in Brooklyn it was about 400. So we did nearly 1,000 mold jobs, the cost of which to most homeowners would have probably been between $5,000-10,000 if they went to a regular company. We did that free of charge. So let's just take an average price of $7,500, we probably were able to put about $7.5 million of services back into the communities, in terms of mold."

The following are a few of the comments that illustrate the role that the Siller Foundation played on Staten Island:

"The most important organization I've [Guyon Rescue] partnered up with has been the Stephen Siller Foundation, which has provided me with building materials and supplies to muck out and rebuild people's homes over the last 2.5 years. They have also provided me with administrative support, and those things have been very, very helpful… We've mucked out over 1000 homes and we have rebuilt over 250 homes for free … over the last 2.5 years, so the Siller Foundation's financial support in purchasing building materials has been essential to the recovery effort here on Staten Island."

"The Stephen Siller Foundation was in the building across the street here, you go in there and they take in information, next day they send somebody out to look at your damage, and after that they go to Home Depot, bring the sheet rock, send a guy, some volunteers, and they start putting the place together. The Mennonites repaired so many houses, not ours, but so many of the houses around here."

"The existing non-profit that spearheaded the rebuild stuff, the way that Project Hospitality did the coordinating stuff, was the Stephen Siller Foundation, it's this non profit that was created in memory of a Staten Islander named Stephen Siller who died helping people in the World Trade Center collapse. So they were formed to assist the families of firefighters and first responders and had a rebuild component to it already… So it was like this local SI non-profit with this rebuilding expertise, and they got a lot of the grant money and they were the umbrella for all of these other national groups, like we had Presbyterian Disaster Assistance, and Habitat for Humanity and so what all these national groups need is a local contact. They need someone to invite them in and to help

coordinate with them and get them lists of the homes that need rebuild assistance. And that's what the Stephen Siller Foundation did, it put together this huge queue of homes that requested assistance, and then to coordinate all these different rebuild groups to have like 10 homes being worked on by the Mennonite Disaster Service, and 10 homes worked on by Guyon and Yellow."

In the Rockaways, twenty-two respondents talk about the assistance provided for gutting out, demolition, and mold remediation by local and non-local volunteers, national and local voluntary organizations coordinating volunteers: Habitat for Humanity, AmeriCorps, Nechama, NY Cares, Team Rubicon, Occupy Sandy, and Project Hospitality, and local non-profits and community groups. Most residents were thankful to have volunteers come in so quickly and speak positively about these sources of assistance (10 respondents), but 3 respondents report poorly done work that needed to be re-done.

The Red Cross also coordinated volunteers and distributed cleaning products, information, and kits for mold remediation in the Rockaways, mentioned by only two respondents. One resident in Breezy point spoke positively about it, and one non-resident community leader who co-founded Respond and Rebuild, who spoke negatively, that the mold remediation advice Red Cross was giving was not accurate or effective.

Respond and Rebuild is a good example of a post-Sandy emergent non-profit, started by volunteers who saw some gaps and formed organizations to fill them. Respond and Rebuild helped to rebuild a number of houses in the Rockaways. They also provided health and safety information, training, and equipment for volunteers doing the rebuilding, as well as expertise on mold remediation. Respond and Rebuild consulted with the CUNY School of Public Health and occupational safety experts from Long Island University and Rutgers University, and the Occupational Health and Safety Administration (OSHA). Their health and safety standards were then taken up by other local voluntary groups undertaking demolition, mold remediation, and rebuilding in the Rockaways.

Few local non-profits other than Respond and Rebuild were involved in rebuilding in the Rockaways. Community leaders active in the recovery process in the Rockaways and on Staten Island report that small non-profits face significant hurdles in accessing funding to provide assistance with rebuilding.

Government resources were mainly directed at repairing and rebuilding, mainly through two NYC programs: Rapid Repair and Build it Back. Rapid Repair was an innovative program through which the NYC government funded emergency repairs after the storm, in order to allow residents to remain in their homes while they undertook more major and long-terms repairs. Rapid Repair intended mainly to enable residents to restore electricity, gas, and plumbing in their homes. The repairs were free to residents. The program began making repairs on November 20, 2012 and finished work in March 2013.

Interviewees gave Rapid Repairs mixed reviews. Nine respondents on Staten Island mentioned Rapid Repair (for a total of 21 references). These references included 6 positive comments (from 2 respondents), 5 mixed comments (from 4 respondents), and

11 negative comments (from 4 respondents). Ten respondents in the Rockaways speak about Rapid Repairs; 4 talk about positively and 7 negatively. One respondent spoke positively of the work that Rapid Repair did, explaining that her electrical work, boiler, and plumbing were all fixed within a month of the storm, and that they all continued to work well. The other positive reference to Rapid Repair stated that the program acted quickly to meet people's immediate needs. Those who gave mixed reviews stated that the work was done quickly and met the immediate needs for many people but that the repairs were often not done well or in a sustainable fashion. The work done by Rapid Repair did not contribute to sustainability because the repairmen were instructed to place boilers, water heaters, and electrical equipment in the same place where they had been, rather than raising the equipment out of reach of future floods. A number of respondents in both neighborhoods stated that the work done was very poor, that communication was bad, that Rapid Repairs work crews showed up unprepared, without tools, or the necessary expertise to undertake the work safely, and that much of the work needed to be redone.

One respondent reports that "Rapid Repair was a city program. They were supposed to come and give you the hot water. So they come with the electricians and plumbers… They sent two guys and a supervisor and another guy going back and forth, other guys coming and looking and seeing how the job is going – $87 an hour. They must have spent $40,000 just to put the furnace, the boiler and the hot water heater in my house. And you don't want to give me money? How about a $5000 voucher, and I can go to Home Depot and buy the baseboard, go to the local plumbing supply and give them some business, they are victims too. $1500 would buy a brand-new boiler, go to the local, insured, licensed by the city plumber and for $2000 he will come and install everything and be done in two days, and three months from now when things are screwing up or there is some problem with the boiler, I can go over there."

NYC government launched the Build It Back program in June 2013. The program was designed to help affected home owners make major repairs to their homes and rebuild homes that were destroyed, had to be demolished, or were deemed by the City to be easier to rebuild than to repair. The Build It Back program was initially funded with $648 million in Federal disaster recovery funding (The City of New York 6/3/13).

Fifteen of the 18 people whom we interviewed on Staten Island mentioned Build it Back (for a total of 55 references). These references included 40 negative (from 11 respondents), 1 mixed (from 1 respondent), and 4 positive references (from two respondents). A few respondents simply explained the program, making no assessment of its effectiveness. The positive comments came from two respondents who also gave negative assessments of the program but mentioned that, (1) Build it Back had so much funding that they were eventually able to help people, and (2) Build it Back was receptive to the legal aid, advocacy, and advice provided by Staten Island Legal Services. The "mixed" comment noted that interactions with Build it Back were relatively smooth and pleasant, but nothing had actually been done after over 5 months of waiting for a consultation regarding the request to elevate the home.

The negative comments characterize Build it Back as extremely slow to act. Respondents note that the paperwork was prohibitively complicated and expensive. A number of respondents noted problems with onerous and changing rules.[15] One respondent mentioned that lack of transparency was a large problem with Build it Back. A respondent notes: "Then Build It Back started … My organization and the Siller Foundation have rebuilt over 1000 homes on Staten Island for free in the last 2.5 years. Build It Back have built about five and they have millions and millions of dollars. They will not coordinate with us..."

Another issue that interviewers mentioned with respect to the Build It Back program is that it established rules that disqualified people who legitimately needed the program's assistance. Built It Back would not accept people who qualified for a Small Business Administration (SBA) loan if they did not take the loan. However, people who qualified could not necessarily afford the loan. Also, Build It Back would not help people who were in foreclosure proceedings. Respondents state the reasons why these two conditions should not have disqualified people in the quotes below.

"This has been a huge problem for people who felt they could not take out that loan, so they declined a $100,000 loan from SBA and they want Build It Back help to build the thing, but you've got to take out the loan before you get any grants. In thinking about it abstractly, that makes sense, right? If people can take out a loan, you know this is taxpayer money, so we have to be careful about how we're spending it, but the problem was that a lot of these people could not take out the loans, they just simply couldn't afford them..."

"When Build it Back first came out, anyone who was in foreclosure was ineligible. Only about 10% of initial foreclosure filings result in loss of the house, because there are a lot of ways to get caught up and fix things. But if Build It Back wouldn't fix the home until it was out of foreclosure, they were putting people in a Catch 22, because they couldn't get out of foreclosure until they could fix the home and get back. So basically they were guaranteeing that a much higher percentage of those foreclosure filings resulted in loss of the house. So that was something that the advocates, both within the Build It Back program as well as outside the program took on as a huge policy initiative to demonstrate to Build it Back why this was unnecessary and damaging to the communities that they were supposed to be rebuilding. I mean, one of the first things that happen after a disaster is that people start missing their mortgage payment. They start falling behind, because all of their money is vanishing out of their pockets with the myriad expenses that nobody can pay. So mortgage default is one of the biggest legal problems that follow after a disaster that affects homeowners. So that was an example of a fight we took on."

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[15] A significant number of articles in the media support the comments made by respondents that Build It Back was extremely slow to act and was much too complicated, involving too many agencies in approvals and too much paperwork. See for example Buettner and Chen 9/4/2014, Chen 3/31/2015, Gay and Dawsey 7/9/2015, Colangelo 3/31/15.

Respondents in the Rockaways, almost all of whom have negative comments about Build It Back, noted, first, that Build It Back stipulated that it had to do the entire job and the house owner would lose the value of anything they had already put into the rebuilding. This would have been less of a problem if the program had worked in the beginning but since it took so long to begin, people had to do significant rebuilding work on their own. Second, the program offered no support for temporary accommodation, therefore it was accessible only to residents who could afford to pay for two homes or who could stay with others for free while they rebuild.

Financial help

Inability to meet the expenses was one of the biggest obstacles to recovery. One of the interviewees states "After a while - I would say three months in, the biggest need that people were asking for was financial assistance… " By far the major sources of financial assistance were insurance and FEMA. Many people also took loans from the Small Business Administration (SBA). The main source of insurance payments was the National Flood Insurance Program (NFIP) for those homeowners who had flood insurance. Regular homeowners' insurance does not cover damages due to flooding. People received some compensation from homeowners' insurance for damages due to wind but the amounts tended to be small. FEMA oversees and regulates NFIP, but private insurance companies administer it. Private insurance companies offer insurance policies to households, accept claims, and make payments that are backed by FEMA (and, by extension, the US Federal Government).

Fifty-nine percent of homeowners in the Rockaways and 45% in the study area on Staten Island had flood insurance when Sandy hit. Twelve interviewees discuss flood insurance. Two respondents received money from their claims relatively quickly and smoothly, but others reported that the process took too long, the paperwork was too complicated, and the insurance companies undervalued their property or refused to pay certain claims. Six respondents expressed concern over increasing flood insurance rates in the aftermath of the storm, some saying that they might lose their homes because they cannot afford to pay the higher premiums. One respondent notes "… here you have an expensive product that is pretty defective because most people did not get what they needed to rebuild … I don't know anybody that said thank God I had insurance because I got everything I need. And then they can't rebuild …" Another states "And you can foresee a new giant crisis coming, which is the rising insurance rates. So a lot of folks will be stuck where they can't afford to elevate the home, they can't afford the insurance premiums, and they can't sell either." An additional issue with flood insurance is that many people who should have had it did not because they felt that they could not afford it.

Respondents in the Rockaways received $9,436 on average in financial assistance from sources other than insurance, while on Staten Island average financial assistance was $7,523. The source of financial assistance that respondents mention most frequently is FEMA. Twelve respondents on Staten Island mention FEMA as a source of financial help, in 27 total references. Of these, four express positive attitudes (eight references), three express mixed attitudes (three references), and four express negative attitudes (five

references). Some references did not include an assessment but rather were just descriptions of what FEMA did. In the Rockaways, of the 23 respondents who speak about FEMA during their interviews, 19 are critical, while 13 speak positively about the assistance. Positive comments largely note that any financial assistance was extremely helpful after the storm. Furthermore, several respondents report that FEMA distributed emergency financial assistance to "almost everyone" immediately after the storm. Some felt that the amounts were too small to be useful.

FEMA provided financial help directly to residents. One interviewee describes the program of direct financial assistance as follows: "[FEMA works] with state government to determine what programs from a sort of menu of available programs they want to make available to their citizens and then we set up mechanisms to do that. In virtually every case, we are doing this in support of the state. It's not the federal government activity per se. Secondly, some of those programs are FEMA specific programs, for example our Individuals and Households program, which is what people typically think of when they think of FEMA assistance. People can register the loss they have encountered with FEMA and if they need quick short-term assistance for rental assistance or alternative housing, that's what this [money] is for. … The Individual and Household program in terms of the individuals and families, I can tell you that it was over almost 212,000 households in New York City and $1 billion dollars, most of which was for housing assistance. A fair amount of unemployment, we supplemented the state's unemployment program..."

All but two of the respondents who mention financial assistance from FEMA describe the direct assistance program. Respondents mention that this assistance could include up to a maximum of $32,000 minus the amount that people received from flood insurance, and the amount received depended on reported losses. In discussing this direct assistance, one respondent notes "FEMA distributed money directly to residents, and they're the only organization to really pull that off on such a grand scale … In the long term [recovery assistance], everyone dropped the ball … But to give direct assistance to residents is kind of amazing, and FEMA pulled it off, and they pulled it off in record time, they were like cutting checks two or three weeks later, it was kind of cool."

The main criticisms of FEMA were that claims for direct assistance through the Individuals and Households program described above required the resident to file complicated paperwork, which was especially difficult to do for people who had just lost some or all of their possessions, were perhaps displaced from their homes, had no electricity, and were overwhelmed with the demands of dealing with flooded homes.

Another type of financial assistance offered on Staten Island was the New York State's Housing Recovery Program's Buyout and Acquisition program, which bought the houses of residents who wanted to relocate in select locations. The program was not available in the Rockaways. Instead, in the Rockaways, Build it Back offered to buy homes from those residents whose home had damages totaling 50% or more of the value of the home. None of the respondents in this study had personal experience with the acquisition program. One community leader offered the following, comparing buyouts in Staten

Island and acquisition by Build It Back: "Oakwood Beach [on Staten Island] got bought out, and the people there were really happy. There were a lot more communities that wanted a buyout but weren't granted it. The Build it Back program has an acquisition option, but it isn't as good as the buyout because they offer the post-storm value of your home and then the city can do whatever they want with the land, whereas in a buyout it returns to nature. I wonder how many houses have been acquired at this time. That doesn't seem to be happening very much."

Another source of financial help offered in the Rockaways was funding for moving costs by the Red Cross and Salvation Army. A respondent reports that "If they need moving assistance, a lot of people that were dislocated and were living in a FEMA hotel, and that's run out, and now they want to move back into Rockaway, they found a new place and they just need a little help. So a lot of agencies are providing … moving assistance. The Salvation Army is doing that, so is the Red Cross."

Financial assistance also came from private sources such as employer groups, NGOs, and religious groups. One respondent said for example: "I think a lot of help came from the people that worked with them, I think that's where your best resources came from. If you worked for the College of Staten Island and you had a loss, they had a fundraiser and gave money. Q: So employer groups? A: yes, employers helped. I think that was probably the quickest delivery of help that people got that I know of… that was moving a lot faster than all your other monies - the Red Cross, the FEMA money - that took forever…" Three respondents mentioned gift cards as a very helpful source of assistance in buying basic goods in the short term. Tzu Chi (Buddhist org) was mentioned twice in this context. Social networks were not a big source of financial assistance.

Financial assistance for residents was not the only funding that influenced the course of the recovery. Residents relied on NGOs and community organizations that provided a range of services, as described above. These organizations needed funding as well. Most of these organizations obtained funding from larger NGOs. As one interviewee explains: "I don't think any of the funding to any of these organizations was government-based, I think a lot of it was Red Cross, Salvation Army. VOAD (Voluntary Organizations Active in Disaster) membership funded a lot of the voluntary organizations that did work here." "VOADs … are a coalition of the big guys, The Salvation Army, the Red Cross, United Methodist, etc. So those are the people who have the money and also have more experience, they have gone disaster to disaster. So VOAD, national, and there is also a city coalition of VOADs, traditionally helped form long-term recovery organizations, which are the community-based version of [VOAD] … non-profits, and spontaneous recovery groups, and local businesses, and entities … form a coalition to facilitate recovery."

Another respondent adds "we were able to work on houses ourselves if necessary, though we also needed additional capacity, and that's when we reached out to the VOADs … It was mainly Storm Aid, which are the Amish, MDS Mennonite Disaster Service, and then Southern Baptist disaster service all had camps up here in Staten Island. They recruited their own volunteers to come up to their camps here in Staten Island and then they would

look to meet up with a local organization and leverage or collaborate on working on homes… and plus they're very skilled, they do this, this is what they do, they send volunteers to disaster sites all over the country. Its just people don't know about them. The whole VOAD system is an unknown national treasure."

Local community and religious groups were not prepared to be competitive grant seekers. They often lacked the structure[16], technological resources, and expertise to put together competitive proposals for funding that complied with the requirements of funding organizations. This affected their ability to provide assistance beyond the relief phase, during which a lot of funding for these smaller community groups came from donations. As relief ended and recovery began, many started to run out of funding and then were unsuccessful in their applications for additional funds.

Another problem that residents faced that was related to financial hardship was the need for legal assistance with insurance claims, readjustments, foreclosures, and contracting for elevations. Many people had trouble claiming financial assistance from insurance and from FEMA, and needed advocacy and legal assistance with contesting their access to funds. At least one local NGO with legal expertise, Staten Island Legal Services, assisted residents with these issues. One respondent explains, "[Staten Island Legal Services (SILS)] … were challenging decisions that FEMA made. If somebody… said 'we were just denied benefits' and if that happened and [they] found that it was unwarranted [they] would go right back to the FEMA desk and say 'this is why this person is eligible and can you re-do it', so there was scrutiny of [FEMA's] decisions but, you know, the purpose of [SILS] work is to make the system work as best as it's supposed to."

Respondents note many gaps and shortcomings in the financial assistance they did receive. Some mentioned that a potential financial crisis could be looming for households that cannot afford to rebuild, cannot sell, do not have access to a buyback program, and for whom insurance rates will be rising soon.

6. **What the recovery from hurricane Sandy says about vulnerability and resilience to coastal storms**

Vulnerability to coastal storms

The main loss that resulted from hurricane Sandy was the damage to housing and other infrastructure due to flooding. This predominant component of vulnerability is specific to coastal storms and would not be relevant to guiding preparations for other types of climate risks. Flooding is likely to be the main driver of loss during coastal storms

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[16] The leader of an emergent non-profit that was active in demolition, rebuilding, mold remediation, and health and safety after Sandy talks about it being difficult for them to receive funding from organizations that traditionally grant money to non-profits. They did not have a normal structure, with an executive director, communications person, and so on, and this made it difficult to fit into boxes required by most funders.

outside of the winter season, based on past storms. In some storms wind damage is more severe than it was during Sandy.

Homeowners emerge as the most vulnerable group because of the heavy losses that they sustained. Even homeowners who had flood insurance had large expenses out of their own resources over and above the insurance and any additional assistance that they received. The assistance that homeowners received was not sufficient to cover the costs of repairing and rebuilding homes. The expense of the recovery caused a long-term reduction in homeowners' assets and reduced this group's resilience to future storms.

The renter population is vulnerable to coastal storms in a different way than homeowners are. The main hardship that renters suffered was the dislocation from their homes and potentially a need to find a new home. In our data, renters are no more likely to be displaced from their homes by the storm than are homeowners, they are no less likely to have a permanent place to live at the time of the survey, and they were displaced no longer than were homeowners. However, our conclusions regarding the hardship that people who were displaced faced with finding new homes are limited by the fact that we do not have complete data on people who were displaced, whether renters or homeowners. We could only make contact with people who were at a residential address in the study areas at the time of the survey. Some people have not returned to the neighborhoods. Some of these people may still be in temporary housing or homeless.

The second vulnerability among renters comprised access to food and health care in the months after the storm. People recovered full access to food and health care completely within months. Poverty, or income more generally, is likely to play a role in this source of vulnerability in a way that our study cannot fully explore because the sample of renters interviewed is small and concentrated in the lower income range.

Another limitation of this study in understanding the vulnerability of renters is that the study excludes large apartment buildings. Vulnerabilities associated with large apartment buildings mainly stem from lack of electricity: difficulty in navigating dark stairwells, difficulty posed for some populations in relying on stairs rather than an elevator, lack of running water on higher floors, and crime in a dark building. The issues relevant in high apartment building are likely to depend on the incomes of the resident population.

Other characteristics generally associated with higher vulnerability after Sandy included presence of people with disability and/or a chronic health condition in the household, presence of individuals older than 65 or younger than 18 in the household, and the size of the household.

Limited understanding of storm forecasts and lack of access to information after the storm were important contributors to vulnerability after Sandy. Residents of the neighborhoods were interpreting forecasts in a deterministic way. Also, warnings failed to explain terms such as storm surge and urged people to evacuate without explaining why they should. As a result people stayed in their homes, and many people died or suffered illnesses and post-traumatic stress. Limited access to information about how to

clean out a home, what do about mold, where to obtain assistance, and how to apply for assistance slowed the recovery down and resulted in avoidable losses and hardships.

The quality of social networks and the absence of strong, local neighborhood organizations contributed to vulnerability because of the critical role that social networks and local non-profits played in the relief and recovery process. The strong social networks and NGOs on Staten Island significantly reduced the greatest source of vulnerability to the storm – the capacity to repair and rebuild damaged homes. This capacity was low in the Rockaways, resulting in poorer recovery.

Implications for creating a Social Vulnerability Index

A common approach to analyzing vulnerability of populations in the literature is a map of a social vulnerability index (SoVI). The map can be used to identify and target vulnerable populations with strategies designed to improve resilience. The index generally ranks populations in different locations as being more or less vulnerable based on a composite of various characteristics such as income, gender, age, health status, distance to various services, and possibly other characteristics (see for example Wu et al (2002) for an application focused on coastal storms). The index is generally constructed in the same way for all climate risks, with the same assumptions about the roles that each of the variables play in determining vulnerability.

The results of this study suggest that a SoVI is likely to be more useful for identifying vulnerable populations if it is tailored to the specific climate risk, and is based on evidence about the main determinants of vulnerability for the specific climate risk. In a typical SoVI, measures of economic deprivation, such as percent of population in poverty, dominate the ranking of vulnerability. In the case of coastal storms, a SoVI dominated by measures of poverty would not identify the most vulnerable populations in a satisfactory way.

A SoVI that identifies populations vulnerable to coastal storms should include homeownership. For homeowners, income matters in their ability to recover only above some level, approximately the level that separates upper income households from middle-income households. The relevant level of income will be different in different locations. Therefore, one approach to the SoVI is to interact homeownership with annual income below some threshold, which for NYC could be an annual household income below some level between $250,000 and $500,000.

The importance of homeownership for vulnerability also suggests that a SoVI that is based on the density of population with a particular characteristic, rather than the proportion of a given characteristic in the population, may again miss the most vulnerable population. In an urban setting, the most densely populated blocks are those with a

preponderance of apartment buildings and therefore a renter population.[17] Homeowners inhabit less densely populated blocks that are dominated by single or two-family homes.

Since identifying and reducing the vulnerability of the renter population to coastal storms requires an entirely different approach than does the vulnerability of homeowners, a SoVI for coastal storms may be more useful if it maps the vulnerability of renters and homeowners separately.

A typical SoVI ignores variables that are available in the Census and important for determining the vulnerability of coastal storms, in particular access to social programs such as WIC and SNAP.

Finally, a SoVI ignores important elements of vulnerability such as access to information, strength of social networks, and types of neighborhood organizations. These variables pose a larger challenge because data on them is less easily available, with the possible exception of neighborhood organizations, some of which are reasonably well documented on the internet. Social networks and local organizations play a critical role in vulnerability and in understanding what needs to be done to improve resilience.

Building resilience to coastal storms

Reducing the vulnerability of homeowners requires reducing the cost of damages suffered from storms in the future. Funding is not likely to be available from either public or private sources to cover the kinds of damages that were sustained during Sandy. Most frequent damages from coastal storms will not approach those from Sandy, but the funds required to support the NFIP are already depleted and homeowners have drained their stocks of resources during the recovery from Sandy. These stocks will not be replenished quickly if at all.

One impediment to reducing damages from future storms is lack of understanding of future climate risks among the exposed populations. The majority of the respondents in the study expect future coastal flooding to be not as bad or the same as in the past. This is one reason why people have been rebuilding their homes as they were before Sandy, missing the opportunity to reduce damages from future storms. Seventeen percent of the respondents raised any of the utilities in their house above the level at which they were before Sandy. No one has raised their home. While raising a home is extremely expensive, raising utilities is not, and other relatively low cost measures are available to reduce future damages. A contributing factor was that the NYC Rapid Repair program was replacing utilities exactly where they were before Sandy as well, not because the City was unaware of future flood risk but in order to speed up repairs.

One implication for improving resilience to future storms is that the populations in the exposed neighborhoods need to understand the future flood risk. Awareness has been

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17 Condominiums and housing cooperatives are exceptions.

increasing rapidly among experts and government officials. However, no programs are yet in place to begin educating the populations that are in harm's way so that they can make informed decisions about the risks that they choose to face.

The second obstacle to reducing future damages is the cost of the measures involved. Some measures, such as raising homes or expanding the buyout program for those homeowners who prefer to move are extremely expensive. A comparison of the costs of future damages to the costs of current measures to reduce future damages would be a useful input into decisions about allocating funding.

Educating exposed communities how to interpret storm forecasts and why their evacuation decisions should depend on elements of the forecast such as the storm surge would build resilience and save lives. Educating communities in advance of storms about how to clean out a home, what to do about mold, what assistance is available, and what they need to apply for assistance from various programs would prepare households and speed the recovery. For example, residents should keep a file of documents that they will need out of the reach of floodwaters, and take it with them when they evacuate.

Experience with Sandy showed that one-stop hubs that offer information and services in one location are tremendously helpful to a recovery. Virtual hubs could be created online with corresponding measures to provide temporary access to electricity immediately after a storm, for example with mobile solar units. Also, plans could be made ahead of time for installing physical hubs in critical locations rapidly after a storm.

The types of organizations involved in the assistance effort influence recovery and therefore the resilience of the population. The evidence in this study suggests the following categorization. One category are small, local organizations with strong presence in the neighborhoods, such as Guyon Rescue, Yellow Boots, YANA, Staten Island Legal Services, and local churches. These generally receive the most positive assessment from respondents. The second category comprises large organizations that either had a strong presence in the community or were invited and introduced to the community by local organizations. These receive equally positive assessments. Third are large organizations that came from outside Staten Island and were more centralized in their operations. These receive much more mixed assessments.

The strengths of small, local organizations were that they were well informed about what people needed and responded quickly to those needs. The main weakness of these organizations was that their funding was limited. Also, they lacked the technical expertise to address some needs, such as health, technical repairs, and sometimes rebuilding, and they were sometimes unable to secure the necessary permits from the NYC government to perform some repair and building jobs.

The larger local organizations, such as the Stephen Siller Foundation, and those that came from outside Staten Island but operated in a decentralized way, most notably Occupy Sandy, and church groups that came from other states were also well informed about what people needed. These were not just non-profits but also private businesses,

especially employer groups. One reason why Occupy Sandy's size became an advantage rather than an obstacle, enabling the organization to meet needs quickly, is that the volunteers had a lot of autonomy. They were able to make their own decisions, which had to comply with a fairly small number of rules, and generally did not have to seek permission from supervisors. Therefore, they were able to respond to information rapidly.

Another strength of the larger organizations is that they generally had more resources. The Siller Foundation had already established itself in repair and rebuilding and had the necessary permits. One interviewer reports: "The Siller Foundation is a great example. We have this big rebuild organization that led all the repairs on homes, like a hundred and fifteen or thirty full rebuild projects, and then like scores of repair projects. That's the number - Build-It-Back hasn't even reached that number in Staten Island. So just one voluntary rebuild organization did more work than what the City has done so far."

The larger organizations, even though better resourced, also depleted their resources before the work of the recovery was done. The respondent who speaks about the Siller Foundation in the quote in the previous paragraph continues to say "But it [Siller Foundation] lost its resources. It couldn't get any more funding and the city did not sanction them as an official entity so they've closed operations. I mean, they still participate in our organization but we've lost about half of our rebuild capacity locally… and a lot of it came from not having an official partnership with the city around trying to engage with certain voluntary rebuild capacity and volunteer labor."

Another respondent speaks about the same problem in the following quote: "… but then after like a year and a half there was a tapering off of the recovery organizations active in helping people on SI. Like volunteers were getting burned out… A lot of the big really useful organizations were running out of money. So we have recently just been able to do less in individual recovery… All of the resources are with the city and the city's Build It Back program and unfortunately the grassroots rebuild groups were not able to participate in that program so they ran out of money and left, even though they were successfully rebuilding thousands of homes and getting people back home and so we are now trying to encourage [Build It Back] to work more quickly and to liaise with us a little bit more because we have the on the ground knowledge that they need."

The third category of organizations, the large, more centralized organizations received the least favorable assessments from respondents. The main concerns about these organizations were that they did not have good information about what was needed on the ground. Therefore, their help was not always appropriate. They tended to move slowly because of bureaucratic structures. There were many rules governing each step of the assistance process and many layers of required approval. Furthermore, the applications for help were complicated.

Interviewees viewed FEMA's financial emergency assistance the most positively out of the larger organizations. The approach was extremely useful because it did not require FEMA to figure out exactly what people needed. The reviews were mixed because

application processes could be onerous, the length of time to receive the money varied, and many people who needed the money in the months after the storm did not receive it.

The large, centralized organizations that received mixed reviews were not all government programs. Respondents reported that the help offered by the Red Cross, a large, international NGO, was frequently poor quality, generic, and slow.

Social networks, volunteer networks, and local non-profit groups were a critical resource for the recovery after Sandy and after other past storms, and they will likely play that role again in the future. Measures that strengthen the capacity of these resources would go a long way toward improving resilience. Such measures would include the education for local communities mentioned above that would better prepare members of social networks and leaders of local organizations. However, local organizations also need better access to funding and links to expertise that they do not have. A theme that repeats in the quotes above is that partnerships between local organizations and volunteer networks and government agencies could put public funding and technical expertise to use addressing specific needs quickly after a storm. The private organizations have shown that they document needs in real time most effectively and they have the human capital needed to translate funding and expertise into action where it is needed.

7. Conclusion

Vulnerability is the potential for loss. In order to understand the nature of vulnerability to a particular climate risk, we need to understand the losses that happen as a result of that risk, and that we are aiming to prevent. Since populations suffer different losses from different climate risks, analysis of vulnerability should be tailored to specific climate risks.

This study focuses on vulnerability to coastal storms in urban neighborhoods, and finds that middle-income homeowners are the most vulnerable population. Renters, and especially low to middle income renters, are vulnerable in a very different way from homeowners. They recovered more quickly and completely from hurricane Sandy but their recovery depended on available assistance. Therefore, their vulnerability also needs to inform preparations for future storms. A social vulnerability index that is tailored to the risk of coastal storms can help to identify and locate vulnerable populations on a map.

A vulnerability analysis needs to go beyond identifying factors that are correlated with vulnerability to understand the process that produces vulnerability in order to guide strategies that can build resilience to future storms. Reducing future damages to homes requires determining why homeowners are not improving the ability of their homes to withstand future floods. Similarly, laying the groundwork for faster recoveries from future coastal flooding requires understanding the roles that individuals and organizations played in the recovery from Sandy and the obstacles that they faced.

The strengths and weaknesses of the recovery from hurricane Sandy suggest two main directions for improving resilience to future storms in urban neighborhoods. First, the

communities exposed to storms need better understanding of the future flood risk, of storm forecasts, and of actions that they need to take after a storm, as well as better access to information about available resources after a storm. Second, the different types of organizations involved in the recovery effort had different advantages and disadvantages, which suggest a need for partnerships between these organizations that enable each type of organization to specialize in what it does best. In particular, social networks, volunteer networks, and local non-profits played a critical role in the relief and recovery effort after Sandy, as they have after other storms. These organizations have the local knowledge and capacity to identify needs and respond to them quickly. Partnerships with better-resourced public agencies, which lack the detailed, local knowledge, could help to apply public funds to recovery needs quickly and efficiently.

Both of these directions have one theme in common. Resilience to future storms requires greater engagement on the part of communities who are at risk. Preparedness and response plans that rely on action by experts and infrastructure solutions have limited potential to limit damage and facilitate recovery largely because experts do not have the human resources and local knowledge necessary to make local decisions and take local actions. The populations in the exposed communities need to have the information needed to make educated decisions, and they need to be engaged in building resilience in their communities in order to bring their knowledge of the problems that they are facing to bear on the solutions.

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