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A Study of Resiliency in New Orleans Neighborhoods Ten Years After Hurricane Katrina

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A STUDY OF RESILIENCY IN ORLEANS PARISH COMMUNITIES TEN YEARS
AFTER HURRICANE KATRINA

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Science

in

The Department of Environmental Sciences

by
Paul R. Algu
B.S., Louisiana State University, 2011
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Mom and Dad, I love you more than I'll ever be able to express. Thank you for always being there for me. Michael, you and I share a special bond. You don't even need to read this to know what I'm about to say. You're the best brother in the world and no matter where our lives take us; you will always be the person I turn to for everything first.

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ABSTRACT

Hurricane Katrina made landfall on August 29, 2005, flooding over eighty percent of the Greater New Orleans area and causing a mass exodus of the local population. Statistical analysis was used to quantify recovery at a neighborhood level and answer the following questions: What is the recovery rate of New Orleans neighborhoods ten years after Hurricane Katrina? What factors account for variation in recovery rates among neighborhoods? Six neighborhoods in Orleans Parish were selected for further study based on their unique geographical and recovery metrics.

Recovery rates among the seventy-two neighborhoods were based on a comparison of United States Postal Service active delivery of mail to residences in Orleans Parish. USPS delivery rates are considered an accurate indicator of population change following a disaster. The neighborhoods with the highest recovery rates based on active delivery of mail were the Central Business District (259.5%), Gert Town (116.9%), and Algiers Point (111.9%). Those with the lowest included West Lake Forest (54.9%), B.W. Cooper (45.6%), and Lower Ninth Ward (36.7%). A closer look at the recovery narrative of six selected neighborhoods is included to provide additional context for consideration of the research results. This study provides an essential look at the chief components of neighborhood solvency which will affect New Orleans in the future and further solidifies the inexorable link between New Orleans residents, their native ecosystem, and the built infrastructure which has done so much to change every facet of the city.

CHAPTER 1. INTRODUCTION

Hurricane Katrina provided a rare opportunity to study the resilience and recovery of a major metropolis on a macro level. Multiple analyses have dissected New Orleans' reclamation from Katrina's floodwaters in terms of social, economic, and physical sciences. However, one unit of analysis which has received less attention is the neighborhood. An amalgam of culture and very much the individual hearts of New Orleans, neighborhoods tell stories other statistical areas cannot. With a renewed interest in land management and planning following Hurricane Katrina, it is vital for land planners and policymakers to understand how New Orleans operates at a neighborhood level. Each community stakeholder has a share in how their neighborhood recovers from, adapts to, and prepares for natural disasters.

This study examines population recovery among sixty-nine neighborhoods in New Orleans and attempts to answer and address the following questions and research objective: What is the recovery rate of New Orleans neighborhoods ten years after Hurricane Katrina? What factors account for variation in recovery rates among neighborhoods? In addition to this analysis, six neighborhoods in Orleans Parish were selected for further study based on their unique geographical and recovery metrics to provide additional detail and insight into the likely influences on recovery.

a. History of New Orleans

La ville de La Nouvelle-Orléans was formally founded in 1718 by Jean-Baptiste Le Moyne, Sieur de Bienville (Bienville) (Campanella 1999). The story of New Orleans, however, begins hundreds of years before. French coureurs des bois, or woodsmen, travelled down the

Mississippi River from French Canada and Louisiana (Kendall 1922). René-Robert Cavelier, Sieur de La Salle was the first European to travel from the Great Lakes to the Gulf of Mexico down the Mississippi River in 1682, opening the idea of linking French Canadian territories to the territory of Louisiane, named after King Louis XVI (Kendall 1922). The first documented expedition to discover the mouth of the Mississippi River and establish a city there was undertaken by Bienville and his brother, Pierre Le Moyne d'Iberville (Iberville) in 1698 (Kendall 1922). The brothers established settlements in what is now Biloxi, Mississippi and Mobile, Alabama; frequently leaving to chart the mouth of the Mississippi and find a suitable location to establish a port city on the river. Iberville preferred Biloxi, but Bienville argued in favor of "...the most beautiful crescent of the river" in between the Mississippi River and Lake Pontchartrain (Kendall 1922). He named the new town after a Duke of Orléans and thus New Orleans was born.

New Orleans was selected by Bienville for a variety of reasons. The city was built on a bend in the river on high ground, allowing a tactical advantage in case of advances up the river by enemy ships (Kendall 1922). The location in between the Mississippi River and Lake Pontchartrain, as illustrated in Figure 1 with current neighborhoods, was the shortest route between the two bodies of water. Please note the Desire Development and Desire neighborhood will be merged for statistical analysis. A portage canal, Bayou St. John, allowed easy access between the two. The deltaic alluvial soil was rich and it was easy to grow crops despite frequent flooding from the river which served a dual purpose of replenishing soil and ruining crop yields simultaneously. Despite these advantages, early inhabitants of New Orleans were also faced with a myriad of hardship. Multiple floods, hurricanes, and fires took their toll on the city and its inhabitants.

Being situated in a humid subtropical climate, settlers also had to combat disease. Over 41,000 New Orleanians died of yellow fever between 1817 and the disease's eradication in 1905 (McKiven 2007). Yellow fever and malaria were transmitted via mosquitos that bred in cisterns and accounted for multiple epidemics in the early history of New Orleans. Other tropical diseases, including cholera and dysentery, were responsible for thousands of deaths until sanitation practices improved around the turn of the 20th Century.



Figure 1: 73 “Official” New Orleans Neighborhoods (NOLA.com 2015)

The reasons for which Bienville selected New Orleans to be the capital of French Louisiana have manifested themselves throughout history and to this day. Because of its location near the mouth

of the Mississippi River, New Orleans grew into a strategic port of great importance, comingling French, Spanish, African, Creole, and eventually American heritages. The city also became a major port for the slave trade, which caused an exponential growth in the city's population from its inclusion into the United States through the Louisiana Purchase in 1803 to the start of the Civil War in 1861 (Kendall 1922, Campanella 2006). New Orleans was the largest city in the Confederate States of America at the start of the Civil War and a primary target for Union strategists hoping to capture the city and blockade supplies from reaching Confederate troops. Admiral David Farragut captured New Orleans in 1862 and the Civil War ended in 1865 (Kendall 1922). During the Reconstruction Era the city was beset with problems stemming from a large military presence, political factionism, and disenfranchisement of African-Americans (Kendall 1922). The city still continued to grow steadily through these issues due to the continued importance of its location which served as a major port for trade and immigration through the end of the 19th Century and into the 20th.

One of the last major flood events to impact New Orleans was the Great Mississippi River Flood of 1927. Heavy rains throughout the Mississippi River Basin swelled the river to record flood stages and inundated 27,000 square miles of land (Campanella 2006, Campanella 2008). In New Orleans, fears of a major natural disaster caused businessmen to detonate a levee in Caernarvon in St. Bernard Parish downriver from the city as a last-ditch effort to save New Orleans from being flooded (Campanella 2006, Campanella 2008). This act was unnecessary and caused widespread flooding in St. Bernard and on the eastbank of Plaquemines Parish. The populations affected by this flooding were not compensated and the repercussions from this decision have set a precedent for resilience research today. After this flood, the United States Army Corps of

Engineers (USACE) enacted a massive building project, leveeing virtually the entire length of the Mississippi River.

The Great Mississippi River Flood of 1927 signaled the beginning of the end of an upward population growth trend in New Orleans and the South as a whole. African-Americans whose residences were flooded by the river moved out of the predominantly rural South to manufacturing centers in the West, Midwest, and Northeast; and this trend persisted until the 1970s (Campanella 2008). During World War II, New Orleans gained fame as the primary location for the manufacture of Higgins Boats, or Landing Craft, Vehicle, Personnel (LCVP) (Strahan 1994). Higgins LCVPs were used in both theatres of World War II and most famously during Operation Overlord as Allied troops invaded beaches in the Normandy region of France on June 6, 1944 (Strahan 1994). After the war, New Orleans' population began to decline, a trend which has continued to the present.

Many postwar trends that swept across the United States took longer to impact New Orleans. The city's urban core experienced growth until the 1960s, a marked difference from similar-sized cities. This was due to the inability of Orleans Parish, co-terminous to the City of New Orleans, to annex suburban development in adjacent parishes (Lewis 2003). The modern metropolitan New Orleans footprint was born out of this movement, as neighborhoods contiguous to the city like Metairie and Gretna in Jefferson Parish grew. The city was also slower to respond to the growing Civil Rights Movement in the 1960s, leading to an educational and income gap which persists to this day.

b. Recent Hurricanes

Two major hurricanes preceding Hurricane Katrina which played an integral part in New Orleans' response to Katrina were Hurricanes Betsy and Camille. Betsy was a Category 3 hurricane which made landfall on the Louisiana coast southwest of New Orleans on September 9, 1965 (Campanella 2008). Betsy drove left of New Orleans, exposing the city to the strongest side of storm and flooding the Lower Ninth Ward and St. Bernard Parish. Locals were quick to believe a rumor that the levees near these areas had been deliberately destroyed in order to save the wealthier areas of the city, a rumor which was also levied in the immediate aftermath of Katrina (Landphair 2007). Betsy was the first hurricane to cause over one billion dollars of damage at the time in the United States (Campanella 2008). In the years after Betsy and aided by the Flood Control Act of 1965, the city and USACE began to construct three hurricane protection systems: New Orleans to Venice, Lake Pontchartrain and Vicinity, and West Bank and Vicinity ("New Orleans District"). At the time of Katrina's landfall none of these projects had been completed. As of 2015, the only project which has been completed is West Bank and Vicinity, as is illustrated in Figure 2 ("New Orleans District").

Hurricane Camille was widely considered to be the worst-case scenario for a hurricane impact on New Orleans. A Category 5 storm on the Saffir-Simpson scale, Camille followed an almost identical path to Katrina but did not impact New Orleans as greatly as Katrina due to the compact nature of Camille and the lower storm surge associated with it (Campanella 2008). The storm made landfall in Waveland, Mississippi on August 17, 1969, mere miles away from where Katrina would land thirty-six years later, as



Figure 2: West Bank and Vicinity Levee (The Times-Picayune 2011)

the estimates of storm surge as illustrated in Figure 3. Camille caused over \$6.8 billion in damages (adjusted to 2000 U.S. currency) and 256 deaths (Sheets and Williams 2001).

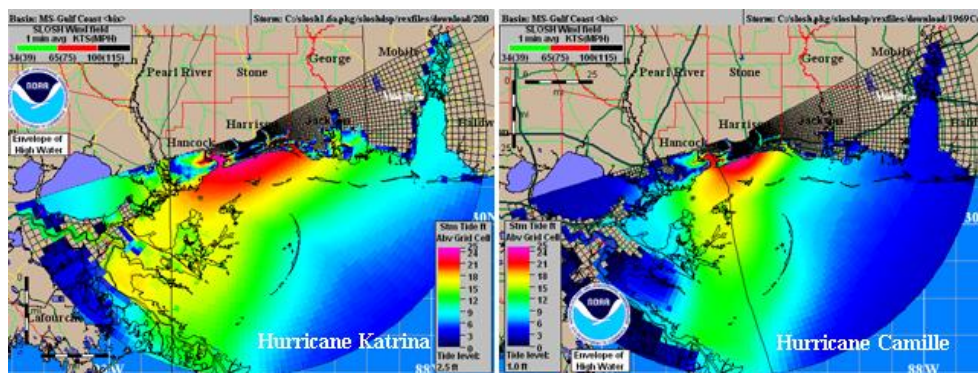


Figure 3: SLOSH Model of Hurricanes Katrina and Camille (National Oceanic and Atmospheric Administration 2005)

In the aftermath of Hurricane Katrina, New Orleans was faced with a crisis unlike any other in American history. Approximately eighty percent of the city was flooded from breaches in levee

protection and canal systems (Plyer 2014). Due to subsidence and residents building away from the high ground on the natural Mississippi River levee, the topography of New Orleans resembles a bowl with the Mississippi River and Lake Pontchartrain serving as rims as illustrated in Figure 4. Fifty-one percent of the parishes that comprise Greater New Orleans (Jefferson, St. Bernard, and Orleans) are at or below sea level and this made pumping out the floodwaters more odious than expected (Campanella 2008).

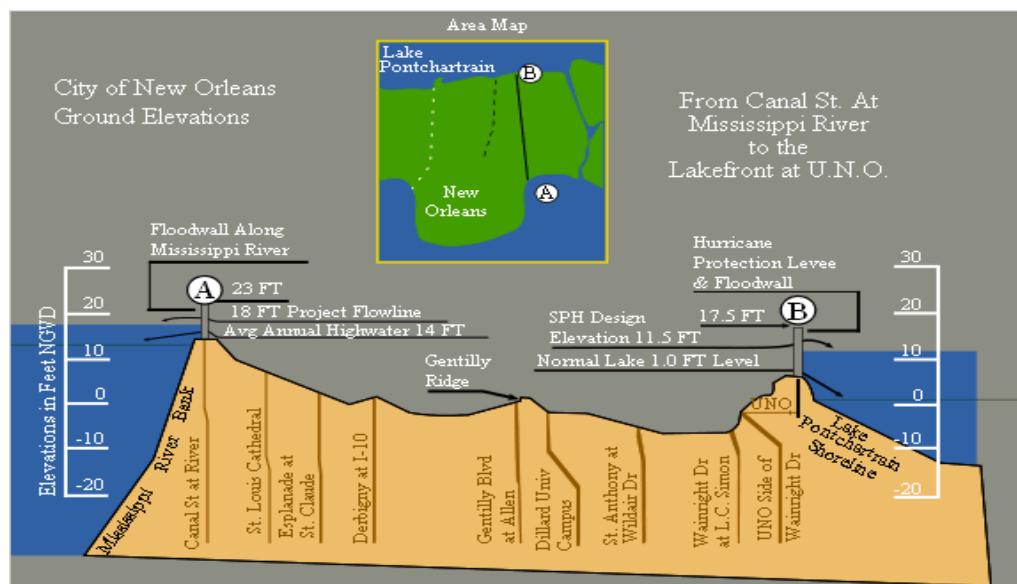


Figure 4: Cross-Section of the City of New Orleans (Staten Island Advance 2008)

Aside from engineering failures, New Orleans was presented with a failure in social support systems during Katrina as well. Approximately eighty to ninety percent of New Orleanians evacuated before Hurricane Katrina made landfall but those who stayed behind were trapped in their own homes by floodwaters or transported to the Louisiana (now Mercedes-Benz) Superdome where widespread reports of squalid living conditions and violence captured national media attention, many of which reports turned out to be false. Looting was also reported across

the city and it was not until weeks later and under martial law residents were allowed back into the Greater New Orleans area. A diaspora of over 800,000 residents left the GNO and as of 2015, mail delivery rates indicate the number of residents currently in New Orleans is roughly equal to pre-Katrina levels (Plyer et. al 2015).

c. Recovery Following Hurricane Katrina

Ten years after Hurricane Katrina opinions are split as to whether New Orleans has fully recovered from the storm. Over \$100 billion in aggregate federal funding was distributed to shareholders and governments in the GNO area and this infusion of cash buoyed the city through the economic crisis of 2008 (Plyer et. al 2015). From 2008 to 2012, New Orleans experienced a total 1 percent increase in job recovery, well above the 2 percent loss suffered by the rest of the United States (Plyer et. al 2015). The population count in New Orleans is estimated to have increased as a 2014 estimate puts total population at 384, 320; an increase from the 2010 Census value of 343,829 (Plyer et al. 2015). New Orleans has since landed on multiple lists for being young professional- and business-friendly. Even the city's moribund National Football League franchise, the Saints, were able to capture a long-overdue and deserved Super Bowl championship in 2009 behind a swelling of civic pride led by owner Tom Benson and the pinpoint accuracy of quarterback Drew Brees. By all economic indicators, the city has rebounded from Katrina extremely well with some going as far as to say the aftermath of the storm was the social and economic wake-up call the region desperately needed.

But even for the redemptive story of economic growth in New Orleans post-Katrina, the story of fractured social strata must also be told. It is estimated 100,000 African-Americans did not return to New Orleans after the storm (Plyer et. al 2015). This loss of population separated families who

had lived in the same house for multiple generations, a practice fifty percent more prevalent in New Orleans pre-Katrina as compared to the rest of the country. The Housing Authority of New Orleans' decision to demolish Section 8 housing developments, locally known as the Big Four, also played a major role in separating residents from each other. While well-known social aid and pleasure clubs like Zulu were able to keep ties together; smaller, more neighborhood-oriented clubs were disbanded due to lack of membership. It is unknown, even ten years after the storm, how these losses will further impact residents in newer Section 8 housing or rapidly gentrifying neighborhoods like the Faubourg Marigny and Upper and Lower Ninth Wards.

This first chapter has presented an overview on the research questions and objectives along with a history of the City of New Orleans. The next chapter presents related research concerning community resilience. Findings from these studies were used to formulate and inform the research questions and objectives. The third chapter contains a detailed description of data selection methods that were used to acquire data related to New Orleans neighborhoods. The fourth chapter presents six case studies of New Orleans neighborhoods ten years after Hurricane Katrina. The fifth chapter includes a discussion of the results, suggestions for future research, and a summary of findings. References, appendices with data used in the analyses, and related maps follow the sixth chapter.

CHAPTER 2. RELATED RESEARCH

At its core, resilience is defined by reaction to disturbance. The catalyst necessary to begin a resilience cycle is the impact caused by a perturbation in a defined system and the recovery afterwards. This pattern was first identified in ecology (Adger 2000). The ecological definition of resilience is the measure of how far a system can be disturbed or the magnitude of the disturbance it can absorb before it shifts to another regime (Walker et. al 2006). The ecology focus has given way to another idea of resilience: engineering resilience. The major difference between ecological and engineering resilience is the number of system states. Engineering resilience is measured by the impact on one system state whereas ecological resilience is measured using multiple systems (Gunderson 2000). This thesis will study both the ecological and engineering concepts of resilience.

Borrowing from ecological resilience, community resilience can be described using four types of community classifications: usurper, resilient, resistant, and susceptible (Lam et al., 2015; DeFrank 2009). In Figure 5 below, these classifications are illustrated on graphs which show the x-axis of exposure, damage, and recovery and the y-axis of z-scores for the aggregate of these dimensions (Li 2011). If the z-score is high after receiving a disturbance to a system, it correlates to a resilient community. Communities which receive a major disturbance and do not fully recover are considered susceptible. Those which recover to pre-disturbance levels are considered resilient. Usurper communities receive a disturbance, but exhibit higher than before z-scores which indicate the transfer of resources or capital from surrounding communities to the usurper community (DeFrank 2009, Li 2011). Counties which receive less of a disturbance from the initial event are considered resistant.

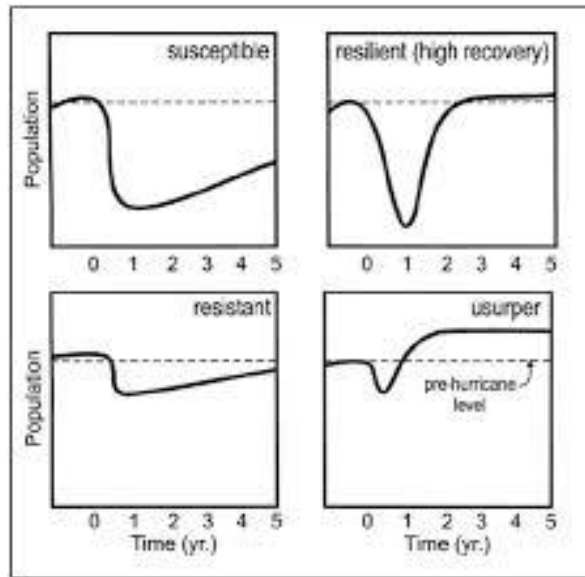


Figure 5: Four Patterns of Recovery in a Social Economic Community (Liu et. al 2006, DeFrank 2009, Li 2011, Lam et. al 2015)

The intersection of ecological and engineering resilience is the study of socioeconomic resilience. Human systems involve communities which must endure a disturbance that disrupts their engineered infrastructure, surrounding ecological systems, and the community's culture and way of life. There are three key characteristics that define resilience as indicated by the Resilience Alliance: the amount of change a system can experience and still maintain the same controls and/or function; the degree to which a system can self-organize; and the system's ability to build and increase its capacity for adaptation and learning (Carpenter et al. 2001, Holling 1973 and 1996).

The amount of change a system can experience and maintain the same controls and/or function varies based on a myriad of variables, most notably the ecological resilience of the natural systems surrounding the socioeconomic system. In Louisiana, and especially New Orleans, the natural ecosystem does not lend itself to a resilient environment. The state has lost over 1,900

square miles of coastal wetlands since 1932 and the loss continues at the rate of roughly one football field per hour (Campanella 2008). This loss can be attributed to the leveeing of the Mississippi River, cross-cutting of canals through marsh by oil and gas prospectors, sea level rise, subsidence, hurricanes, and invasive species (Campanella 2008). Orleans Parish and the greater New Orleans area has virtually been separated from the water surrounding it due to levees and pump stations. These measures are taken to protect economic assets and residences from flooding during storms but also prevent the Mississippi River from depositing sediment over the levee, a historical event which allowed for the creation of the river delta over the course of 7,000 years (Campanella 2008).

Self-organization is the foundation of resilience and can be hindered by excessive external subsidies (Carpenter et. al 2001). In the aftermath of Hurricane Katrina, the city of New Orleans did not exhibit the necessary self-organization and reliance on local systems to be considered resilient. Over 100,000 residents were not able to evacuate in advance of the storm despite a plan which had been honed by past hurricanes (Plyer et. al 2015). The most vulnerable populations were those without personal vehicular transportation. In the aftermath of the storm the city relied too heavily on state and federal resources which were delayed and disorganized in transit and execution when they arrived in New Orleans. It is clear the city did not succeed at any municipal or private level in self-organizing before or immediately after the storm.

Adaptive and organizational learning are among the most important of strategies needed to build resilience. An organization has three paths when faced with a crisis: learn no lessons from the crisis and risk repeating the same mistakes which led to the crisis, take steps to mitigate the

impact of the crisis and maintain a system as close to the normal state as possible, or adapt and react to the crisis in a way which builds resilience and allows for a proactive response during the next crisis event. In the case of the city of New Orleans, the approach taken to adaptive and organizational learning was one that targeted high-visibility variables while ignoring other low-visibility yet equally important ones, one such example being the constant attention paid to the levee systems while ignoring non-structural measures such as community organization and proactive planning and management strategies.

Organizational learning, or the capacity of an organization to create, retain, and disseminate information internally, is one of the most critical pathways to ensuring an organization can operate in the midst of any type of crisis, fast- or slow-burning. Organizations that do not develop this capacity cannot draw on the experience of past crisis management decisions and often repeat the same mistakes in their decision-making which lead to losses from a social or economic standpoint in previous crises. The importance of organizational learning cannot be understated, and if a modern organization is to succeed in the realm of crisis and disaster management these principles must be enacted to create a strong, sustainable culture able of withstanding internal and external shocks to the core competencies of the organization.

The review of these studies sheds light on the attributes and abilities of more resilient human communities. These studies point to the important role of socioeconomic resources in encouraging resilience. Thus, this analysis will include measures of socioeconomic vulnerability along with a measure of the exposure of the residents to the disruptive events of Hurricane Katrina.

This chapter reviewed several research studies that were used to inform the data selection and analysis process. The next chapter is an explanation of data analysis.

CHAPTER 3. DATA SELECTION

United States Postal Service (USPS) counts of residential addresses actively receiving mail in Orleans Parish annually from June 2005 – June 2015, socioeconomic variables based on the Resilience Inference Model (RIM) and Baseline Resilience Index for Communities (BRIC) analyses, and average flood depth by neighborhood were used to indicate and explain variations in recovery between neighborhoods in relation to Orleans Parish (Lam et al. 2015, Cutter et al. 2010). These variables were provided by the New Orleans Data Center (NODC) at the neighborhood level and include a combination of recovery, human/social, economic, and natural/physical elements. The variables selected were: Percentage of Mail Delivery to Active Residential Addresses from June 2005 – June 2015; Race: Percent black population; Female headed household with no husband present; Education: population 25 years and older with a bachelor's degree; Median household income; Number of owner occupied housing units; Median Rent; and Average Flood Depth.

The NODC dataset of active mail recipients takes into account variations in the data such as mail delivery to trailers, unoccupied housing units, and differences at the Census block and tract level by requesting data through the Valassis Residential and Business Database and checking the data against Department of Housing and Urban Development Aggregated USPS Administrative Data on Address Vacancies and USPS Delivery Statistics Product (Ortiz et al. 2011). Valassis uses a proprietary formula based on the USPS Computerized Delivery Sequence software to mimic active residential addresses receiving mail (Ortiz et al. 2011). The mail return rates used for this study are tabulated at June of every given year with the exception 2006 and 2007 due to the disruption in postal service after Hurricane Katrina. Seventy-two neighborhoods comprise the

NODC census of New Orleans neighborhoods. Table 1 shows the percent recovery in population by neighborhood, the dependent variable for this analysis.

Table 1 – Percent Change in Active Residential Addresses Receiving Mail (June 2005 – June 2015)

Neighborhood	% Recovery June 2005 - June 2015	Neighborhood	% Recovery June 2005 - June 2015
Central Business District	259.5%	Seventh Ward	91.2%
Fischer Development	136.0%	McDonogh	91.1%
Gert Town	116.9%	Gentilly Terrace	91.0%
Algiers Point	111.9%	Read Blvd East	90.8%
Lower Garden District	110.4%	Milan	90.4%
Black Pearl	104.9%	Navarre	89.7%
Marigny	104.6%	St. Claude	88.8%
Mid-City	103.4%	Little Woods	87.5%
Whitney	102.5%	Read Blvd West	87.5%
East Carrollton	101.9%	Broadmoor	86.8%
East Riverside	101.9%	Dillard	86.8%
French Quarter	101.7%	Freret	85.8%
Irish Channel	101.6%	Pines Village	84.4%
West Riverside	100.2%	Behrman	84.2%
Tulane/Gravier	100.2%	Hollygrove	81.8%
Fairgrounds	99.6%	Filmore	81.3%
Lake Terrace & Oaks	99.6%	West End	80.6%
Leonidas	99.4%	St. Roch	80.2%
Marlyville/Fontainebleau	99.3%	Lakeview	79.3%
Lakeshore/Lake Vista	99.1%	Treme'/Lafitte	78.5%
Uptown	98.4%	Milneburg	78.2%
Dixon	98.4%	Gentilly Woods	78.1%
Audubon	98.1%	Plum Orchard	75.6%
New Aurora/English Turn	98.1%	Holy Cross	74.6%
Central City	97.6%	St. Anthony	73.7%
Garden District	97.3%	Desire Dev & Neighborhood	70.9%

Neighborhood	% Recovery June 2005 - June 2015	Neighborhood	% Recovery June 2005 - June 2015
City Park	96.6%	Village de L'est	70.5%
Bywater	96.4%	Viavant/Venetian Isles	69.5%
Tall Timbers/Brechtel	96.4%	Lake Catherine	69.3%
Touro	95.9%	U.S. Naval Support Area	63.7%
Old Aurora	95.4%	St. Bernard Area	59.6%
Bayou St. John	93.3%	Florida Area	57.6%
Pontchartrain Park	92.7%	West Lake Forest	54.9%
Lakewood	92.5%	B.W. Cooper	45.6%
		Lower Ninth Ward	36.7%

In addition to the recovery variable based on mail delivery to active residential addresses, six other variables representing human/social, financial, and economic capital indicators were selected from the RIM and BRIC analyses. The RIM model uses exposure, damage, and recovery indicators to determine the vulnerability and adaptability of a location to a disturbance (Lam et al. 2015). RIM variables selected were female headed household with no husband present and median rent. BRIC is an empirically based resilience index which was developed to measure the overall resilience of a location. BRIC variables selected for analysis were percent black population, population 25 years and older with a bachelor's degree, median household income, and number of owner occupied housing units.

Average flood depth data was calculated using data provided by the City of New Orleans and joined using a neighborhood statistical area shapefile in ArcGIS. This data was used to calculate an average absolute flood depth in each neighborhood. Flood depths were recorded by property after Hurricane Katrina and converted into polygons with a value for absolute flood depth. The flood depths provided by the City of New Orleans are absolute flood depths, or depths that take

into account water depth and elevation changes. For example, if an area's elevation is four feet below sea level and the flood depth measures four feet, the absolute flood depth of the area would be eight feet. This absolute flood depth is the number used by the City of New Orleans and was used for this analysis for that reason. Flood data was augmented using high water marks provided by the Federal Emergency Management Agency (FEMA) in their document High Water Mark Collection for Hurricane Katrina in Louisiana (Federal Emergency Management Agency 2006). High water marks were recorded at certain addresses in selected neighborhoods and those points were overlaid on the flood map generated using the City of New Orleans data as a method of checking high water marks against mean absolute flood depths. The difference in flood depths can be explained by FEMA's use of mean elevation and the City of New Orleans not using flooding relative to mean sea level as a measurement.

Based on a percent recovery rate of active residential addresses receiving mail from 2005 to 2015, the neighborhoods which experienced the most mail recovery received little to no flooding damage during Katrina have experienced a usurper pattern of recovery led by the Central Business District, which has had a 259.5% increase in addresses actively receiving mail. Other neighborhoods with a similar pattern include Gert Town (116.9%), Algiers Point (111.9%), and Marigny (104.6%).

Six independent variables were selected from the related research as indicators of community resilience (Lam et al., 2015; Cutter et al. 2010) and the earlier study of New Orleans population return using mail delivery to active residential address data at the Census tract level (DeFrank, 2009). The variables for the analysis are show in Table 2.

Table 2 – Variables for Neighborhood Analysis

Capital	Variable	Source
Recovery	Percentage of Mail Delivery to Active Residential Addresses from June 2005 – June 2015	New Orleans Data Center
Human/Social	Race: Percent black population	2000 U.S. Census, 2010 U.S. Census
Human/Social	Female headed household with no husband present	2000 U.S. Census, 2010 U.S. Census
Human/Social	Education: population 25 years and older with a bachelor's degree	2000 U.S. Census, 2010 U.S. Census
Financial	Median household income	2000 U.S. Census, 2013 American Community Survey
Financial	Number of owner occupied housing units	2000 U.S. Census, 2013 American Community Survey
Financial	Median Rent	2013 American Community Survey
Physical/Natural	Average Flood Depth	City of New Orleans

This chapter has provided a description of the data and methods used in the analysis of New Orleans neighborhoods. The next chapter presents six case studies of New Orleans neighborhoods selected for their unique recovery indicators.

CHAPTER 4. CASE STUDIES

In the context of New Orleans, the neighborhood designation speaks to the city's community more than Census tracts or ZIP codes. Born out of a classification system which divided New Orleans into wards, each neighborhood in New Orleans has a distinct culture and history all its own. All neighborhoods experienced a significant decline in mail delivery after Hurricane Katrina. Six neighborhoods that experienced unique recovery patterns due to socioeconomic factors after Hurricane Katrina were the Central Business District (CBD), Marigny (MARG), Mid-City (MID), Village de L'Est (VILL), Lakeview (LAKE), and the Lower Ninth Ward (NINTH). Recovery patterns for these neighborhoods are illustrated in Figure 6.

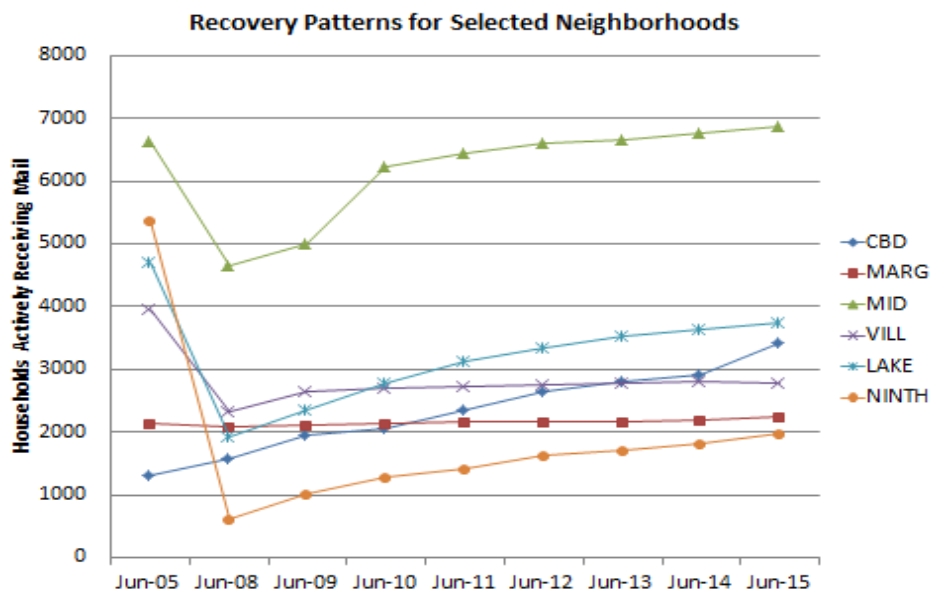


Figure 6: Recovery Patterns for Selected Neighborhoods

Many neighborhoods fall into different neighborhoods, but the NODC data parsing makes analysis more feasible and able to generate results. Table 3 shows the change in selected RIM

and BRIC variables in Orleans Parish. Please note average flood depth is not listed as it is only applicable on a neighborhood level.

Table 3 – Changes in Selected RIM and BRIC Variables in Orleans Parish

Orleans Parish		Change in Variables from 2000 - 2010
Recovery Rate (%)	89.2%	NA
% African-American (2000)	60.3%	-3.1%
% African-American (2010)	57.2%	
% Female-Headed Households (2000)	16.9%	-3.0%
% Female-Headed Households (2010)	13.9%	
% Population Over 25 With Bachelor's Degree (2000)	14.7%	3.2%
% Population Over 25 With Bachelor's Degree (2010)	17.9%	
Household Income in Dollars (2000)	\$61,859.27	\$ (2,845.18)
Household Income in Dollars (2010)	\$59,014.09	
% Owner-Occupied Housing Units (2000)	48.4%	0.8%
% Owner-Occupied Housing Units (2010)	49.3%	
Median Rent in Dollars (2013)	\$ 823.72	NA

As a whole, Orleans Parish advanced in resilience capital indicators with the exception of median household income. These variables are further explained with the introduction of six case studies.

a. Central Business District

The Central Business District, or CBD, is financial center of New Orleans. Built adjacent to the French Quarter across Canal Street, the CBD was once a neighborhood which was largely inhabited by American settlers who flocked to the area following the Louisiana Purchase of 1803. This demographic switch gave the CBD its first nickname: the American Sector (Campanella 2006, 2008). In the decades after the Louisiana Purchase the neighborhood expanded and by the 20th Century the CBD was considered the economic heart of New Orleans. Skyscrapers, high-rise buildings, and multipurpose venues such as the iconic Mercedes-Benz

(then Louisiana) Superdome were constructed and still stand today. The CBD has experienced widespread growth since Hurricane Katrina due to the revitalization of the Warehouse District and influx of young professionals into the city. The CBD was selected for case study due to its 259.5% recovery rate in mail delivery to active mailing addresses, 12.6% increase in Owner-Occupied Housing Units, and \$17,204.66 decline in household income during that time. Table 4 shows the statistics for the CBD.

Table 4 – Statistics for Central Business District

Central Business District		Change in Variables from 2000 - 2010
Recovery Rate (%)	259.5%	NA
% African-American (2000)	32.9%	-9.8%
% African-American (2010)	23.1%	
% Female-Headed Households (2000)	0.9%	0.2%
% Female-Headed Households (2010)	1.1%	
% Population Over 25 With Bachelor's Degree (2000)	25.4%	8.0%
% Population Over 25 With Bachelor's Degree (2010)	33.4%	
Household Income in Dollars (2000)	\$93,198.62	\$ (17,204.66)
Household Income in Dollars (2010)	\$75,993.96	
% Owner-Occupied Housing Units (2000)	23.2%	12.6%
% Owner-Occupied Housing Units (2010)	35.8%	
Median Rent in Dollars (2013)	\$ 977.88	NA
Average Flood Depth (in feet)	2.2	NA

In perhaps the most widely-shared story told of the hurricane, the then-Louisiana Superdome was damaged by wind and water as Hurricane Katrina made landfall. Much of the Superdome's white roof was sheared off by wind and over 20,000 residents were forced to spend the duration of the storm and up to a week after in the venue without air conditioning and electricity, which led to rapidly devolving sanitary and health conditions (Lewis 2015). The Superdome's roof and images of residents trying to leave New Orleans from the battered stadium became one of the

most identifiable symbols of the city after Hurricane Katrina. Every resident in the Superdome was evacuated to the Houston Astrodome by September 4, 2005 (Lewis 2015). Due to the hazards posed by human waste and storm damage from Katrina, the Superdome was forced to undergo a 336-million dollar cleaning and renovation as shown in Figure 7; and opened for its first event after Hurricane Katrina on September 25, 2006, when the New Orleans Saints defeated the Atlanta Falcons 23-3 in their first game back after being forced to move temporarily to San Antonio for the 2005 season (Lewis 2015). The now-Mercedes-Benz Superdome celebrated its fortieth anniversary in 2015.



Figure 7: Mercedes-Benz Superdome Following Hurricane Katrina and in September 2006
(Louisiana Recovery Authority 2008)

The CBD is unique in that it has been a catalyst for growth in New Orleans after Hurricane Katrina. The neighborhood experienced an average of 2.22 feet of flooding, but it was focused away from the natural levee at the Mississippi River where most of the tourist and business

interests in the city lie. This allowed the CBD to welcome visitors back relatively quickly while other parts of the city faced a longer recovery period. The CBD experienced 259% growth in mail delivery from 2005 to 2015 and many other key indicators of socioeconomic recovery have followed as well. Owner occupied housing units have increased from 23.2% in 2000 to 35.7% in 2010, but the average household income dropped from \$93,198 in 2000 to \$75,993 in 2010 and the percentage of female headed households increased from 0.9% to 1.1% though that increase is negligible. This trend is likely due to the influx of residents in the neighborhood as before Katrina the CBD was largely a commuter neighborhood. The CBD has also experienced development of the new residential “South Market District” around the Mercedes-Benz Superdome which has seen numerous apartment and condominium complexes built on Poydras Street in an effort to make downtown New Orleans more livable.

b. Marigny

The word “faubourg” from French roughly translates into suburb. The Marigny and Treme neighborhoods are often described together colloquially as “the Faubourg” or individually as “Faubourg Marigny” and “Faubourg Treme,” respectively. This area has seen an influx of transplants post-Katrina, described by Richard Campanella as YURPS, or Young Urban Rebuilding Professionals. YURPS are skilled, educated professionals who were drawn to the rebuilding of New Orleans as a personal cause or endeavor and settled into neighborhoods like Marigny, Treme, and Mid-City which had historic housing and were coterminous to each other. Over the course of recovery these neighborhoods became more affluent and natives who did not own their houses were often being priced out. This trend has led to oft-contentious relationships between the new residents and older natives about the course of their neighborhood and the issue

of culture. Marigny was selected due to its \$14,295.29 increase in household income, 5.0% decrease in African-American population, and negligible flooding in the neighborhood. These indicators point to an increase in affluence and influence of YURPS in the neighborhood. Statistics for the Marigny are presented in Table 5 below.

Table 5 – Statistics for Marigny

Marigny		Change in Variables from 2000 - 2010
Recovery Rate (%)	104.6%	NA
% African-American (2000)	17.7%	-5.0%
% African-American (2010)	12.7%	
% Female-Headed Households (2000)	3.0%	-1.6%
% Female-Headed Households (2010)	1.4%	
% Population Over 25 With Bachelor's Degree (2000)	18.8%	4.9%
% Population Over 25 With Bachelor's Degree (2010)	23.7%	
Household Income in Dollars (2000)	\$49,283.97	\$ 14,295.29
Household Income in Dollars (2010)	\$63,579.26	
% Owner-Occupied Housing Units (2000)	32.9%	3.4%
% Owner-Occupied Housing Units (2010)	36.3%	
Median Rent in Dollars (2013)	\$ 777.70	NA
Average Flood Depth (in feet)	0.02	NA

The Marigny Neighborhood is located in between the French Quarter and Bywater neighborhoods travelling on the Mississippi River due north. Once a plantation, the land was sold by owner Bernard Marigny de Mandeville to create New Orleans' first suburb (Campanella 2008). Incidentally, de Mandeville also owned land which became St. Bernard Parish and the city of Mandeville, lending his name to three areas in greater New Orleans. The Marigny grew through the reunification of New Orleans in 1851 into a multi-ethnic neighborhood due to de Mandeville selling lots to whoever would be willing to buy (Campanella 2008). The area became

industrialized and property valued dropped severely from the turn of the century to World War II. The gentrification process of reclaiming the neighborhood started in the 1970s and continues to this day. The Marigny received negligible flooding from Katrina and today, along with the Bywater, is among the most desirable neighborhoods to live in for young professionals and families (Campanella 2008). Despite this growth the neighborhood has become a flashpoint for many issues plaguing the city since Katrina, the primary concern of natives being gentrification. A map of post-Katrina gentrification hot spots is listed as Figure 8 below.

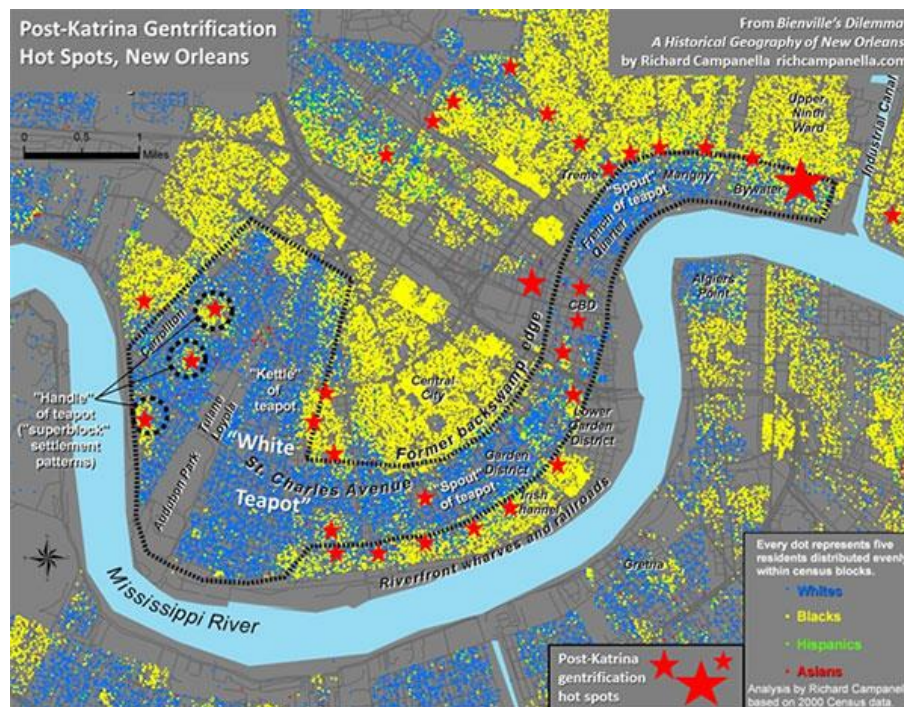


Figure 8: Hot Spots (Marked With Red Stars) of Post-Katrina Gentrification in New Orleans, Shown With Circa-2000 Demographic Data and a Delineation of the “White Teapot” (Campanella 2008)

The Marigny has also seen tangible growth after Hurricane Katrina. Mail delivery rates to active residential addresses placed population recovery at 104% from 2005 to 2015.

c. Mid-City

Mid-City was once considered back of the town, or “backatown” in local dialect; the back end of the natural Mississippi River levee which kept the Vieux Carre elevated above sea level. This meant the neighborhood, built along the New Basin Canal, was largely uninhabitable until 1913 when the invention of the screw pump made it possible to drain parts of the city under sea level. Mid-City is considered the “heart” of New Orleans both geographically and culturally, with little tourist value and a host of local associations and neighborhood shops. While Mid-City was swamp for the early part of New Orleans’ history, the adjacent neighborhoods build on the higher Esplanade Ridge bordering Bayou St. John were home to multi-million dollar Creole homes. Mid-City was flooded during Hurricane Katrina, but not to the extent of other neighborhoods near to it because of the Esplanade Ridge and proximity to the levee breaks in Lakeview.

Mid-City has seen a similar growth pattern to the Marigny after Katrina despite high absolute flood depths, mainly due to the geography of Mid-City being at the back end of the Mississippi River Levee and in the middle of New Orleans’ “bowl” as seen in Figure 4. Mid-City was selected for case study due to its recovery rate based on mail delivery to active residential addresses of 103% despite the neighborhood’s absolute flood depth average of 9.7 feet. FEMA high water marks in the neighborhood include 2913 Gravier Street which measured 2.6 feet; the Lafitte Greenway, which measured 2.4 feet; and 3005 St. Philip Street, which recorded a high water mark of 2.4 feet. The flood depths surveyed by the City of New Orleans data measure

10.9, 10.29, and 10.5 feet for these points respectively. These discrepancies can be traced to the City of New Orleans' use of absolute flood depths, which does not use mean sea level as a basis for measurement. The statistics for Mid-City are shown in Table 6 below.

Table 6: Statistics for Mid-City

Mid-City		Change in Variables from 2000 - 2010
Recovery Rate (%)	103.4%	NA
% African-American (2000)	64.3%	-9.3%
% African-American (2010)	55.0%	
% Female-Headed Households (2000)	15.9%	-1.3%
% Female-Headed Households (2010)	14.6%	
% Population Over 25 With Bachelor's Degree (2000)	7.2%	5.8%
% Population Over 25 With Bachelor's Degree (2010)	13.0%	
Household Income in Dollars (2000)	\$43,327.91	\$ (4,438.61)
Household Income in Dollars (2010)	\$38,889.30	
% Owner-Occupied Housing Units (2000)	27.9%	-3.9%
% Owner-Occupied Housing Units (2010)	24.0%	
Median Rent in Dollars (2013)	\$ 774.74	NA
Average Flood Depth (in feet)	9.7	NA

Household income dropped from \$43,327 in 2000 to \$38,889 in 2010 and owner-occupied housing decreased from 27.9% to 24%. One possible explanation for the fluctuation in numbers is the increase in non-English speaking residents in the community after Katrina. The Hispanic community in Mid-City increased from 10% percent of the total population of the neighborhood in 2000 to 15.2% in 2010. Many of these families moved to New Orleans post-Katrina to aid in the cleaning and re-construction of the city, and stayed in Mid-City due to the affordability of housing. Many chose to stay, leading to a population increase in Orleans and surrounding parishes. The jobs taken by Hispanic workers were generally low-wage and may have contributed to the increased vulnerability metrics in the neighborhood.

d. Village de L'Est

The neighborhood of Village de L'Est is one of the most unique neighborhoods in New Orleans. In its present form, the neighborhood is the result of Vietnamese Catholics who fled the communist government of Ho Chi Minh in 1975 (Leong et al. 2007). This diaspora was resettled into the Versailles Arms apartments in New Orleans East and more Vietnamese immigrants followed. The neighborhood grew into a multiethnic enclave with Vietnamese, existing African-American families, and Central American workers living in a sparsely populated area of New Orleans East (Leong et al. 2007). The unique characteristic of this Village de L'Est and the reason it was selected for case study arrives from its post-Katrina return of Vietnamese, who created a resilient community strong in the three key characteristics of resilience: the amount of change a system can experience and still maintain the same controls and/or function; the degree to which a system can self-organize; and the system's ability to build and increase its capacity for adaptation and learning (Carpenter et al. 2001, Holling 1973 and 1996).

The "Vietnamese Versailles community" as they were referred to post-Katrina have withstood multiple changes in their community from the influx of Central American populations to rising housing prices and have maintained the same level of function, are self-organized around the Mary Queen of Vietnam Catholic Church which serves as a meeting place and rallying point for the community, and have actively engaged in stakeholder participation as a method for learning and adapting to changing political and ecological systems (Leong et al. 2007). Despite the media attention garnered from the resilient adaptation of residents of Village de L'Est, community leaders have made sure to note the need for top-down funding from the state and federal

government, and the challenges the community would have faced without it. The statistics for Village de L'Est are shown in Table 7 below.

Table 7: Statistics for Village de L'Est

Village de L'Est		Change in Variables from 2000 - 2010
Recovery Rate (%)	70.5%	NA
% African-American (2000)	55.4%	- 12.0%
% African-American (2010)	43.4%	
% Female-Headed Households (2000)	24.2%	- 7.6%
% Female-Headed Households (2010)	16.6%	
% Population Over 25 With Bachelor's Degree (2000)	9.2%	- 1.0%
% Population Over 25 With Bachelor's Degree (2010)	8.2%	
Household Income in Dollars (2000)	\$50,788.68	\$ (9,862.51)
Household Income in Dollars (2010)	\$40,926.17	
% Owner-Occupied Housing Units (2000)	47.1%	16.5%
% Owner-Occupied Housing Units (2010)	63.6%	
Median Rent in Dollars (2013)	\$ 636.40	NA
Average Flood Depth (in feet)	3.5	NA

The majority of homes in the Village de L'Est neighborhood were flooded with 2-4 feet of water based on absolute flood depth, but the immediate aftermath of the storm saw over 90 percent of the Vietnamese population return. No FEMA high water marks were recorded in Village de L'Est, but points around the neighborhood serve as proxy for flooding depths in the neighborhood as indicated by FEMA high water marks at 6391 Eastover Drive which measured - 1.4 feet; Fernley Drive, which measured -1.1 feet; and 13414 Old Gentilly Drive, which recorded a high water mark of 2.0 feet (Federal Emergency Management Agency 2006). All proxy addresses were located in the adjacent neighborhood of Read Boulevard East. The flood depths surveyed by the City of New Orleans data measure 13.5, 12.8, and 13.9 feet for these points respectively. These discrepancies can be traced to the City of New Orleans' use of absolute flood

depths in their measurement, which does not use mean sea level as a basis for measurement.

African-Americans who shared apartment complexes with the Vietnamese only returned at a rate of 50 percent due to rising rent prices which had begun driving many African-American tenants out before Katrina (Leong et al. 2007). The aggregate of these population returns saw Village de L'est return 70.5 percent of its pre-Katrina population, the majority of this population being Vietnamese.

e. Lakeview

Lakeview was one of the most impacted neighborhoods in the aftermath of Hurricane Katrina.

The failure of the 17th Street Canal levee to the west inundated the neighborhood with floodwaters reaching up to an average absolute depth of sixteen feet. No FEMA high water marks were recorded in Lakeview proper, but points around the neighborhood serve as proxy for flooding depths in the neighborhood as indicated by FEMA high water mark 5590 Canal Boulevard, in the Navarre neighborhood, which measured 2.4 feet; 720 Gem Street, in the Lakeshore-Lake Vista neighborhood which measured 2.4 feet; and on Marconi Drive, in Navarre which recorded a high water mark of 0.7 feet (Federal Emergency Management Agency 2006). The flood depths surveyed by the City of New Orleans data measure 10.5, 13.87, and 13.88 feet for these points respectively. These discrepancies can be traced to the City of New Orleans' use of absolute flood depths in their measurement, which does not use mean sea level as a basis for measurement.

Lakeview is an affluent neighborhood with an average rent of more than 442 dollars above the average for Orleans Parish and an average household income of 97,926 dollars, over 37,000 dollars higher than the Orleans Parish average. Only 5.4% of residents in Lakeview live in

poverty as opposed to 27.9% in Orleans Parish. Only 73.9% of residents returned to Lakeview after Hurricane Katrina despite Lakeview being one of the most affluent neighborhoods in the Parish, ranked tenth in household income out of seventy-two neighborhoods based on 2010 Census Data which is why it was selected for case study. Surrounding neighborhoods Lakeshore/Lake Vista and Lakewood also ranked fifth and first, respectively. Financial capital has allowed these neighborhoods to rebound quicker as residents collected insurance settlements that allowed them to begin the rebuilding more quickly. Lakeview, Lakeshore/Lake Vista, and Lakewood also rank in the top eleven in both percentage of residents with a bachelor's degree and owner-occupied housing units, which infer educated residents who were able to purchase insurance for their homes and not just rely on Louisiana Road Home money and the bureaucratic problems which followed it. The statistics for Lakeview are shown below in Table 8.

Table 8: Statistics for Lakeview

Lakeview		Change in Variables from 2000 - 2010
Recovery Rate (%)	79.3%	NA
% African-American (2000)	0.7%	2.7%
% African-American (2010)	3.4%	
% Female-Headed Households (2000)	5.4%	-0.3%
% Female-Headed Households (2010)	5.1%	
% Population Over 25 With Bachelor's Degree (2000)	28.6%	11.1%
% Population Over 25 With Bachelor's Degree (2010)	39.7%	
Household Income in Dollars (2000)	\$88,170.92	\$ 9,755.25
Household Income in Dollars (2010)	\$97,926.18	
% Owner-Occupied Housing Units (2000)	69.5%	-0.7%
% Owner-Occupied Housing Units (2010)	68.8%	
Median Rent in Dollars (2013)	\$ 1,223.58	NA
Average Flood Depth (in feet)	15.8	NA

The Lakeview neighborhood is located on the southshore of Lake Pontchartrain. It is bordered by Lakeshore/Lake Vista to the north, City Park to the east, Navarro to the south, and West End and Lakewood to the west. Lakeview and its surrounding neighborhoods were largely undeveloped swampland until after World War II, when expansion to the suburbs such as Metairie and Kenner became the norm of life in New Orleans.

f. Lower Ninth Ward

The reason for selected the Lower Ninth Ward for case study was that the neighborhood became the face of Hurricane Katrina for much of the world after media outlets reported multiple breaches in the Industrial Canal levee and the failure of floodwalls bordering MRGO, the combination of which flooded the Lower Ninth Ward. The Lower Ninth Ward is one of the poorest neighborhoods in Orleans Parish, ranking fifty-sixth in mean household income at \$33,557, twenty-seventh in female-only headed households at 18.7%. In contrast to these numbers, however, is that the Lower Ninth Ward ranks twelfth in owner-occupied housing at 66.4%. This number can be explained by the widespread existence of multigenerational housing in the neighborhood. A large number of families live in houses which have been passed down from generation to generation. This arrangement allows lower-income families to live free of rent in the same neighborhood for decades and also contributes to a stronger sense of community, an aspect for which the Lower Ninth Ward has been celebrated.

The flood data used for this analysis shows the average flood depth at twelve feet for the Lower Ninth Ward, but many residences that flooded at an equal or higher depth in the north part of the neighborhood were not accounted for during the City of New Orleans' Phase I and II labeling of flood depths. In actuality, the flood depth in the Lower Ninth Ward was much higher as indicated

by FEMA high water mark at 1616 Caffin Street, which measured 19.0 feet; 1833 Tricou Street, which measured 13.0 feet; and 1724 Esteban Street, across the St. Bernard Parish line but still may serve as a proxy for the Lower Ninth Ward, with recorded a high water mark of 11.0 feet (Federal Emergency Management Agency 2006). All depths provided by the City of New Orleans for these locations averaged 10 feet. Much like the scene at the then-Louisiana Superdome, images of residents who could not afford to evacuate signaling for help from their rooftops became enduring pieces of Katrina media coverage. The statistics for the Lower Ninth Ward are shown below in Table 9.

Table 9: Statistics for Lower Ninth Ward

Lower Ninth Ward		Change in Variables from 2000 - 2010
Recovery Rate (%)	36.7%	NA
% African-American (2000)	98.3%	-2.8%
% African-American (2010)	95.5%	
% Female-Headed Households (2000)	24.9%	-6.2%
% Female-Headed Households (2010)	18.7%	
% Population Over 25 With Bachelor's Degree (2000)	4.7%	-0.7%
% Population Over 25 With Bachelor's Degree (2010)	3.9%	
Household Income in Dollars (2000)	\$37,894.10	\$ (4,336.73)
Household Income in Dollars (2010)	\$33,557.37	
% Owner-Occupied Housing Units (2000)	59.0%	7.4%
% Owner-Occupied Housing Units (2010)	66.4%	
Median Rent in Dollars (2013)	\$ 591.55	NA
Average Flood Depth (in feet)	12.0	NA

This chapter has presented six case studies of New Orleans neighborhoods. The next chapter includes the discussion of the analysis and case studies, suggestions for future research, and a summary of findings.

CHAPTER 6. DISCUSSION AND CONCLUSIONS

In the weeks and months after Hurricane Katrina there was a fear that New Orleans as America knew it would cease to exist. Outwardly a destination for revelry, featuring hot trumpets and loose morals, New Orleans was reduced to the largest insurance claim in history with over \$76 billion in federal funding spent in Louisiana after the storm. However, the recovery effort spurred a renaissance that buoyed the city through the recessions of 2008 and 2010, and new transplants who worked in every sector from construction to finance injected energy, vigor, and most importantly money into the local economy. Roughly ten years after the storm Orleans Parish has recovered 89.2% of its population based on using mail delivery as an indicator, 12.1% of that in the last five years, and metrics shows stable growth which will allow the parish to reach 100% of its pre-Katrina population based on indicators before the twentieth anniversary of Hurricane Katrina. The use of 2010 Census variables in the analysis compared against recovery indicators in 2015 presents a slight incongruence in the data, but the 12.1% growth in mail delivery to residential addresses shows that the area is still experiencing growth after the hurricane, even if it will be another five years before an official census is conducted.

As rosy a picture the overall metrics of recovery paint for New Orleans, the actual portrait is much more uneven. Neighborhoods that received the most water have taken the longest to recover. While this may seem obvious, the struggle for normality crosses racial and economic boundaries. Lakeview is one of the most affluent neighborhoods in the city, but ranks in the twenty-third percentile of recovering neighborhoods. The Lower Ninth Ward ranks dead last in recovery by population, and is also one of the poorest neighborhoods in the city. These two

neighborhoods linked by nothing more than a nine to eleven foot high cascade of water explain how recovery, like many things in New Orleans, transcends all boundaries.

Primary among lessons learned after Katrina was the need to manage the relationship between land and water better. Katrina's floodwaters did not discriminate in depth and extent of flooding, and maybe the city should not either. However, when the complex tapestry that is the neighborhood ethos in New Orleans is laid over the land itself the question becomes impossibly complex. New Orleans' traditions and stubbornness seem to predate the city itself, a location at the mercy of then-yearly flooding by the Mississippi River and hurricanes which arrived like cathartic clockwork to clean the nascent city out before the Fall arrived. Out of this persistent survival grew the Wards of New Orleans, first on the levee where high ground preordained survival and then further back to Lake Ponchartrain as technology fought Mother Nature. Faubourgs gave way to backatown and ultimately baby boomers; and the names stuck. Those living in their neighborhoods knew their lot in life from their traditions: Catholic schools, block parties, second lines, even down to how amalgamated was their accent. To tell a New Orleanian they must move out of the neighborhood which has served as de facto mother, family, and nest is to tell a New Orleanian they cannot watch the Saints on Sunday or stand on their block for Endymion. Simply put, it is the worst form of offense.

This ethos which has pervaded in the city for centuries is perhaps the most limiting factor of successful land management in the city. New Orleans has grown unsustainable in preventing damage from hurricanes. Hurricane Katrina's flooding profile matches that of Hurricanes Betsy and Camille and even that of Sauvé's Crevasse, a flood caused by a break in the Mississippi

River Levee in 1849. The most widely known brass band in New Orleans folklore is Rebirth, and for good reason. New Orleanians are well-versed in the art of rising from the water. While the U.S. Army Corps of Engineers has finished the first portion of their hurricane protection system for New Orleans, the West Bank and Vicinity Levee; two other systems on the Eastbank of New Orleans: Lake Pontchartrain and Vicinity and New Orleans to Venice have yet to be completed. The trio of protection projects were awarded in 1965 and the combined project cost has ballooned to over \$765 million over fifty years of NEPA review and bureaucratic snags.

Compounding the issue is wetland loss along the Louisiana coast, at a rate of almost sixteen square miles a year. A total of 2.7 miles of wetlands absorbs one foot of storm surge and current rate of loss leaves New Orleans extremely vulnerable to another storm similar to Katrina, whose eleven to nineteen foot surge overtopped levees along MRGO and the Industrial Canal levee and contributed to the catastrophic flooding of the Lower Ninth Ward (DeFrank 2009). Funding for the Louisiana State Coastal Master Plan whose main goal is to combat and reverse the land loss trend is currently lacking, even with over \$18.7 billion in fines paid for by British Petroleum as the result of a 2010 oil spill in the Gulf of Mexico (BP Press Office 2015). Without proper planning and resource management, New Orleans and its environs are set to become a peninsula, separated from the mainland only by an elevated roadway and a yet-to-be completed levee system.

a. Suggestions for Future Research

The single most daunting task in researching an event more than a decade after its impact is the availability of data related to said impact. Multiple servers were sunset prior to the tenth anniversary of Katrina and this made it near impossible to find significant data with which to run

an analysis. The New Orleans Data Center was by far the best source for socioeconomic and mail delivery data to active residential address, but there are substantial limitations as to what academics could and could not use as the NODC restricts data availability to individuals and organizations other than registered non-academic non-profit agencies.

Another issue which arose in data sourcing was the availability of flood depth data and the measurements taken by differing agencies. The flood depth data for this analysis was obtained from the City of New Orleans and was provided in absolute flood depth, which provides a sum of water depth plus elevation changes in its measurement. This absolute measurement differs from other sources of flood depth data such as FEMA, the Department of Housing and Urban Development, and Louisiana State University, whose data used methods including point data taken in the field after Katrina and LIDAR. The City of New Orleans did not release how the absolute measurements were taken nor was there available metadata that could be traced to the files provided. The flood depth data was obtained through public records request and was provided on good faith from the city. This data was considered a primary source due to the agencies which provided the data and therefore was used in the analysis for that reason. This data was also checked against FEMA high water marks which take factors such as elevation into account.

A future study could perhaps expand this analysis to adjacent parishes and compare the means of analysis using 2010 Census variables. The City of New Orleans may be coterminous to Orleans Parish, but New Orleans is very much a commuter city. Expanding a study to Jefferson, St. Bernard, and Plaquemines Parish would shed a light on the region's vitality as a whole ten years

after the storm, important because St. Bernard and Plaquemines Parish arguably suffered equal or greater scaled damage from Katrina. However, this study would remove the sub-group analysis of neighborhoods from the scope because neighborhoods are not as well-defined in the largely suburban parishes bordering Orleans Parish. In fact, many of these neighborhoods bleed into Orleans Parish, with West End and Metairie considered an extension of Lakeview and St. Bernard a continuation of sorts from the Ninth Ward.

Where earlier studies could not predict how New Orleans would grow after so devastating a blow to the region, it is now known that the city is experiencing stable growth and will return to or exceed pre-Katrina populations with an increased quality of life for its residents. The scope of projects in the city range from culinary to recreational to industrial and all have a positive impact on the post-Katrina New Orleans. Further and constant analyses are required of the city and its environs, much like a heart attack patient who is preparing to run a marathon: the recovery may have been near-miraculous and exceeded all expectations, but it is still in the best interest of all parties to be as prudent as possible when examining and predicting adverse effects that may crop up in the future.

b. Summary of Findings

Ten years after Hurricane Katrina the majority of indices show New Orleans close to recovering 100% of its pre-Katrina population based on indicators, though the recovery patterns have been uneven and skewed toward upwardly mobile neighborhoods which experienced negligible flood damage. This knowledge can be used to better predict and prepare vulnerable neighborhoods for flooding risks.

New Orleans remains a city to be watched as it is one of a handful in the country to experience a catastrophic natural disaster and be repopulated in the 21st Century. The union of social, economic, and natural systems will determine the viability of the city in the decades to come, even as questions surrounding political, infrastructure, and ecosystem capital continue to persist. Despite these continuing questions as the second decade of recovery begins, New Orleanians continue to live by the credo set forth by former Times-Picayune writer Chris Rose, "...as bad as it is here, it's better than being somewhere else."

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APPENDIX A: MAIL DELIVERY DATA TO ACTIVE RESIDENTIAL ADDRESSES BY NEIGHBORHOOD

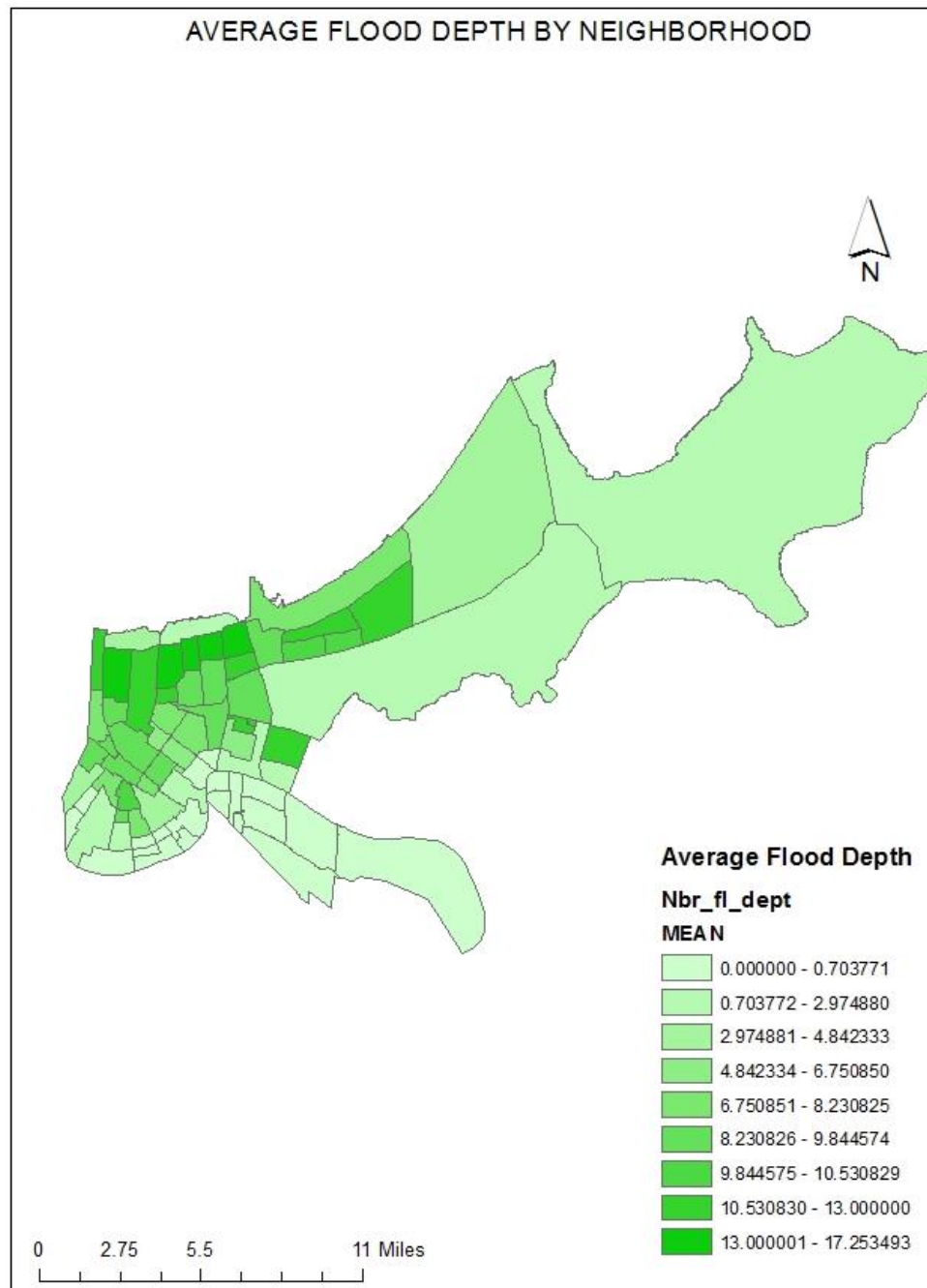
Neighborhood	Jun-05	Jun-08	Jun-09	Jun-10	Jun-11	Jun-12	Jun-13	Jun-14	Jun-15	Change June 2010-	% Recovery June 2015
Algiers Point	1,322	1,351	1,417	1,429	1,395	1,402	1,406	1,464	1,479	3.5%	111.9%
Audubon	7,576	7,344	7,292	7,319	7,388	7,390	7,386	7,424	7,433	1.6%	98.1%
B.W. Cooper	1,269	357	345	379	382	411	619	446	579	52.8%	45.6%
Bayou St. John	2,292	1,921	1,976	2,027	2,027	2,077	2,118	2,133	2,139	5.5%	93.3%
Behrman	3,878	3,697	3,832	3,670	3,341	3,294	3,316	3,257	3,265	-11.0%	84.2%
Black Pearl	1,115	1,107	1,082	1,082	1,110	1,123	1,126	1,154	1,170	8.1%	104.9%
Broadmoor	3,139	2,551	2,324	2,378	2,469	2,534	2,610	2,671	2,725	14.6%	86.8%
Bywater	2,570	2,091	2,165	2,181	2,208	2,324	2,372	2,414	2,478	13.6%	96.4%
Central Business District	1,316	1,585	1,939	2,060	2,357	2,635	2,799	2,917	3,415	65.8%	259.5%
Central City	8,175	6,405	6,233	6,417	7,062	7,322	7,517	7,725	7,980	24.4%	97.6%
City Park	1,670	1,534	1,585	1,600	1,632	1,645	1,645	1,651	1,613	0.8%	96.6%
Desire Dev & Neighborhood	1,555	565	660	812	1,020	1,053	1,073	1,085	1,102	35.7%	70.9%
Dillard	2,608	1,728	1,767	2,040	2,354	2,349	2,408	2,309	2,264	11.0%	86.8%
Dixon	631	453	529	565	598	615	621	604	621	9.9%	98.4%
East Carrollton	2,286	2,275	2,276	2,244	2,282	2,297	2,312	2,326	2,330	3.8%	101.9%
East Riverside	1,539	1,601	1,472	1,474	1,509	1,533	1,539	1,562	1,568	6.4%	101.9%
Fairgrounds	3,091	2,843	2,919	3,000	3,001	3,025	3,044	3,072	3,079	2.6%	99.6%
Filmore	2,831	1,345	1,480	1,686	2,033	2,096	2,144	2,238	2,302	36.5%	81.3%
Fischer Development	300	294	291	292	328	405	401	412	408	39.7%	136.0%
Florida Area	1,351	457	523	614	642	697	719	740	778	26.7%	57.6%
Florida Development	460	1	2	2	2	3	3	3	4	100.0%	0.9%
French Quarter	4,106	3,917	3,936	3,888	3,984	4,030	4,053	4,144	4,176	7.4%	101.7%
Freret	1,014	671	789	839	865	879	885	892	870	3.7%	85.8%
Garden District	1,216	1,192	1,192	1,179	1,182	1,192	1,191	1,171	1,183	0.3%	97.3%
Gentilly Terrace	4,417	3,380	3,589	3,745	3,939	3,999	4,042	4,085	4,018	7.3%	91.0%
Gentilly Woods	1,512	764	906	979	1,092	1,137	1,149	1,166	1,181	20.6%	78.1%
Gert Town	1,513	1,411	1,547	1,545	1,597	1,719	1,742	1,743	1,768	14.4%	116.9%
Hollygrove	2,751	1,772	1,889	1,995	2,122	2,244	2,282	2,204	2,250	12.8%	81.8%
Holy Cross	2,240	774	1,061	1,226	1,426	1,522	1,562	1,619	1,672	36.4%	74.6%
Iberville Development	830	815	801	646	593	658	651	649	1	-99.8%	0.1%
Irish Channel	1,973	2,002	1,913	1,907	1,940	1,969	1,983	1,991	2,004	5.1%	101.6%
Lake Catherine	733	420	420	439	451	491	498	506	508	15.7%	69.3%
Lake Terrace & Oaks	688	653	657	675	678	684	685	690	685	1.5%	99.6%
Lakeshore/Lake Vista	1,608	1,424	1,482	1,495	1,572	1,554	1,571	1,592	1,593	6.6%	99.1%

Lakeview	4,711	1,912	2,358	2,774	3,133	3,337	3,516	3,636	3,734	34.6%	79.3%
Lakewood	786	590	593	624	670	696	711	720	727	16.5%	92.5%
Leonidas	3,726	3,521	3,485	3,288	3,425	3,494	3,610	3,664	3,705	12.7%	99.4%
Little Woods	16,504	8,907	11,385	12,751	13,743	14,066	14,146	14,267	14,448	13.3%	87.5%
Lower Garden District	4,406	4,073	4,295	4,542	4,656	4,670	4,721	4,796	4,863	7.1%	110.4%
Lower Ninth Ward	5,363	601	1,017	1,271	1,417	1,624	1,697	1,826	1,970	55.0%	36.7%
Marigny	2,133	2,079	2,119	2,128	2,150	2,167	2,160	2,177	2,232	4.9%	104.6%
Marlyville/Fontainebleau	3,010	2,706	2,752	2,792	2,866	2,939	2,959	2,968	2,989	7.1%	99.3%
McDonogh	1,270	1,323	1,281	1,279	1,202	1,222	1,227	1,234	1,157	-9.5%	91.1%
Mid-City	6,634	4,652	4,998	6,217	6,442	6,606	6,667	6,765	6,858	10.3%	103.4%
Milan	3,452	2,720	2,718	2,835	2,959	3,016	3,061	3,122	3,119	10.0%	90.4%
Milneburg	2,273	1,008	1,342	1,450	1,556	1,648	1,691	1,734	1,777	22.6%	78.2%
Navarre	1,528	972	1,153	1,210	1,296	1,317	1,342	1,359	1,370	13.2%	89.7%
New Aurora/English Turn	2,127	2,198	2,123	2,096	2,180	2,187	2,200	2,211	2,086	-0.5%	98.1%
Old Aurora	6,241	6,215	6,187	6,131	6,243	6,227	6,230	6,221	5,951	-2.9%	95.4%
Pines Village	1,864	862	1,161	1,189	1,357	1,495	1,499	1,532	1,573	32.3%	84.4%
Plum Orchard	2,488	1,210	1,407	1,517	1,708	1,778	1,805	1,850	1,882	24.1%	75.6%
Pontchartrain Park	1,024	389	507	566	871	913	910	928	949	67.7%	92.7%
Read Blvd East	3,099	2,162	2,307	2,493	2,635	2,693	2,722	2,752	2,814	12.9%	90.8%
Read Blvd West	2,107	1,104	1,275	1,430	1,689	1,767	1,783	1,823	1,843	28.9%	87.5%
Seventh Ward	6,470	4,665	4,939	5,116	5,481	5,654	5,717	5,769	5,901	15.3%	91.2%
St. Anthony	2,450	1,088	1,395	1,510	1,682	1,728	1,757	1,748	1,806	19.6%	73.7%
St. Bernard Area	1,936	446	420	467	941	1,007	1,058	1,133	1,154	147.1%	59.6%
St. Claude	4,490	2,957	3,276	3,454	3,508	3,651	3,732	3,901	3,986	15.4%	88.8%
St. Roch	4,735	2,804	3,105	3,255	3,277	3,417	3,519	3,617	3,799	16.7%	80.2%
St. Thomas Development	386	627	862	1,091	1,123	1,132	1,136	1,150	1,174	7.6%	304.1%
Tall Timbers/Brechtel	5,504	4,679	4,710	4,811	5,238	5,252	5,232	5,250	5,304	10.2%	96.4%
Touro	1,829	1,803	1,752	1,761	1,741	1,764	1,762	1,766	1,754	-0.4%	95.9%
Treme'/Lafitte	3,556	2,520	2,291	2,247	2,454	2,550	2,631	2,686	2,792	24.3%	78.5%
Tulane/Gravier	1,830	1,215	1,237	1,684	1,590	1,621	1,719	1,770	1,833	8.8%	100.2%
U.S. Naval Support Area	1,404	1,106	1,041	1,016	1,074	884	862	889	895	-11.9%	63.7%
Uptown	3,329	3,274	3,202	3,201	3,278	3,303	3,315	3,267	3,277	2.4%	98.4%
Viavant/Venetian Isles	616	383	328	380	415	428	434	440	428	12.6%	69.5%
Village de l'est	3,948	2,322	2,642	2,701	2,726	2,763	2,775	2,799	2,783	3.0%	70.5%
West End	2,711	1,218	1,511	1,702	1,850	1,937	2,031	2,104	2,185	28.4%	80.6%
West Lake Forest	3,822	1,276	1,399	1,570	1,681	1,755	2,043	2,061	2,100	33.8%	54.9%
West Riverside	2,838	2,864	2,720	2,706	2,756	2,791	2,795	2,839	2,844	5.1%	100.2%
Whitney	1,006	1,007	995	1,009	994	999	1,008	1,026	1,031	2.2%	102.5%
Unknown (could not be geocoded)	276	16	13	22	19	19	27	29	32	45.5%	11.6%
Total	203,457	146,174	154,592	162,115	170,607	174,825	177,682	179,888	181,766	12.1%	89.3%

APPENDIX B: SOCIOECONOMIC VARIABLES FOR NEIGHBORHOODS

Neighborhood	% Recovery June 2015	RACEBLK00	RACEBLK10	FEMHH00	FEMHH10	POPBCH00	POPBCH10	HHINC00	HHINC10	OOHOU00	OOHOU10	MEDRENT	AVGFLD
Central Business District	259.5%	0.3290	0.2311	0.0090	0.0111	0.2545	0.3342	93198.6182	75993.9582	0.2320	0.3579	977.8813	2.2204
Fischer Development	136.0%	0.9920	0.9741	0.6330	0.3755	0.0194	0.0828	17790.4172	23700.3497	0.1210	0.1561	332.8829	0.0000
Gert Town	116.9%	0.9450	0.8760	0.1950	0.1849	0.0458	0.0615	31260.2543	25011.3328	0.2420	0.2491	771.0989	9.1932
Algiers Point	111.9%	0.2510	0.2248	0.0770	0.0708	0.1739	0.1831	72285.8879	84864.5057	0.4800	0.4662	838.9344	0.0000
Lower Garden District	110.4%	0.3420	0.1892	0.0680	0.0310	0.2422	0.3509	78520.3436	103239.9673	0.2480	0.3086	1019.0595	0.0001
Black Pearl	104.9%	0.3670	0.2151	0.0680	0.0438	0.2585	0.3103	59420.5716	58712.0000	0.3810	0.4103	903.1423	0.0000
Marigny	104.6%	0.1770	0.1271	0.0300	0.0144	0.1882	0.2368	49283.9705	63579.2560	0.3290	0.3626	777.7000	0.0175
Mid-City	103.4%	0.6430	0.5498	0.1590	0.1457	0.0722	0.1301	43327.9105	38889.2973	0.2790	0.2398	774.7446	9.7176
Whitney	102.5%	0.8500	0.8338	0.2730	0.2119	0.0661	0.0885	46320.4525	42929.3779	0.5040	0.4490	787.1391	0.0000
East Carrollton	101.9%	0.3150	0.1966	0.0770	0.0537	0.2944	0.3006	82106.2174	71843.2059	0.3920	0.3911	937.8601	0.7038
East Riverside	101.9%	0.6390	0.4142	0.1570	0.0695	0.1094	0.2268	44055.0349	55361.8182	0.4290	0.4856	849.5935	0.0000
French Quarter	101.7%	0.0430	0.0435	0.0100	0.0076	0.2977	0.2977	80711.5410	100320.1003	0.2460	0.3226	1021.7175	0.1208
Irish Channel	101.6%	0.6840	0.3988	0.1920	0.0757	0.1500	0.2770	41887.3573	60744.4578	0.3740	0.4270	952.4070	0.0000
West Riverside	100.2%	0.3610	0.2281	0.0930	0.0546	0.2073	0.3221	67262.8656	74440.9903	0.4080	0.4601	933.6547	0.0000
Tulane/Gravier	100.2%	0.7820	0.7117	0.2070	0.2087	0.1001	0.1009	22832.3376	28974.0678	0.1930	0.1375	633.1946	9.5235
Fairgrounds	99.6%	0.6900	0.6402	0.1310	0.1118	0.1224	0.1679	53759.5141	47267.2771	0.4360	0.4335	880.1922	8.0582
Lake Terrace & Oaks	99.6%	0.1890	0.2593	0.0130	0.0275	0.1984	0.3933	155458.0396	146581.4727	0.9510	0.6782	805.6818	2.0171
Leonidas	99.4%	0.7550	0.6203	0.1870	0.1333	0.1141	0.1856	44118.9605	51215.5735	0.4180	0.4439	751.1100	4.3804
Marlyville/Fontainebleau	99.3%	0.2790	0.2392	0.0810	0.0737	0.2599	0.3230	82773.2428	87450.3046	0.5200	0.5375	1045.2525	8.1014
Lakeshore/Lake Vista	99.1%	0.0060	0.0214	0.0400	0.0383	0.3419	0.3789	153874.9560	125472.9181	0.8570	0.8376	1149.5413	3.8809
Uptown	98.4%	0.3600	0.2181	0.0800	0.0411	0.2503	0.3585	76179.3148	107832.1464	0.4340	0.4646	990.3226	1.6434
Dixon	98.4%	0.9490	0.9031	0.2290	0.2250	0.0741	0.1034	34586.3487	35623.5529	0.4210	0.3615	841.9162	9.7927
Audubon	98.1%	0.0510	0.0479	0.0270	0.0270	0.2779	0.2796	150153.3391	153702.1792	0.5430	0.5575	1388.5686	2.9749
New Aurora/English Turn	98.1%	0.6810	0.6339	0.2140	0.1580	0.0907	0.1312	86730.8659	104242.0085	0.7280	0.7473	698.0354	0.0000
Central City	97.6%	0.8710	0.7237	0.2400	0.1366	0.0678	0.1213	32021.1886	35687.0826	0.1630	0.2307	626.4618	4.8423
Garden District	97.3%	0.0270	0.0322	0.0150	0.0103	0.4222	0.4694	124988.5743	128701.2435	0.4910	0.5268	1153.2300	0.0114
City Park	96.6%	0.0940	0.0764	0.0510	0.0352	0.2934	0.3899	64798.1230	76162.4519	0.4200	0.4202	956.4498	12.2110
Bywater	96.4%	0.6100	0.3311	0.1580	0.0658	0.1212	0.2828	37544.7143	54024.2708	0.3810	0.4237	739.4118	1.5779
Tall Timbers/Brethel	96.4%	0.5460	0.6981	0.1570	0.1688	0.1649	0.1499	73420.8387	57807.1199	0.3540	0.3734	745.4921	0.0000
Touro	95.9%	0.1840	0.1448	0.0200	0.0121	0.2920	0.3835	66344.2206	71375.6656	0.3230	0.3352	1052.0496	0.1740
Old Aurora	95.4%	0.3090	0.5450	0.0960	0.1352	0.2175	0.2197	77750.8135	66867.8664	0.7370	0.6345	782.1449	0.0000
Bayou St. John	93.3%	0.6780	0.4902	0.1730	0.0942	0.1262	0.2007	50037.2303	51746.3987	0.3500	0.4142	799.5851	6.5579
Pontchartrain Park	92.7%	0.9670	0.9717	0.1150	0.1962	0.1851	0.1352	60729.0318	38441.1765	0.9210	0.7967	805.5556	17.0492
Lakeview	92.5%	0.0170	0.0402	0.0290	0.0352	0.2985	0.2691	212201.0075	179088.6179	0.9170	0.8842	2238.4615	8.1843
Seventh Ward	91.2%	0.9360	0.8736	0.2330	0.1914	0.0499	0.0882	36544.0902	29840.1300	0.3320	0.3522	678.1756	7.6666
McDonogh	91.1%	0.8760	0.8670	0.2350	0.1952	0.0914	0.0480	37401.7981	32552.9470	0.4790	0.4455	671.0824	0.0000
Gentilly Terrace	91.0%	0.6970	0.7777	0.1530	0.1692	0.1641	0.1530	58318.9094	53599.1754	0.6870	0.6386	861.2261	9.6376
Read Blvd East	90.8%	0.7330	0.8116	0.1140	0.1351	0.1763	0.1405	85052.9619	63508.9113	0.8860	0.8771	760.4839	12.1608
Milan	90.4%	0.7380	0.5904	0.1760	0.1341	0.1348	0.2211	50242.9563	55291.9452	0.3300	0.3904	842.2606	7.6905
Navarre	89.7%	0.0320	0.0505	0.0630	0.0563	0.2556	0.2957	75007.3133	70502.0084	0.5590	0.5330	924.0891	9.6004
St. Claude	88.8%	0.9050	0.8110	0.2620	0.1718	0.0719	0.0696	41066.9197	29029.4951	0.4490	0.4888	738.1790	5.4483
Little Woods	87.5%	0.8610	0.9262	0.2140	0.2416	0.1425	0.0840	59553.0679	40222.4630	0.5140	0.5087	732.6653	8.2308
Read Blvd West	87.5%	0.7980	0.9262	0.1490	0.1962	0.1213	0.0872	62427.9586	40498.0880	0.8510	0.7850	762.2642	10.5308
Broadmoor	86.8%	0.6820	0.6110	0.1720	0.1734	0.1370	0.2013	50158.0138	58215.6723	0.4810	0.4780	920.5304	10.5200
Dillard	86.8%	0.8840	0.9126	0.1470	0.1462	0.1190	0.1527	48359.1045	39013.8843	0.5790	0.5755	713.9001	9.0640
Freret	85.8%	0.8260	0.7201	0.2100	0.2130	0.0608	0.1176	56065.3348	46938.4848	0.3540	0.3843	692.9412	9.6652
Pines Village	84.4%	0.8750	0.9487	0.2510	0.2654	0.0724	0.0722	59786.4596	48098.6891	0.6350	0.5173	707.1856	9.1904
Behrman	84.2%	0.7740	0.8146	0.2610	0.2287	0.0671	0.0794	41903.7575	40574.3799	0.4710	0.5280	742.7867	0.0000
Hollygrove	81.8%	0.9470	0.9390	0.2240	0.2164	0.0626	0.0789	42248.2878	32664.8564	0.5420	0.5065	662.3404	9.8023
Filmore	81.3%	0.5690	0.7050	0.1000	0.1239	0.1829	0.1679	79776.9817	70679.8960	0.8560	0.7672	1015.1603	14.5668
West End	80.6%	0.0170	0.1103	0.0460	0.0638	0.2178	0.2880	96335.5208	77560.5801	0.6070	0.5680	1036.8664	12.1943
St. Roch	80.2%	0.9150	0.8682	0.2530	0.1966	0.0624	0.0669	38970.4234	29135.9494	0.4220	0.4505	624.5091	9.8446
Lakeview	79.3%	0.0070	0.0339	0.0540	0.0509	0.2857	0.3970	88170.9249	97926.1763	0.6950	0.6882	1223.5813	15.8388
Treme/Lafitte	78.5%	0.9240	0.7446	0.3220	0.1302	0.0517	0.1361	26959.6673	33409.4634	0.2180	0.3429	634.3705	6.5061
Milneburg	78.2%	0.7540	0.8699	0.1640	0.1960	0.1181	0.0917	58356.4500	40925.1105	0.7120	0.6028	860.9524	17.2535
Gentilly Woods	78.1%	0.6840	0.6933	0.1120	0.1331	0.1567	0.0911	57182.9022	50583.5616	0.7570	0.6336	870.0000	12.0409
Phm Orchard	75.6%	0.9310	0.9570	0.2300	0.2390	0.0973	0.0841	45120.8421	36214.0441	0.5740	0.5886	688.1517	10.1494
Holy Cross	74.6%	0.8750	0.8928	0.2510	0.2173	0.0541	0.0771	44375.1112	36462.5272	0.4180	0.5548	728.1915	2.5073
St. Anthony	73.7%	0.5800	0.7330	0.1550	0.2378	0.1487	0.0858	52321.0305	38428.8716	0.5750	0.4385	663.5569	16.7074
Desire Dev & Neighborhood	70.9%	0.9470	0.9526	0.2810	0.3260	0.0380	0.0046	35041.6036	28786.2185	0.4392	0.5044	363.6029	9.2155
Village de l'est	70.5%	0.5540	0.4342	0.2420	0.1657	0.0915	0.0819	50788.6758	40926.1661	0.4710	0.6363	636.4030	3.4878
Vivant/Venetian Isles	69.5%	0.7650	0.6143	0.2720	0.1163	0.0854	0.0256	28380.6123	20703.2086	0.2760	0.2122	511.1842	2.7042
Lake Catherine	69.3%	0.0200	0.0628	0.0250	0.0274	0.1023	0.1388	75464.0574	71489.3939	0.9020	0.9288		2.7042
U.S. Naval Support Area	63.7%	0.6320	0.6698	0.1590	0.1468	0.0841	0.0796	50580.6375	47594.8317	0.5050	0.4863	872.9050	0.0000
St. Bernard Area	59.6%	0.9780	0.9055	0.4920	0.2060	0.0204	0.1065	27535.7996	28482.9982	0.1700	0.4938	558.3333	12.5388
Florida Area	57.6%	0.9840	0.9647	0.2040	0.2071	0.0346	0.0498	40369.2840	29450.2049	0.5850	0.6450	649.2537	11.8195
West Lake Forest	54.9%	0.9530	0.9572	0.2830	0.3011	0.1216	0.1296	44516.6113	35079.8280	0.2380	0.3672	763.8462	12.3192
B.W. Cooper	45.6%	0.9840	0.9082	0.5910	0.2830	0.0031	0.0820	18277.0172	16130.6709	0.0390	0.0723	310.0324	7.4402
Lower Ninth Ward	36.7%	0.9830	0.9546	0.2490	0.1866	0.0468	0.0393	37894.0966	33557.3696	0.5900	0.6645	591.5493	12.0043
		2000	2010	2000	2010	2000	2010	2000	2010	2000	2010		NA
Orleans Parish		0.6029	0.5719	0.1689	0.1386	0.1467	0.1791	61859.2650	59014.0900	0.4844	0.4925	823.7211	6.2899
A 2000-2010		-0.0310		-0.0302		0.0324		-2845.1750		0.0081			

APPENDIX C: ARCGIS MAP OF ABSOLUTE FLOOD DEPTHS BY NEIGHBORHOOD



APPENDIX D: POPULATION COUNT FOR NEW ORLEANS NEIGHBORHOODS

Total numbers (2010)	Population	Total households
Algiers Point	2,455	1,229
Audubon	15,865	5,335
B.W. Cooper	806	318
Bayou St. John	3,529	1,719
Behrman	8,064	2,877
Black Pearl	1,734	936
Broadmoor	5,381	2,203
Bywater	3,337	1,763
Central Business District	2,276	1,260
Central City	11,257	5,279
City Park	2,708	1,447
Desire Dev & Neighborhood	2,005	678
Dillard	4,373	1,901
Dixon	1,270	520
East Carrollton	4,253	2,084
East Riverside	2,699	1,324
Fairgrounds	5,192	2,496
Filmore	4,227	1,654
Fischer Development	849	269
Florida Area	1,302	507
Florida Development	6	2
French Quarter	3,813	2,635
Freret	1,715	648
Garden District	1,926	1,063
Gentilly Terrace	8,210	3,351
Gentilly Woods	2,817	999
Gert Town	3,614	1,060
Hollygrove	4,377	1,761
Holy Cross	2,714	1,040
Iberville Development	1,238	482
Irish Channel	3,373	1,665
Lake Catherine	892	365
Lake Terrace & Oaks	2,464	982
Lakeshore/ Lake Vista	3,453	1,435
Lakeview	6,394	2,672
Lakewood	1,642	596

Leonidas	6,769	3,001
Little Woods	31,698	11,591
Lower Garden District	6,363	3,843
Lower Ninth Ward	2,842	1,061
Marigny	2,973	1,881
Marlyville/Fontainebleau	5,749	2,443
McDonogh	2,428	963
Mid-City	14,633	5,258
Milan	5,286	2,372
Milneburg	3,405	1,337
Navarre	2,298	1,120
New Aurora/English Turn	5,769	1,943
Old Aurora	16,781	6,465
Pines Village	3,410	1,187
Plum Orchard	3,951	1,473
Pontchartrain Park	1,482	551
Read Blvd East	7,283	2,473
Read Blvd West	4,213	1,493
Seventh Ward	10,187	4,248
St. Anthony	3,510	1,430
St. Bernard Area	974	403
St. Claude	6,820	2,713
St. Roch	6,632	2,604
St. Thomas Development	2,161	1,001
Tall Timbers/Brechtel	11,906	5,136
Touro	2,998	1,572
Treme'/Lafitte	4,155	1,913
Tulane/Gravier*	3,649	1,222
U.S. Naval Support Area	2,205	804
Uptown	5,984	2,921
Viavant/Venetian Isles	840	344
Village de l'est	8,008	2,414
West End	3,147	1,551
West Lake Forest	4,015	1,468
West Riverside	4,747	2,493
Whitney	2,328	911
Orleans Parish	343,829	142,158

VITA

Paul Ramnauth Algu, a native of Gretna, Louisiana and alumnus of Brother Martin High School, received his bachelor's degree in Environmental Management Systems at Louisiana State University in 2011. He worked for three years at PPM Consultants, Inc. in Baton Rouge, Louisiana, in environmental compliance and began to develop an interest in policy formation and implementation, especially in the greater New Orleans area. He began his graduate career in the School of Coast and Environment at Louisiana State University in 2013 and is a candidate for graduation in December of 2015.