INDIVIDUAL RISK PERCEPTIONS OF FLOODING: EVALUATING THE ASSOCIATIONS BETWEEN EXPERIENCE, PERCEPTIONS, AND PREPAREDNESS

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by

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CHAPTER ONE

INTRODUCTION

During the 20th century, floods caused more deaths and property damage than any other natural hazard in the United States (Perry, 2000). Flooding can be caused by both natural and human induced factors and is often associated with other types of hazards, such as hurricanes and landslides. Almost 90% of all natural hazards involve some degree of flooding (Knocke and Kolivras, 2007). Flooding occurs when too much water accumulates in a given area too quickly. When drainage or infiltration is inhibited flooding will be exacerbated, for example, when the ground is frozen or saturated with water. Several organizations take measures to assess the potential for specific rivers to flood and provide warnings to residents in flood zones. These include the United States Geological Survey (USGS), the National Weather Service (NWS), and the Federal Emergency Management Agency (FEMA). These agencies mainly focus on monitoring river levels and flood potential, warning the public, and providing relief to affected citizens.

This research explores individual risk perceptions of flooding of residents in Painesville, OH. Painesville is situated along the banks of the Grand River in Lake County, Ohio (Fig. 1). This focus of this study is the examination of the relationships between experience, perceptions, and preparedness. The goal is to assess in what ways
experiencing an event has impacted individual’s perceptions of flooding and how such experiences and perceptions impact preparedness for future flood events.

The Painesville region is prone to flooding, which is influenced by the climatology, topography, and built environment of the area. The water level of the Grand River near Painesville is monitored by USGS stream gauge station 04212100 located at the geographic coordinates 41.718889°N, 81.228056°W, just south of route 84 and a short distance upstream of where the worst flood damage occurred during a flood in 2006. Daily discharge means have been recorded and are available from the
USGS for the time period 1975-2009. The Grand River has reached flood stage several times in recent years, including the memorable flooding in 2006 as a result of excessive rainfall. Flood stage at Painesville is 8.0 feet, and on July 28, 2006, the river crested at 19.35 feet, the highest level ever recorded (NWS, 2010). This flood caused significant disruptions and damage throughout the region, including the evacuation of 600 people from their homes, the destruction of 100 homes and businesses, 81 of which were in the Painesville area alone, damage to 731 homes, five destroyed bridges, 13 damaged roads, and one death (Ebner et al., 2007). Two years later, on February 6, 2008, the river reached its second highest recorded crest at the Painesville stream gauge of 13.70 feet (NWS, 2010). No major damages were associated with the 2008 flood.

While the real risk of flooding in the Grand River valley has been determined, and floodplain boundaries have been delineated, vulnerabilities are not solely shaped by actual risk. Research has shown that at the individual level, prior experience with flooding does not necessarily affect flood readiness (Takao, 2004). However, studies have also shown that hazard experience positively affects future protective actions when damage was severe (Weinstein, 1989) or recent (White, 1964; Barnett and Breakwell, 2001). These two considerations make Painesville, Ohio, a suitable site to study how past experiences have affected the resident's flood perceptions and flood preparedness, as it has recently experienced major flooding with significant damages.
The city covers an area of 7.9 square miles. According to a demographic profile complied by Painesville’s Department of Economic Development using 2000 census data, the city has a population of 17,503. In terms of safety equipment that would be vital during disaster response efforts, the city owns two rescue trucks, one utility truck, one hazmat trailer, three rescue boats, two ambulance trucks, and one fire prevention car. The county is also able to provide equipment during disaster response. There are six schools, one hospital, 20 churches, and one YMCA within city limits. These types of facilities are often vital infrastructure after disasters for medical and shelter purposes.

In order to assess the associations between experience, perceptions, and preparedness of residents in the study area, a mail survey was sent to 1,200 residential addresses located within the Painesville region. As several residential blocks are located within the 100-year floodplain, attempts were made to include as many of these residents as possible. In total, 87 residents in the floodplain received a survey, 15 of whom responded, equating to a 17.2% response rate among residents inside the floodplain. Of the other 1,113 residents who received a survey, 170 responded, equating to a 15.3% response rate among residents residing outside the floodplain. The overall response rate was 15.4%.

Through a series of multiple choice questions, the survey collected data regarding respondents’ experiences, perceptions, and preparedness of flooding. Within each of these three categories a set of variables was identified, and these variables were
crosstabulated and tested for association via a chi-square model. Demographic data was also collected to help determine if any associations exist between demographic attributes and the perception and preparedness variables.

The mail survey also included multiple-response multiple choice questions and open ended questions. These groups of questions mainly focused on how people receive information regarding flooding, what their major concerns are, and how they anticipate responding to a potential future flood event. These questions were analyzed following a procedure used by Knocke and Kolivras (2007) in surveying residents of southwest Virginia regarding their flash flood awareness. A set of common themes and phrases were identified for each open ended question and the frequency with which respondents used those themes was evaluated.

An ancillary subset of this research also focuses on how experience impacts perceptions and preparedness of hazard events at the administrative level. Interviews held with city and county officials who lead response and recovery efforts during hazard situations will help shed light upon how prior experience with a hazard event, specifically the July 2006 flood, has affected perceptions and preparedness among the administration.

Issues related to the prevention of loss of life and property damage due to flooding, as well as other types of hazards, often incorporate hazard perceptions. While most areas in the United States (U.S.) and abroad have been evaluated in terms of their
likelihood of experiencing a specific hazard, the level of risk does not necessarily shed light upon how effectively a risk can be mitigated. Understanding the way people anticipate or behave during a hazardous event is an important process for developing mitigation strategies and maintaining useful communication between experts, policy makers, and the public. If the public believes they are not likely to be harmed during a hazardous event, they may be less likely to take protective measures. Perceptions of harm can have more influence on a person’s behavior than the actual risk of harm. Refusal of individuals to evacuate hazardous areas during events such as hurricanes or wildfires may relate to their perceptions of the risk. While many aspects of the individual and the situation may contribute to perceptions and preparedness, prior experience with an event has proven to be particularly dynamic and will serve as a major focus of this research.
CHAPTER TWO

PERCEPTIONS OF RISK

2.1 Introduction

The field of hazards geography is a large academic and policy-oriented discipline that covers many aspects of vulnerability within the environment. Within this broader field lies the subdiscipline of risk analysis (Mitchell, 1989). The goal of risk analysis is to identify potential threats to individuals, businesses, governments, and general populations that may be incurred due to both natural and human-induced events. There are various components and approaches to risk analysis, including understanding both risk and vulnerability. The terms risk and vulnerability are at times used interchangeably, but herein shall be considered as related but separate from one another. Risk is generally defined as the likelihood that an event will take place. To be considered a risk, the potential event must pose a threat in the form of physical, economic, or social damage or disruption. This research will distinctly differentiate between two types of risk: actual risk and perceived risk. Actual risk can be thought of as a statement of probability. For example, a potential flood may be referred to as a 100-year flood, meaning that in any given year the probability of a flood of a specific
magnitude occurring in a certain region is one in 100, or 1%. Apart from actual or real risk is perceived risk. Perceived risk is defined as the amount of risk that individuals or groups of people believe they are subjected to. Ideally, the actual risk and the perceived risk of a population will be identical, however this is unlikely to always be the case.

Vulnerability is defined as the susceptibility of an individual or population to become damaged or disrupted during a hazardous event. Risk is often difficult, if not impossible, to control. Vulnerability on the other hand can be thought of as a social construction that can be increased or decreased based on individual or collective actions. For example, imagine two neighbors living in an area that is at risk of being affected by wildfires. Suppose one neighbor built his home with fire-retardant materials, and the other did not. The actual risk that these two neighbors would be impacted by a wildfire may be the same, but their vulnerability to damages from such an event is not the same. On the other hand, the neighbor with the home made from fire-retardant materials might perceive his actual risk level as being lower than his neighbor, even if it is not. In order for hazard experts to properly communicate with the general public regarding their real risk and vulnerability to a hazard, it is important for such experts to be keenly aware of not only the real risk, but of the perceived risk as well (Knockee and Kolivras, 2007).
The notion that perceived risk is an important element to any vulnerability assessment dates back to the 1960s when concerns over the hazards associated with nuclear power became widespread (Sjoberg, 2000). During this time, risk relationships were developed by Sowby (1965), who claimed that mitigation tactics ought to be proportional to the magnitude of a particular hazard. This idea was commonly held as significant in understanding communications of risk (Sjoberg, 2000). However, insights by Starr (1969) explained that risk perceptions incorporate much more than objective determiners of risk, and that subjective perceptions are important factors as well. In the 1970s, the extent to which perceived risk aligned correctly with actual risk was evaluated in terms of subjective probabilities, or probabilities of judgment biases (Tversky and Kahneman, 1974; Sjoberg, 1979). Three heuristics, representativeness, availability of knowledge, and anchoring (cognitive biases based on the starting point of reasoning) were considered to be a central element in developing correct perceptions of risk (Tversky and Kahneman, 1973 and 1974). The second element, availability of knowledge, would indicate that media outlets play a pivotal role in risk perception (Combs and Slovic, 1979), a concept that has since been much debated (Freudenburg et al. 1996; Wahlberg and Sjoberg, 2000; Agha 2003; Sjoberg and Engelberg, 2010).

One of the earlier research initiatives investigating the disparity between real risk and perceived risk was the work by Richard Wilson in 1972 that compared deaths per kilowatt-hour for different types of energy production (Greenberg and Lowrie, 2010). While growing concerns over the dangers of nuclear power was the trend,
Wilson demonstrated that many more deaths were attributed to Black Lung disease suffered by coal miners than was associated with nuclear power. Despite the fact that much of the fear of nuclear power was ill founded or misrepresented, public unease spread. Clearly, risk perceptions held by individuals are conditioned by societal and cultural values (Boholm, 1998). In many cases some risks are overestimated, while others are underestimated (Weinstein, 1989). An example of this is maintaining an intense fear of flying in a plane, but regularly driving in a car. The fact that so many people live in and develop communities in floodplains of major rivers or low lying coastal areas suggests a general underestimation of flood risks.

2.2 *The Psychometric Paradigm*

The discrepancies that exist between perceived risk and real risk have been examined through the psychometric paradigm, a model focusing on the contributing factors of the generation of risk perceptions. The psychometric paradigm was developed out of the disciplines of psychology and decision science (Sjoberg, 2000). This model draws on the cognitive biases held by individuals, which contribute to risk perceptions. Such biases are subjectively generated by psychological, social, and cultural influences. In this regard, the availability of knowledge heuristic promoted by Tversky and Kahneman (1973) is considered significant. This approach is similar to that taken by behavioral geographers in evaluating the cognitive processes underlying spatial
interpretation, decision-making, and individual actions (Golledge and Stimson, 1997).

Within the psychometric framework, risk is considered unable to exist independent of our imaginations and perceptions because risk itself is socially constructed. The paradigm considers factors contributing to the subjective formation of risk perceptions quantifiable with proper survey techniques (Slovic, 1992). A well-known study by Fischhoff et al. (1978) utilized this paradigm to quantify various aspects that contribute to perceptions of risks. They found that novelty (the newness or lack of knowledge of a risk), dread (the potential for catastrophic results) and exposure (the number of people potentially effected) were major factors in developing a high level of concern over potential hazards. These conclusions have since been repeated (Slovic et al., 1980).

While the psychometric model has been highly regarded within the discipline of risk analysis, the validity of the results offered by its methodology has been questioned. Survey results within this framework are computed as group means for many hazards, which does not capture the full range of individual perceptions or how such perceptions are generated (Vlek and Stallen, 1981; Kraus and Slovic, 1988). The methodology employed by the proponents of the psychometric paradigm is factor analysis. Subjects are asked to rate the risk level of various hazards based on different factors (novelty, dread, voluntariness etc.) and the mean of these risk levels are computed, and are referred to as scales. A matrix is then constructed based on the scales X hazards, and the matrix is then factor analyzed (Sjoberg, 2000). This is the methodology Fischhoff et al. and Slovic et al. used to identify novelty, dread, and exposure as major explanatory
factors for the development of risk perceptions. However, analyzing risk perceptions as group means ignores the fact that people tend to differ in their perception of risks and hazards and that such perceptions are conditioned by social and cultural values, and that great variation may exist within a population (Marris et al., 1997; Sjoberg, 2000). For this reason, Marris et al. (1997) conducted a similar study as the Fischhoff et al. and Slovic et al. studies but instead generated a series of matrices for each respondent, rather than for the mean of all respondents. When this data was analyzed using the raw data, rather than group means, several of the correlations previously found did not hold up (Marris et al., 1997). However, other relationships seemed to hold true, and the correlation between lack of knowledge and risk perception proves especially dynamic (Sjoberg, 2000).

2.3 The Importance of Subjective Perceptions

Although the psychometric paradigm has been questioned, there is no lack of evidence that it has contributed to building a stronger awareness of how people perceive their risk to various hazards, and that understanding risk perceptions is an important aspect to assessing vulnerability. This framework has shown that experts should look at not only the actual risk, but also perceived risk to help determine individual behaviors regarding mitigation. There is currently a knowledge gap between hazard experts and the public, which makes communication efforts difficult and can
result in misinterpretation of information (Gregg et al. 2003; Frewer, 2004). Because of this dichotomy, it is important to include in any risk assessment the demographic attributes of those at risk, such as age, gender, and education, as well as intangible characteristics that may contribute to awareness, such as prior exposure and experience with a particular hazard (White, 1988). It must also be acknowledged that vulnerability may have different meanings for different people (Cutter, 1996). For example, some may consider themselves vulnerable if they believe they are likely to experience a hazard. Others may consider themselves vulnerable only if they believe that being exposed to a hazard would have appreciable negative impacts on their lives. Understanding social structures, such as political, economic, and development trends, becomes particularly important in regions prone to natural disasters. Although the knowledge base regarding the physical processes related to hazards is greater than ever before, increasing populations in hazard prone areas has increased vulnerability in many localities (Montz et al., 2004). This is apparent from recent disasters such as the 2004 tsunami, Hurricane Katrina in 2005, and the 2010 earthquake in Haiti.

2.4 Experience and Perceptions

A common theme in risk perception research is the relationship between perceived risk and prior experience/exposure to a particular hazard. Despite numerous studies examining this relationship, it is dynamic and remains indistinct. It has been
demonstrated that risk perceptions vary depending on whether the hazard is a potential or existing threat (Rogers, 1997). In this case, the perceived probability that an event will actually take place is likely to increase only after a similar event has occurred. Once a person has been directly exposed to a hazard, or experiences it indirectly as in the case of a friend or family member being exposed to a hazard, it becomes easier for that person to remember or imagine the event, and the more likely they are to perceive the hazard as a probable occurrence (Tversky and Kahneman, 1974). On the other hand, frequent exposure can have the opposite effect. For example, people living farther away from industrial facilities tend to be more concerned about contamination issues than those living in close proximity (Lindell and Earle, 1983). This lack of concern by those at higher levels of exposure has been attributed to desensitization (Richardson et al., 1987), but more recently the idea that people become desensitized as exposure increases has been shown to occur only in selected circumstances (Barnett and Breakwell, 2001). The notion of desensitization can be seen in situations where a hazard occurs frequently, but with minor or negligible impacts. Residents of the Virginia seismic zone, for example, are subjected to somewhat frequent, though irregular earthquakes (USGS, 2003). Although they are a recurrent event, most are small with little or no damage, so concern over the risk of earthquakes is not a common theme among residents of Virginia. Clearly, experience involves much more than frequency.
2.5 Aspects of Experience

While experience may be an important indicator of risk perception, simply knowing when and how often a person has experienced a particular hazard is not enough to establish a concrete relationship between experience and perception. Not everyone experiences events in the same way so it becomes important to evaluate different aspects of individual experiences. The frequency with which one has encountered an event varies among people, and frequency alone is not an adequate assessment of one’s experience (Cutter, 1996; Twigger-Ross and Breakwell, 1998). Barnett and Breakwell (2001) included frequency as well as two ancillary aspects of experience, impact and outcome, in a survey examining perceptions of both voluntary and involuntary risks. Although exposure frequency is an important aspect to one’s experience, it does not give an indication of how events are internalized. People use the term “blessing in disguise”, which suggests that events typically thought of as causing adverse impacts in a person’s life may have beneficial outcomes as well. The impact that a hazardous event has on someone may have been very large, or only marginal. The outcome may be devastating or favorable depending on circumstances. Floods, for example, are often thought of as negative incidents, particularly in urban areas. However, in many locations, especially agricultural regions, flooding is a normal and beneficial occurrence. Farmers in Bangladesh rely heavily upon annual floods to provide sustenance to their farmlands, which are considered a necessary element to the prosperity of the people (Paul, 1984). Understanding the way people experience events
is elemental to understanding how that experience is used to develop risk perceptions, and in what ways those perceptions are incorporated into preparedness and protective measures (Vaughan, 1993).

2.6 Experience, Perceptions, and Preparedness Pertaining to Flooding

Ultimately it is important to identify not only the actual risk to an area from a given hazard, but also the perceived risk by the general public in order to establish appropriate mitigation strategies. However, even if we can quantify how experience affects perception, there is no substantial evidence that suggests that perception necessarily determines preparedness. By surveying over 2000 people in Shinkawa, Japan, Takao (2004) found that flood preparedness was not determined by prior flood experience. Early work suggests that recent experience with a hazard does have a positive relationship with preparation actions (White, 1964), but that this impression of perceived risk diminishes with time. Barnett and Breakwell (2001) similarly suggest that the influence of experience upon perception is affected by the lapse of time. It is commonly held that protective actions increase in individuals previously exposed to a hazard associated with severe damages (Weinstein, 1989). This was the case in Cologne, Germany, in 1995 when a flood caused damages totaling €30 billion, down from the €65 billion in damages produced in a similar sized flood two years prior (Grothmann and Reusswig, 2006). However, there are instances where the opposite
seems to be the case. For example, in 2007 over 15% of new policy holders in the state of Louisiana opted not to renew their flood insurance policies, despite the devastating effects of Hurricane Katrina in 2005 (Horney et al., 2010).

Unfortunately, misconceptions about personal risk from natural hazards are not usually addressed properly since policy makers tend to focus on actual risk, rather than on what people believe about risk. A study carried out by Gruntfest (1977) documenting the Big Thompson Canyon Flood of 1976, which killed at least 139 people and caused extensive property damage, exemplifies the importance of understanding public perceptions of hazardous events and preparation or loss prevention measures. Many people in the canyon (but not all) received verbal warnings of the impending flash flood, but numerous groups took no action until word spread that the Estes Dam had broken. While the dam had not actually failed, and the flood was indeed caused from excessive rainfall, it became clear through the actions of those in the canyon that the fear of a dam break was much greater than the fear of a precipitation induced flood (Gruntfest, 1977). Had the people in the canyon possessed a more accurate awareness of their vulnerability to flash flooding and the rainfall regimes capable of producing such a flood, many people may have taken the warnings more seriously and might have taken protective measures sooner. Similarly, had policy makers possessed a more accurate awareness of the perceptions of flooding in the canyon, warnings could have been more effectively implemented. As there are opposing findings within the literature, it remains...
unclear as to what extent prior experiences and perceptions of hazards influence preparedness.

2.7 Hazards in the Urban and Built Environment

Natural hazards affect millions of people every year in a variety of environments. In many ways, highly developed areas increase their vulnerability to hazards due to components of the built environment. Vulnerability becomes intensified due to potential damage to large infrastructure, possible disruptions in access to utilities, disruptions to communication networks, and extensive impermeable surfaces. The latter attribute especially increases vulnerability to flood hazards. In a time when the majority of people in the United States and elsewhere are living and working in developed areas, research in risks and vulnerability in the built environment has become increasingly important. Research regarding urban hazards has grown tremendously in recent years, and a paradigmatic shift from evaluating risk to understanding vulnerability has refocused modes of inquiry.

One research regime has focused on increasing the resiliency of developed areas in order to better cope with disasters when they occur (Godschalk, 2003). A resilient city would be one in which the physical and social structures within the community would be able to cope with hazardous events effectively and independently and without major disruptions to the health and vitality of the city. Physical structures include both natural environments, such as topography, climatology, and geology, and well as
manmade environments such as buildings, infrastructure, and utilities. Social structures include networks of individuals, such as schools, police, and city management groups. The idea is that with a full understanding of the natural physical structures, a network of manmade structures designed with hazard resilience in mind, and a strong set of connections between members of the community, then a city will be able to bear the burden of a hazard without incurring major damages.

A key behavior in establishing resilient cities is the ability to learn from past experiences, both at the individual and community levels. Two U.S. cities that have been successful at increasing their resiliency by learning from the past are Berkeley, California and Tulsa, Oklahoma (Godschalk, 2003). Berkeley is faced with seismic activity and wildfires that threaten lives and property. In order to become more resilient towards these hazards, the city has funded projects to retrofit various infrastructures, as well as created rebate programs to help individuals make their own homes more resistant to earthquake damage. In an entirely different environment, Tulsa is faced with severe weather threats, including both tornadoes and floods. A number of past experiences stimulated an effort to reduce the likelihood of significant damages in the future, which included the relocation of hundreds of buildings away from the floodplain.

By focusing on ways to decrease a community’s vulnerability to hazards, we are able to conceptualize vulnerability as a malleable social construction, rather than a fixed attribute of an area (Mitchell, 1989). In the City of Painesville, we see the social
construction of vulnerability revealed as residential development in high-risk flood
designated areas. Additional vulnerabilities during disaster response develop via a
complex and interconnected web of interactions between the physical environment,
engineered systems, and response efforts (Comfort, 2006).

The ideas of resiliency and decreasing vulnerability do not focus on preventing
disasters or eliminating uncertainty. City planners and decision makers will always be
faced with unknowns regarding both future disasters and social and political norms and
trends. Instead, the idea of resiliency focuses on a framework in which uncertainty is
acknowledged, yet rational and proactive actions can still be made (Foster, 1997). And
while decision makers do face a great deal of uncertainty, there are vast pools of
knowledge which help guide our decisions, such as the decision to restrict development
in a floodplain.
CHAPTER THREE

STUDY AREA AND THE JULY 2006 FLOOD

3.1 Introduction

Painesville, Ohio is located in Lake County in northeast Ohio (Fig. 1). The Grand River flows north through the Painesville region and empties into Lake Erie. The region is prone to flooding along the banks of the Grand River and its tributaries. In July 2006 a 500-year flood event caused significant damages and disruptions throughout the area. This chapter will detail the geomorphology and climatology of the region, as well as the 2006 flood event and the conditions leading up to it.

3.2 Geomorphology

The terrain in northeastern Ohio has undergone numerous periods of glaciation, the most recent of which, during the Late Wisconsinan, resulted in ice retreat from the region approximately 10,000 years ago. Most of Ohio was at one time covered in glacial ice with the exception of the Allegheny Plateaus in the southeastern part of the state. Four major lobes existed in Ohio during the Wisconsinan glacial episode: the Miami lobe, the Scioto lobe, the Killbuck lobe, and the Grand River lobe. The Grand River lobe
sat over areas of modern day Ashtabula, Lake, Geauga, Portage, Trumbull, Mahoning, Stark, and Columbiana counties (Camp, 2006).

The drainage of northeast Ohio was significantly altered due to the presence of the ice. Prior to the advance of the Grand River lobe, the Great Lakes did not exist and water flowed freely to the lower elevations to the North. As the ice advanced, however, rivers became dammed, forming huge pro-glacial lakes. Meanwhile, the Grand River lobe eroded the underlying bedrock significantly, which has affected the evolution of the Grand River Valley as it exists today. As the ice retreated in stages, glacial deposits in the form of tills, outwash, and moraines altered the landscape. The presence of the Painesville and Ashtabula moraines has played a significant role in determining the course of the Grand River.

The headwaters of the Grand River are located near Champion, Ohio. From its headwaters, the river flows north towards Austinburg and is characterized by a strong meandering course through glacial tills and lake deposits until reaching the Painesville moraine. The moraine acts as a barrier causing the river to take a sharp turn to the west south of I-90. The river continues to parallel the Painesville and Ashtabula moraines westward until south of Painesville where it changes course again, now flowing to the north, cutting through the moraines and ancient beach ridges (Camp, 2006). As the Grand River cuts through these moraines, the constrained topography and steep slopes have a bottleneck effect that significantly increases water levels upstream during a flood
event, an effect known as hydraulic damming, and also cause ice jams during winter. Beyond the Painesville and Ashtabula moraines, the Grand River empties into Lake Erie at the town of Fairport Harbor (Fig. 2).

![Figure 2. The Grand River in Lake County](image)

### 3.3 Climatology

Painesville, Ohio is located at 41.75° N latitude in the temperate climate zone. The average daily high temperature ranges from 80°F in July to 32°F in January, and the
average daily low temperature ranges from 60°F in July to 18°F in January. The annual average precipitation amount is 38 inches and the average snowfall is about 80 inches (Schmidlin and Schmidlin, 1996). The prevailing winds are out of the southwest. The Grand River flows north through Painesville, draining into Lake Erie.

Like the rest of the middle latitudes, the weather of Ohio is often determined by the passage of large high and low pressure systems. The most significant changes occur when midlatitude cyclones pass, causing frontal lift and converging air masses. Associated with these systems are warm fronts, which bring extended periods of rain, extensive cloud cover, warmer temperatures, and variable winds, and cold fronts, which move faster across the landscape bringing cooler temperatures, high pressure, strong winds, and severe thunderstorms. Intense rainfall events can occur during the late spring and summer months when intense solar heating increases convection.

Painesville is located in Lake County in northeast Ohio, along the banks of the Grand River and in close proximity to the shores of Lake Erie. The influence of the lake on this region has significant impacts which cause variations in the climate patterns as compared to other regions of the state. The average daily high temperature in January in Lake County is near 33°F, as compared to northwest Ohio, at the same latitudinal position but upstream of the westerly winds blowing off the lake, with an average daily high temperature in January of less than 32°F. The moderating effect of the lake is more pronounced in the spring and summer when the jet stream is situated to the north. The
average daily high temperature in July is only about 80°F in Lake County, as opposed to near 85°F in northwest Ohio (Schmidlin and Schmidlin, 1996).

Northeast Ohio’s position downstream of the westerly winds gusting off the shores of Lake Erie makes it the wettest region in the state. The highest annual rainfall in Ohio occurs in the higher terrain of Geauga and Ashtabula Counties, averaging between 41 and 45 inches. To the immediate northwest lies Lake County, with an average rainfall of 35 to 41 inches (Fig. 3). While Lake, Geauga and Ashtabula Counties all receive the same wind flow, Geauga and southern Ashtabula Counties are at a higher elevation which accounts for the higher amount of precipitation.
As with rainfall, Geauga and Ashtabula counties see the most snowfall every year, receiving anywhere from 90 to 105 inches annually, while neighboring Lake County receives 80 to 90 inches (Fig. 4). Although Geauga and southern Ashtabula Counties do not border Lake Erie, the area receives higher snowfall totals due to the higher elevation.
relative to Lake County (Schmidlin and Schmidlin, 1996). For this reason Geauga County has the lowest number of growing days in the state.

![Map of Ohio showing snowfall distribution](image)

**Figure 4.** Mean snowfall for winter season, 1936-1965.

*Source: Hydrologic Atlas for Ohio; Ohio Department of Natural Resources, Division of Water*

While more precipitation does fall in summer than in winter, it is fairly evenly distributed throughout the year (Fig. 5). However, due to persistent snowfall and
snowmelt in the winter, especially in northeast Ohio, the ground is often saturated giving a false sense of a wet season (Schmidlin and Schmidlin, 1996).

![Image of Monthly Average Precipitation across Ohio, 1931-1980.]

**Figure 5.** Average monthly precipitation across Ohio, 1931-1980.
One inch of rain is about equal to ten inches of snow.

*Source:* Water Cycle Fact Sheet; Ohio Department of Natural Resources, Division of Soil and Water Resources

### 3.4 The July 2006 Flood Event

Storms on July 27-28, 2006 in northeast Ohio caused severe flooding across the region. The floodwaters did not recede below flood stage until July 31st, causing extensive damage in the meantime. Three counties in Ohio, Lake, Ashtabula, and Geauga, were declared both Federal and State disaster areas, warranting a visit from President George W. Bush. Throughout Lake County, approximately 600 people were evacuated from their homes, 100 homes and businesses were destroyed, 81 of which were in the Painesville area alone, 731 homes were damaged, five bridges were
destroyed, 13 roads were badly damaged, and one death was attributed to flood waters (Ebner et al., 2007). The storms that produced the flood struck the region at a vulnerable time as both June and July of 2006 had higher than average rainfall, leaving the ground saturated and susceptible to flooding.

*June 2006.* Most of the state of Ohio received rainfall amounts above normal for the month of June, with the only exceptions being south-central, southeastern, and portions of northwestern Ohio. Total rainfall amounts for June 2006 for the state of Ohio are displayed in Figure 6. The average rainfall for the month was 0.96 inches above normal. The northeast region, where Lake County is located, received an average of 5.42 inches, which is 143% of normal (Fig. 8). The mean discharge of the Grand River at Painesville for the month of June has been reported differently by the USGS and the Ohio Department of Natural Resources (ODNR). This is due to the fact that the stream gauge is located near the bridge over route 84 which was under construction at the time, and the impact of the construction hampered the flow of water. Due to this situation, along with time restraints on the part of the ODNR, estimates were used for the flow rates. According to the USGS the average discharge for the month of June is 601 cubic feet per second (cfs), and the average discharge for June 2006 was slightly lower at 596.7 cfs. However, according to the ODNR the average discharge of the Grand River for June is only 263.9 cfs and the average discharge for June 2006 was 520 cfs, which is 197% of normal. Knowing that the region received higher than average rainfall it is likely that the ODNR estimate is closer to the actually average discharge rates. June
of 2006 was the 12th wettest month of any June in the northeast region of the prior 112 years (Kirk, 2006a).

*July 2006.* During the month of July, all ten climatological regions in the state received rainfall amounts above normal. Total rainfall amounts for July 2006 for the state of Ohio are displayed in Figure 7. The average rainfall for the month was 1.7 inches above normal. The northeast received an average of 8.47 inches, which was 221% of normal (Fig. 9). Like in June, the mean discharge of the Grand River for the month of July has been reported differently by the ODNR and the USGS. According to the USGS the average flow in July is 352 cfs and the average flow for July 2006 was 2,803 cfs, which is 796.3% of normal. However, according to the Monthly Water Inventory produced by the ODNR, the average discharge for July is 199 cfs and the average flow for July 2006 was 3,171 cfs, which is 1593.5% of normal. Although these numbers are very different estimates, they both exemplify the fact that the discharge for the month of July 2006 was well above average. *July 2006 was the 3rd wettest month of any July on record in the northeast region of the prior 124 years* (Kirk, 2006b).
Figure 6. Rainfall totals for June 2006. (from Kirk, 2006a)

Figure 7. Rainfall totals for July 2006. (From Kirk, 2006b)
Figure 8. Average inches of rainfall over percentage of normal rainfall for June 2006. (From Kirk, 2006a)

Figure 9. Average inches of rainfall over percentage of normal rainfall for July 2006. (From Kirk, 2006b)
July 27-28, 2006. On the morning of July 27th a stationary front was situated to the north of Ohio, spanning central Michigan and Ontario, while a high pressure center was located over the southeast United States (Fig. 10). The combination of these two factors led to westerly winds in the upper levels that persisted over the region throughout the day, steering the storms due east across northern Ohio. At the surface, anti-cyclonic winds around the center of high pressure steered warm moist air from the Gulf of Mexico to the northeast, bringing unstable air into Ohio. As the flow aloft moved storms quickly from west to east, the warm moist air was replenished, causing new storms to form rapidly. This set up of westerly winds aloft, and southwesterly winds at the surface persisted throughout the day, allowing convection to continue for hours.
Storms continued throughout the afternoon and into the evening of July 27\textsuperscript{th}. There was a break in intensity late in the day on the 27\textsuperscript{th} due to decreased solar radiation. However, in the early evening an upper level disturbance moved across the area spawning additional thunderstorm activity which developed into a mesoscale convective system. This system produced heavy rainfall throughout the region before moving to the east on July 28\textsuperscript{th} (Fig. 11).
Initially, small creeks and storm drains were filled beyond capacity and the ground became fully saturated. Flooding began in the early evening hours of July 27th and waters continued to rise overnight. During the 48 hours of July 27-28 the Painesville weather station, which is located four miles northwest of downtown Painesville, recorded 8.49 inches of rainfall. However, Ebner et al., 2007 reported over 11 inches of rain in Painesville during the same 48 time period. This rainfall rate exceeds the 1000-year Average Recurrence Interval (ARI) as determined by NOAA’s Hydrometeorological Prediction Center.
Design Studies Center for this location. In fact this event exceeded the ten day 1000-year ARI for this location over a two-day period (NWS, 2009). The ensuing flood was determined to have an ARI of 500 years (Ebner et al., 2007). Flood waters at the USGS stream gauge in Painesville crested at 19.35 feet (NWS, 2010), and reached a peak discharge of 35,000 cfs (Ebner et al., 2007). Both the peak water stage and discharge volume were record breaking for this location (Fig.s 12 and 13).

The flood of 2006 would generally be described as a regional flood, but due to various blockages flashflood-like conditions existed at times. This resulted from both the topography of the region and the built environment. As previously mentioned, the Grand River cuts through glacial moraines that are composed of unconsolidated sand and gravel that can easily erode. The constrained topography and steep slopes have a bottleneck effect that can significantly increase water levels upstream during a flood event.
Figure 12. Streamflow hydrograph from the USGS stream gauge on the Grand River near Painesville from July 26-August 4, 2006. (From Ebner et al., 2007)

Figure 13. Stage hydrograph from the USGS stream gauge on the Grand River near Painesville from July 26-August 4, 2006. The red line at eight feet signifies flood stage. (From Ebner et al., 2007)
As the flood waters gushed downstream, heading north to Painesville and Lake Erie, debris consistently was picked up and transported long distances by the flood waters. As the waters rose higher and higher in Painesville, bridges began to act as dams, blocking the debris and causing enormous amounts of water to build up behind it. The bridge on Route 84, which crosses the Grand River upstream of central Painesville, was already closed due to construction. There was a large amount of construction equipment adjacent to the bridge which ultimately acted as a dike, blocking the flow. A huge amount of debris-laden water became dammed at the bridge. At approximately 3:20am on July 28th the pressure of the water and debris became too great and the dam-like pileup broke, releasing a wall of water and debris that surged downstream.

City manager Rita McMahon recounts the events:

“It was just this wall of water, that just came... The police lieutenant was gonna go get the police chief who lives on the other side of the river. [At] 3:15 he drives over to get the police chief, at 3:35 he’s driving through water coming back, and he was like one of the last cars to come back up the road to get across the bridge before we had to shut everything down and get those people out.”

This process was repeated as the flood moved down the river valley, picking up more wreckage along the way until reaching the next bridge and repeating the ordeal. By the end of the flood, Painesville lost five bridges, causing severe transportation problems that ensued for days.
CHAPTER FOUR

METHODOLOGY

4.1. Introduction

Data regarding individual flood experience, perceptions, and preparedness were collected in the form of a mail survey. Many studies have successfully utilized surveys in risk perception research (Barnett and Breakwell, 2001; Takao, 2004; Grothmann and Reusswig, 2006; Knockee and Kolivras, 2007; Horney et al., 2010). The survey focused on topics related to individuals’ experience with floods at the personal and community levels, perceptions relating to causative mechanisms of flooding, as well as risks and impacts, preparation related activities, sources of information, and reactions to past flood events. The target survey audience was the adult population of the City and Township of Painesville, so the only requirements to be eligible to participate were being age 18 or over and currently having a residence in the study area. Both homes and apartments were included, as well as both owners and renters. Surveys were mailed out to 1200 residents, 87 of which lived in the floodplain (Fig. 14). Addresses were purchased from USAdata.com. Address can be purchased in two ways: by selecting a random sample within a geographic region (i.e., by city name or zip code), or by selecting a random sample with a specific radius of an address. In order to access as many respondents who live in or near the floodplain as possible three separate areas were selected. The worst hit region in 2006 was an area of the city along a bend in the
Grand River near Main Street, Grand River Avenue, Steele Street, Gristmill Drive, and Millstone Drive. A 0.2-mile radius around a central address in this area produced 400 addresses. The next area of focus was a 1-mile radius around a central address on Newell Road, a region encompassing Pebble Brook stream, a tributary of the Grand River. A total of 300 random addresses were selected from this area. The third and final selection area was a 1-mile radius around a central address on Garwood Road which is located on higher ground near the high school where evacuees were taken. A total of 500 random addresses were selected from this area. This method of selection was used in an attempt to capture as many residents residing in the floodplain as possible as well as gaining input from residents located in parts of the city away from and above the floodplain.

In order to increase response rates business reply mail was used (Mangione, 1995). A letter written by me was included explaining the purpose of the survey, the rights of the participants, and information on how to contact me or the Kent State University Institutional Review Board, along with a letter of endorsement written by the City Manager of Painesville (Appendix A-B). Most of the survey questions were multiple-choice responses, while others were open-ended (Appendix C). The surveys were mailed on July 20, 2010. All responses received by October 1, 2010 were included in this study. The anticipated response rate was 10-15%. The actual overall response rate was 15.4%, totaling 185 surveys. The response rate was higher among those who lived in the floodplain at 17.2%, compared to those who did not live in the floodplain at 15.3%.
Figure 14. Map of survey area showing all addresses to which a survey was mailed

4.2. Quantitative Analysis

Most multiple choice questions were single answer, meaning the respondent was to choose only one answer per question. Single-answer multiple choice questions, aside from those pertaining to demographics, were split into three main categories: experience, perceptions, and preparedness. Experience variables aimed to assess in
what ways people have experienced flooding in the past. Related literature has suggested that greater concern and increased levels of preparedness is correlated with the frequency of exposure (Knocke and Kolivras, 2007; Barnett and Breakwell, 2001), how recently a person has experienced a similar event (White, 1964; Barnett and Breakwell, 2001), and past negative impacts that were severe (Weinstein, 1989; Grothmann and Reusswig, 2006). Based on these findings, a set of variables was designated for the experience category (Table 1). In some cases responses were aggregated into smaller classes based on the distribution of responses. This was done in cases when very small numbers of respondents chose a particular response, which would make statistical analysis less powerful. For example, the Most Recent variable originally had five response options and has since been aggregated into three. To view the survey with all original response options, see Appendix C.
Table 1. Experience variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survey Question</th>
<th>Aggregated Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>How often have you experienced river flooding in the past?</td>
<td>- Never</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Once</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- More than Once</td>
</tr>
<tr>
<td>Most Recent</td>
<td>When was your most recent experience with river flooding?</td>
<td>- Never experienced flooding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 0-5 years ago</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- More than 5 years ago</td>
</tr>
<tr>
<td>Injury</td>
<td>Have you or someone you know ever been injured in a flood?</td>
<td>- I have not been injured but someone I know has</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Neither I nor anyone I know has been injured</td>
</tr>
<tr>
<td>Property Damage</td>
<td>Have you or anyone you know ever had property damaged in a flood?</td>
<td>- Either I or someone I know has property damaged</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Neither I nor anyone I know has property damaged</td>
</tr>
<tr>
<td>Past Personal Impact</td>
<td>River flooding has had a negative impact on my personal life in the past.</td>
<td>- Strongly Agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Somewhat Agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Somewhat Disagree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Strongly Disagree</td>
</tr>
<tr>
<td>Past Community Impact</td>
<td>River flooding has had a negative impact on my community in the past.</td>
<td>- Strongly Agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Somewhat Agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Somewhat Disagree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Strongly Disagree</td>
</tr>
</tbody>
</table>

The purpose of identifying a set of variables under the category of risk perception was to gain an understanding of whether or not individuals are concerned over potential flood events and whether or not they anticipate being impacted in the future. It is anticipated that individuals who have been negatively impacted in the past are more likely to anticipate similar future impacts and have greater level of preparedness. Related literature (Barnett and Breakwell, 2001) identified concern and dread as two major risk characteristics related to risk perceptions. Two similar variables,
worry and danger, are used in this research as well as two other variables which help to identify whether or not respondents feel they will be impacted in the future (Table 2).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survey Question</th>
<th>Aggregated Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger</td>
<td>Do you feel river floods are dangerous?</td>
<td>- Yes, very dangerous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sometimes, but not always</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No, they aren’t dangerous</td>
</tr>
<tr>
<td>Worry</td>
<td>Do you worry about river flooding?</td>
<td>- Yes, very much</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Somewhat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No, not at all</td>
</tr>
<tr>
<td>Future Personal Impact</td>
<td>Do you feel that river flooding could negatively impact your personal life in the future?</td>
<td>- Yes, long term impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Yes, short-term impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No, I doubt it</td>
</tr>
<tr>
<td>Future Community Impact</td>
<td>Do you feel that river flooding could negatively impact your personal life in the future?</td>
<td>- Yes, long term impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Yes, short-term impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No, I doubt it</td>
</tr>
</tbody>
</table>

When thinking about individual flood preparedness, two actions come to mind: the development of a plan of action, and the ownership of flood insurance. Both FEMA and the Lake County Emergency Management Agency (EMA) encourage individuals in flood prone areas to protect their lives and property by establishing a personal response plan for emergency situations and purchasing flood insurance. Therefore, these two variables are designated for the preparedness category (Table 3). Since some individuals are required to purchase flood insurance because they live in a flood designated area, and others may choose to do so but are not required to, appropriate answer options will account for this difference.
Table 3. Preparedness variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survey Question</th>
<th>Aggregated Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan of Action</td>
<td>Do you have a plan of action if flooding occurred where you live?</td>
<td>-Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-No</td>
</tr>
<tr>
<td>Insurance</td>
<td>Do you own flood insurance?</td>
<td>-Yes, I had to purchase a policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Yes, it was optional and I did purchase a policy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-No</td>
</tr>
</tbody>
</table>

Demographic attributes were also collected and compared to the perception and preparedness variables to determine if any associations exist. Within each category, all variables were compared to the variables of each other category. The only exception is between the demographic and experience categories. The reason for this is that it is unlikely that past experience is highly affected by demographics (i.e. men having more recent experiences with flooding than women).

When the surveys were mailed out they were demarcated to indicate which surveys were completed by residents residing in the 100-year floodplain versus which were completed by residents residing outside the floodplain. This variable is referred to as actual location, and respondents were identified as either in the floodplain or out. In addition, all respondents were asked whether or not they lived in the floodplain with the response options of Yes, No, and Not Sure. This variable is referred to as perceived location. Actual location and perceived location were compared to determine if residents were knowledgeable as to whether or not they live in the floodplain.
A series of crosstabulations were performed making comparisons between each set of variables. Six series were produced: Demographics Vs. Perceptions, Demographics Vs. Preparedness, Actual Location Vs. Perceived Location, Experience Vs. Perceptions, Perceptions Vs. Preparedness, and Experience Vs. Preparedness. With each individual crosstabulation, a chi-square analysis was performed to determine if a statistical association exists. The calculation a chi-square value depends upon a contingency table, which is produced via the crosstabulation. The contingency table generates the expected values for each cell, meaning the value each cell would contain if no association exists. Chi-square analysis tests the null hypothesis that the observed values will be close to the expected values. If the observed values differ significantly from the expected values then an association exists and the null hypothesis is rejected.

In analyzing the survey results, variables that produced a chi-squared result with a $p$ value $\leq 0.05$ were determined to be associated at the 95% confidence interval, and variables that produced a chi-squared result with a $p$ value $\leq 0.1$ were determined to be associated at the 90% confidence interval. Variables with $p$ values $> 0.1$ were not considered statistically associated, although in some cases analysis of the results still revealed patterns. Because chi-square results rely on a sufficient sample size, it was important to consider the expected counts of each cell within the contingency table produced via crosstabulation. When 20% or more cells have expected counts less than five, or any expected count is less than one, it is possible that the chi-squared result may
not be accurate. In such cases a further examination of the distribution of the data is useful to determine if any patterns are present corroborating the statistical association.

Multiple-answer multiple choice questions, meaning the respondents were prompted to choose all answers that applied, were tallied on a question by question basis. These results are presented in table format.

4.3 Qualitative Analysis

Several questions were open ended and therefore must be analyzed qualitatively. This portion of analysis is modeled after the procedure utilized by Knockee and Kolivras (2007) in surveying residents of southwest Virginia on their flash flood awareness. A set of common themes and phrases were identified for each open ended question and the frequency with which respondents used those themes was evaluated. Any responses that were repeated five or more time were included in the frequency counts. At times, various ways of wording the same theme were presented and were aggregated into the same category. For example, one question asked what types of events respondents expected to cause a flood. Responses including the terms ‘rain’, ‘rainfall’, and ‘precipitation’ were aggregated into one category. The use of open ended questions gave respondents an opportunity to express the way in which they think about and prepare for flooding in their own words. These results are presented in table format.
The final question of the survey asks respondents how the flood of 2006 has changed the way they think about and prepare for natural hazards, if at all. While the frequency of use of common keywords and themes were also charted for this question, there was also an additional opportunity here to extract significant quotations pertaining to the impact of this specific flood event. The respondents were given the most amount of room to answer this question and many respondents took the opportunity to discuss their personal feelings about the flood and related response efforts. Such responses lend themselves to a contextual analysis and discussion.

4.4 Interviews

Two interviews were conducted with a total of five administrative personnel from the City of Painesville and Lake County. On June 2, 2010 an interview was conducted with Rita McMahon, the Painesville City Manager, Richard Lesiecki, the City Engineer, Lee Homyock, the Recreation and Public Lands Director, and Kevin Lynch, the city’s Public Services Director. On June 17, 2010 an interview was held with Larry Greene, Director of the Lake County EMA. During these times the interviewees discusses their experience with the flood of 2006 from both a personal perspective as well as from the prospective of city and county officials in charge of mitigating the damages from the flood. Topics discussed included the timing of events, initial response, clean up efforts, damages, long term response, and in what ways the
experience of the flood has impacted the ways in which the local government plans for and prepares for future floods and other hazard events. These issues were evaluated separately from the data collected at the individual level and are discussed in the following chapter.
CHAPTER FIVE

FLOOD EXPERIENCE, PERCEPTION, AND PREPAREDNESS: THE ADMINISTRATIVE PERSPECTIVE

5.1 July 2006 Flood Response

While the main focus of this research relates to the associations of experience, perceptions, and preparedness of flooding at the individual level, it is useful to consider if and how these relationships exist at the municipal level as well. In order to determine how public officials have been influenced by past experience, who are charged with orchestrating the planning, mitigating, and recovery stages of hazard management, a series of interviews were held. On June 2, 2010 an interview was conducted with Rita McMahon, the Painesville City Manager, Richard Lesiecki, the City Engineer, Lee Homyock, the Recreation and Public Lands Director, and Kevin Lynch, the city’s Public Services Director. On June 17, 2010 an interview was held with Larry Greene, Director of the Lake County EMA. The information that follows regarding the flood response and the influence the flood had on the administration was obtained during these interviews.

Just east of central Painesville, the Grand River meanders sharply around the low lying area where a condominium complex was destroyed during the July 2006 flood. Several other apartment buildings and numerous homes are located in this area as well. The buildings in this area are sitting on a point bar along the river in a topographic setting that is essentially bowl-like, causing drainage to be very slow. During the flood
of July 2006 mandatory evacuations were called for individuals who lived in this area. However, by the time the evacuations were called many homes were already flooded and people wanted out. Many residents, including those at the Gristmill and Millstone condominiums, were stranded on their roofs while heavy rain was still falling. Many people were ultimately rescued by boats. Evacuated residents were taken to Riverside High School, which is located on higher ground. Once evacuations were occurring the only way back into the area was by city van. Residents were not permitted to travel back to the flooded areas on their own.

On the morning of Sunday, July 30th the city decided to pump the area to speed up the much needed drainage, and by Sunday evening over one million gallons of water had already been pumped. Despite this effort, water was still several feet deep in the low lying areas. At this point a decision had to be made about whether to dig a drainage channel, which would require breaking several sewer pipes. Ultimately the city chose to go ahead with the channel to speed up the drainage process, aiming to get people back into their homes as quickly as possible. To ensure safety, every building had to be inspected before residents were allowed back in. Several homes were pushed off their foundations and had to be demolished. The condominiums at Gristmill and Millstone were badly damaged and deemed uninhabitable. Due to their location within the floodplain, they cannot be rebuilt.

The brunt of the cleanup effort in Painesville lasted approximately four to five days after the flood, a relatively quick process given the widespread damage to the area.
A significant reason for this speedy cleanup was the decision by administrators to invest in waste haulers that drove through the town the Sunday following the Friday storm and aided residents in the removal of damaged and rotting property. The decision to invest in this equipment cost the city $200,000 which was eventually reimbursed by FEMA.

Richard Lesiecki, Painesville’s City Engineer, discusses the cleanup:

“Our philosophy was ... how long can you let people drive home and see their childhood memories sitting on the lawn rotting? We were able to clean up this town in a four or five day period of time whereas some communities hadn’t even started because there really wasn’t an importance to them, but to us, we just knew what we were gonna get, and I mean, you throw away a hundred years worth of living, photographs... When that person came home you wanted it out of the lawn, cause then you forgot.”

Other areas of the city fared better, but the combination of flooded streams and a rising water table caused significant basement flooding in many locations. While these areas did not receive a mandatory evacuation, the electricity in several neighborhoods was shut off for safety purposes, causing some residents to evacuate voluntarily. After the water receded from these areas, inspections were performed to determine if it was safe to restore power to each home. It took approximately three days to restore power to all homes.

After the flood took place there was a large community out pouring of residents who wanted to help individuals who had suffered losses. In fact, the outpouring was so great that it become almost unmanageable by city administrators. While there was no shortage of generosity on the part of residents wanting to help with the response and recovery efforts, the city had to be very careful about letting people assist due to
liability reasons. Concerns over the instability of many structures and utilities also
impeded volunteer response efforts. Since the flood occurred on a Friday morning the
city administrators decided to stay open over the weekend in order to take phone calls
from residents. People were calling with both questions about what they should be
doing, and offering donations to those in need.

The first FEMA personnel arrived July 29th. Once the level of devastation became
apparent, the area was declared a federal disaster zone, enabling additional FEMA
resources to be deployed to the city. The disaster declaration was made by President
George W. Bush on August 2, 2006 for Lake, Ashtabula, and Geauga Counties. This was
helpful because many resources available through the Red Cross had been depleted in
other communities to the south and west, which were affected prior to Painesville. Prior
to FEMA’s arrival on July 29th, a shelter was set up which, in light of the lack of
remaining support from the Red Cross, was staffed solely by Painesville city officials.
Residents in need of evacuation were transported to the high school where their names
and addresses were recorded in order to keep track of who was there. The city was very
much in need of the outside support and FEMA was welcomed when they arrived.

However, it was also a significant challenge for city administrators in terms of
communication and compliance with FEMA regulations. Initially, the shelter at the high
school did not meet FEMA standards initially so adjustments had to be made. To
comply with the standards air conditioners and other supplies were brought to the
shelter. Despite the difficulties of a lack of aid from the Red Cross and coordinating
issues with FEMA, the ample number of volunteers from the community made response and recovery possible. In addition to support from within the community, the county EMA Director Larry Greene maintained frequent contact with city officials in order to provide whatever aid was available to the city.

While working with FEMA, the city of Painesville was able to acquire three grants; two Hazard Mitigation Grant Program (HMGP) grants, and a Flood Mitigation Assistance (FMA) grant. These grants allowed the city to acquire the land where property was destroyed at the pre-flood value as long as the residents agreed. The Gristmill and Millstone condominium complexes qualified for the program. Once the city took ownership of the condominiums they were to be demolished. The city was then restricted on the allowable land use to open space activities due to their location within the floodplain. Gristmill was acquired, demolished, and is now open space. Millstone is still standing as of January 2011 because one of the 38 property owners refused to sell. The matter is currently going through the litigation process. The city hopes that they will be able to acquire the property to convert the whole area into an 18-acre park.

The city also got a grant from the Ohio EPA that comes as a result of making improvements to the city’s waste water treatment plant. Through the Water Resource Restoration Sponsorship Program, the city was given back the interest from the loan received to make the improvements to the plant. The interest refund can then be used towards a stream restoration project. City officials used the refund, which totaled
almost $1,000,000 to restore the area acquired by the FEMA grants back to its natural habitat.

5.2 Lessons Learned

Although several residential areas within Painesville are located within the 100-year floodplain, the magnitude of the 2006 flood was a surprise to everybody according to city administrator Rita McMahon. After the flood, officials decided a better warning system was needed. The city began implementing reverse 911 calls to residents who reside in flood designated areas. When the river level is forecast to reach flood stage, residents are now informed via the reverse 911 system. The town of Eastlake, which is located approximately 15 miles west of Painesville on the banks of the Chagrin River, also has a reverse 911 system in place, which was in effect prior to the 2006 flood. The reverse 911 in Eastlake consists of two messages that are pre-recorded in the voice of the town’s Mayor. The first message warns of impending flood waters and instructs residents to move personal belongings and cars to higher ground. The second message warns of dangerous flood waters and advises residents to evacuate immediately. During the July 2006 flood event, these two messages were sent out only twenty minutes apart.

The adoption of a reverse 911 system in Painesville exemplifies the increase in resiliency efforts and proactive behaviors on the part of the city administration after the flood. In Painesville, the reverse 911 call is made by the Fire Chief when the river has left
its banks at the end of Grand River and Steele Avenues, which is at a stage height of approximately 13 feet. Despite the possibility that not all residents will have telephones, this may be the most reliable system to ensure reaching as many people as possible during a flood event. Other methods of warning residents include the use of a community access channel and the city’s website to notify residents of potential flooding. The Lake County EMA encourages all residents to own a weather radio, although according to the organization’s Director Larry Greene, few people actually do. Many residents feel they do not want to be woken up every time there is a thunderstorm watch or warning in the area. The city is also equipped with sirens which go off during tornado warnings, and since the July 2006 flood these are now permitted for use during other hazardous life threatening events, such as floods of great magnitude. Despite these efforts, warnings communicated via television, radio, and sirens are often not received, especially in the middle of the night. This is why reverse 911 has become such a vital component to Painesville’s warning system. Lesiecki expresses the importance of reverse 911 in light of the experience of 2006:

“The one thing that we learned is that people at three o’clock in the morning with water up to their second floor, they don’t hear alarms ... It may be nice to have a countywide system, but they haven’t heard it, and by the time they’ve heard it, it’s too late. And that’s why the reverse 911 is an excellent way to do it because at least then you know you’re gonna get somebody.”

In addition to implementing new technologies to aid in disaster response, city officials have also changed the way they react and communicate during disasters. A year and a half after the 2006 flood the city was faced with dealing with the effects of a
train derailment, a very different but also very serious type of hazard. The experience of
the previous year helped city officials to streamline the process of response by assessing
who is responsible for what, which departments house various types of expertise, and
what equipment is available. Lee Homyock, Director of the Recreation and Public Lands
Department discusses how the response to the train derailment was affected by the
experience of the flood:

“Sometimes it has nothing to do with your daily job description or anything, but
who does something better, or has experience some place that they normally
don’t use here that actually helps start with a procedure of where we start from,
where we go, who we contact and everything. So if anything the flood’s benefit
was it really put that on the top ... and it’s been time tested that we naturally go
there now [referring to the police station where officials now congregate during
disasters]”.

The actions that will be taken during disasters have clearly been defined by the
experience of the 2006 flood. It became very clear to officials what needs to be done,
who needs to do what, and the seamlessness with which response actions need to
happen. Kevin Lynch, Painesville’s Public Services Director speaks to the value of
immediate action during disasters in light of the flood experience:

“All type of disaster like this, the greatest effort that you give at the beginning
the quicker it’s gonna end. If you procrastinate, if you don’t develop a plan, it
just isn’t gonna work... There were a lot of communities ... we would see that our
garbage was already picked up and when ... are they gonna start picking theirs
up? You gotta come in and you gotta plan, you gotta stick to that plan, find your
resources and go ahead and do it, because if you don’t someone else is plucking
that stuff up, and then you’re in trouble. So, that’s what we learned.”
City Manager Rita McMahon similarly expresses ways in which disaster response has changed since the flood:

“What’s changed I think is that people don’t wait for me to show up to start making the calls to get the people in ... There’s a greater anticipation now, you know, like the fire chief, while he’s calling me as safety director and city manager to come in and do X, Y, and Z, you know, he’s calling me and he’s calling Kevin, and he’s calling the water guys and he’s calling the electric guys, and they’re all showing up. So when I’m here, now I don’t have to spend that time calling those people in, they’re all on their way, showing up, so by the time we get here we can start doing things.”

She goes on to discuss how the flood has affected her preparedness on a personal level as well:

“I can tell you from personal experience that once you get flooded it forever changes your perception of a rain event... Now there’s nothing in my basement that won’t float. I got a furnace and a hot water tank, and everything else, if it gets wet, I don’t care.”

Prior to the 2006 flood it would have been hard to imagine that such a catastrophic event could occur in the quiet community of Painesville. Floods were not uncommon in the area, but no other event on record came close to causing the level of destruction that was reached that July. Despite numerous flood warnings broadcast over network television days leading up to the rain event, the residents did not anticipate the level of devastation that was to come. Several residents in the nearby township of Concord were first made aware of the rising flood waters when swift water rescue teams began pounding on second story windows from rescue boats, arising people from their slumber in order to evacuate them from the area. The flood waters
surged into the area during the overnight hours creating an immediate need to rescue so many people from their homes and roofs in the early morning hours of July 28th. While the response efforts throughout Northeast Ohio on the part of city and county administrations, as well as the Red Cross in some areas, was admirable, this event made clear the importance of better warning systems.

The most significant change that has come about in Painesville as a result of this flood event is the implementation of the reverse 911 system. The 2006 flood taught the city administrators that relying on the news networks and weather radios as a means of informing residents were not enough. In a survey conducted in Painesville regarding the impact of flooding in the region, 85% of respondents believed it was the responsibility of local and regional government officials to inform residents of an impenitent flood. Only 68% felt that this responsibility also fell to television news networks. Reverse 911 and the increased use of sirens in extreme situations are both excellent ways of taking on the responsibility the community has charged the local government with.

Not only has the city of Painesville taken efforts to improve their warning systems, but a more streamlined response regime has been established in the face of both natural human induced hazards and disasters. The importance of quick response was emphasized during the flood, and the failure to utilize Red Cross efforts underlined the necessity to establish access to resources immediately. The significance of streamlining response efforts also became apparent, and in disasters occurring post-2006 such organizations enabled more efficient use of response time and resources.
The flood of 2006 has been a learning experience, for city and county officials, and residents alike. Not everything went as smoothly as possible prior to, during, or after the event, but the most commendable efforts were made by the administration. The outpouring of volunteers and donations from the community was above and beyond expectations, to the point it was difficult to coordinate. It is unfortunate so few residents are willing to equip their homes with a weather radio, particularly those who reside in a flood designated area. However, from the perspective of the local and regional government, the important thing is to recognize this fact and make necessary strides to ensure that adequate warnings are received with reasonable lead time during hazardous events. This has been, and continues to be, a goal of the city and county officials.
CHAPTER SIX

SURVEY RESULTS

6.1 Introduction

A total of 185 responses were received between August 1st and October 1st, 2010, which constituted a response rate of 15.4%. The survey collected information that was separated into three main groups of variables: experience, perceptions, and preparedness. Additionally, demographic attributes were collected and compared to the perception and preparedness variables to determine if any associations exist. Within each category, all variables were compared to the variables of each other category using a chi-square model. The only exception is between the demographic and experience categories. The reason for this is that it is unlikely that past experience is highly affected by demographics (i.e. men having more recent experiences with flooding than women).

6.2 Demographics

The gender demographic of the sample matched closely that of the population of the City of Painesville. The sample represents a greater portion of the older, white, higher educated and higher income groups of the population (Table 4).
As previously discussed, it is important to include demographic attributes in any risk assessment. Before evaluating associations between the experience, perception, and preparedness variables, it is useful to examine any associations that may exist relating to socioeconomic variables. The demographic variable of Race/Ethnicity was left out of any analysis since all but five respondents, 95.7%, were of the same race. This fact would make determining statistical associations impossible. Additionally, when

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**Table 4. Sample and population demographics of respondents and all Painesville residents**

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Painesville</th>
<th>Survey</th>
<th>Painesville Percentage</th>
<th>Survey Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8,616</td>
<td>91</td>
<td>49.2%</td>
<td>49.2%</td>
</tr>
<tr>
<td>Female</td>
<td>8,887</td>
<td>90</td>
<td>50.8%</td>
<td>48.6%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>30.5</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 25</td>
<td>6,971</td>
<td>3</td>
<td>39.3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>25 to 34</td>
<td>3,109</td>
<td>12</td>
<td>17.1%</td>
<td>5.5%</td>
</tr>
<tr>
<td>35 to 44</td>
<td>2,582</td>
<td>30</td>
<td>14.8%</td>
<td>16.2%</td>
</tr>
<tr>
<td>45 to 54</td>
<td>1,938</td>
<td>41</td>
<td>11.1%</td>
<td>22.2%</td>
</tr>
<tr>
<td>55 to 64</td>
<td>1,109</td>
<td>46</td>
<td>6.3%</td>
<td>24.9%</td>
</tr>
<tr>
<td>65 to 74</td>
<td>840</td>
<td>30</td>
<td>4.9%</td>
<td>16.2%</td>
</tr>
<tr>
<td>74 to 84</td>
<td>673</td>
<td>10</td>
<td>3.8%</td>
<td>5.4%</td>
</tr>
<tr>
<td>85 and over</td>
<td>281</td>
<td>11</td>
<td>1.6%</td>
<td>5.9%</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>13,475</td>
<td>177</td>
<td>77.0%</td>
<td>95.7%</td>
</tr>
<tr>
<td>Black</td>
<td>2,254</td>
<td>3</td>
<td>12.2%</td>
<td>1.6%</td>
</tr>
<tr>
<td>American Indian</td>
<td>51</td>
<td>0</td>
<td>0.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Asian</td>
<td>74</td>
<td>0</td>
<td>0.4%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>2,256</td>
<td>0</td>
<td>12.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Two or More Races</td>
<td>500</td>
<td>2</td>
<td>2.5%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Other/Prefer Not to Say</td>
<td>1</td>
<td>0</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High School Graduate</td>
<td>7,900</td>
<td>101</td>
<td>74% *</td>
<td>54.6%</td>
</tr>
<tr>
<td>Bachelor's Degree or Higher</td>
<td>1,321</td>
<td>78</td>
<td>12.4% *</td>
<td>42.2%</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than $25,000</td>
<td>2,274</td>
<td>28</td>
<td>34.9%</td>
<td>15.1%</td>
</tr>
<tr>
<td>$25,001 - $50,000</td>
<td>2,346</td>
<td>39</td>
<td>35.9%</td>
<td>21.1%</td>
</tr>
<tr>
<td>$50,001 - $75,000</td>
<td>1,294</td>
<td>27</td>
<td>19.8%</td>
<td>14.6%</td>
</tr>
<tr>
<td>$75,001 - $100,000</td>
<td>342</td>
<td>30</td>
<td>5.2%</td>
<td>16.2%</td>
</tr>
<tr>
<td>$100,001 or higher</td>
<td>275</td>
<td>30</td>
<td>4.3%</td>
<td>16.2%</td>
</tr>
<tr>
<td>Prefer not to say / No Response</td>
<td>0</td>
<td>31</td>
<td>0.0%</td>
<td>16.8%</td>
</tr>
</tbody>
</table>

*Among residents 25+
evaluating the education variable individuals with less than a high school diploma were left out of analysis because only one respondent fell into this category. Contingency tables were produced and associated chi-square analysis was preformed comparing both perception variables and preparedness variables to demographics. Summaries of these results are found in Tables 5 and 6.
Table 5. Summary of crosstabulation and chi-square analysis results of associations between perception and demographic variables, and legend

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Variable</th>
<th>df</th>
<th>$x^2$</th>
<th>p</th>
<th>%EC &lt; 5</th>
<th>Any EC &lt; 1</th>
<th>Direction of Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Danger</td>
<td>2</td>
<td>0.648</td>
<td>0.723</td>
<td>33.3%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>2</td>
<td>1.105</td>
<td>0.570</td>
<td>0.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>2</td>
<td>0.182</td>
<td>0.913</td>
<td>0.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>2</td>
<td>3.048</td>
<td>0.218</td>
<td>0.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td>Age</td>
<td>Danger</td>
<td>14</td>
<td>14.850</td>
<td>0.388</td>
<td>54.2%</td>
<td>Y</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>14</td>
<td>24.923</td>
<td>0.090</td>
<td>50.0%</td>
<td>Y</td>
<td>Increase levels of worry among middle aged adults (35 - 74)</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>14</td>
<td>16.745</td>
<td>0.270</td>
<td>45.8%</td>
<td>Y</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>14</td>
<td>14.275</td>
<td>0.429</td>
<td>54.2%</td>
<td>Y</td>
<td>.....</td>
</tr>
<tr>
<td>Education</td>
<td>Danger</td>
<td>2</td>
<td>4.309</td>
<td>0.116</td>
<td>39.3%</td>
<td>Y</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>2</td>
<td>9.141</td>
<td>0.010</td>
<td>0.0%</td>
<td>N</td>
<td>Increase levels of worry among those without a college degree</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>2</td>
<td>7.727</td>
<td>0.021</td>
<td>0.0%</td>
<td>N</td>
<td>Increased anticipation of negative long term impacts among those without a college degree</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>2</td>
<td>0.425</td>
<td>0.797</td>
<td>16.7%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td>Income</td>
<td>Danger</td>
<td>4</td>
<td>12.663</td>
<td>0.018</td>
<td>39.3%</td>
<td>Y</td>
<td>Increased perception of greater danger among those with lower incomes</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>4</td>
<td>7.267</td>
<td>0.122</td>
<td>11.1%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>4</td>
<td>4.921</td>
<td>0.290</td>
<td>0.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>4</td>
<td>6.381</td>
<td>0.160</td>
<td>39.3%</td>
<td>N</td>
<td>.....</td>
</tr>
</tbody>
</table>

Legend:

- 95% CI
- 90% CI
- Bold: %EC < 5 = ≤20% OR No EC < 1

Table 6. Summary of crosstabulation and chi-squared analysis results of associations between preparedness and demographic variables, same legend as Table 2

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Variable</th>
<th>df</th>
<th>$x^2$</th>
<th>p</th>
<th>%EC &lt; 5</th>
<th>Any EC &lt; 1</th>
<th>Direction of Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Plan of Action</td>
<td>1</td>
<td>0.938</td>
<td>0.333</td>
<td>0.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>3</td>
<td>1.102</td>
<td>0.797</td>
<td>50.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td>Age</td>
<td>Plan of Action</td>
<td>7</td>
<td>5.260</td>
<td>0.521</td>
<td>31.3%</td>
<td>Y</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>21</td>
<td>14.714</td>
<td>0.834</td>
<td>78.1%</td>
<td>Y</td>
<td>.....</td>
</tr>
<tr>
<td>Education</td>
<td>Plan of Action</td>
<td>1</td>
<td>3.719</td>
<td>0.054</td>
<td>0.0%</td>
<td>N</td>
<td>Majority of individuals with a plan do not have a college degree</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>3</td>
<td>2.402</td>
<td>0.493</td>
<td>25.0%</td>
<td>N</td>
<td>.....</td>
</tr>
<tr>
<td>Income</td>
<td>Plan of Action</td>
<td>2</td>
<td>7.992</td>
<td>0.018</td>
<td>0.0%</td>
<td>N</td>
<td>Majority of individuals with a plan have lower incomes</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>6</td>
<td>3.073</td>
<td>0.900</td>
<td>58.3%</td>
<td>N</td>
<td>.....</td>
</tr>
</tbody>
</table>
6.3 Associations between Perceived and Actual Risk

Prior to mailing the survey, all addresses were mapped with ArcMap 9.3.1 software to determine which residents resided in the 100-year floodplain. Floodplain hazard areas are defined by the ODNR Geographic Information Management Systems (GIMS) Program. Return envelopes were demarcated to identify which surveys were completed by residents living in the floodplain and which were completed by residents not living in the floodplain. Respondents were asked whether or not they live in the floodplain with the response options of:

- Yes
- No
- Not Sure

Actual locations of residence relative to the floodplain (In Floodplain or Not In Floodplain) and perceptions of residents locations were compared (Fig. 15). Of residents who do live in the floodplain, 80% correctly answered Yes, while 20% incorrectly answered No. Of residents who do not live in the floodplain, 7.1% incorrectly answered Yes, 74.7% correctly answered No, and 17.1% answered Not Sure. A Chi Square value of 65.135 with a significance level of < 0.001 was produced. This suggests that the two factors are strongly associated. Although the expected count of 50% of the cells in the contingency table were less than five and the minimum expected count is less than one, Figure 14 shows that 75.1% of respondents correctly identified their
location in or out of the floodplain and the distribution of data corroborates the statistical association.

**Figure 15.** Comparison between actual residence relative to the floodplain and perception of residence relative to the floodplain

**Table 7.** Chi-squared analysis of perceived versus actual location

<table>
<thead>
<tr>
<th>Question</th>
<th>Variable</th>
<th>$df$</th>
<th>$x^2$</th>
<th>$p$</th>
<th>%EC &lt; .5</th>
<th>%EC &lt; .1</th>
<th>Direction of Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you live in the floodplain?</td>
<td>Residence in FP</td>
<td>3</td>
<td>65.135</td>
<td>0.000</td>
<td>50.0%</td>
<td>Y</td>
<td>Majority of residents correctly identified their location in or out of the floodplain</td>
</tr>
</tbody>
</table>
6.4 Associations between Experience and Perceptions

To investigate the relationship between past experiences with flooding and perceptions of flooding, several crosstabulations are performed. There are six variables which represent the experience of the respondents, which are:

- Frequency - (How often have you experienced river flooding in the past?)
- Most Recent - (When was your most recent experience with river flooding?)
- Injury - (Have you or anyone you know ever been injured in a river flood?)
- Property Damage - (Have you or anyone you know ever had property damaged in a river flood?)
- Past Personal Impact - (River flooding has had a negative impact on my personal life in the past)
- Past Community Impact - (River flooding has had a negative impact on my community in the past)

These variables were compared to variables relating to individuals' perceptions of flooding. There are four perception variables which are:

- Danger - (Do you feel river floods are dangerous?)
- Worry - (Do you worry about river flooding?)
- Future Personal Impact - (Do you feel that river flooding could negatively impact your personal life in the future?)
- Future Community Impact - (Do you feel that river flooding could negatively impact your community in the future?)

Chi-squared analysis was performed for each pairing of experience and perception variables. Two levels of significant associations were defined: associations at the 90% confidence interval ($p \leq 0.1$) and at the 95% confidence interval ($p \leq 0.05$). Contingency tables that have greater than 20% of cells with expected counts less than five, or with any expected count less than one need to be considered with caution as they
may not be reliable. In such instances it is useful to carefully examine any patterns within the distribution of data which will help determine the validity of the chi-square result. A summary of results is displayed in Table 8.
<table>
<thead>
<tr>
<th>Question</th>
<th>Variable</th>
<th>df</th>
<th>x2</th>
<th>p</th>
<th>%EC &lt; 3</th>
<th>Any EC &lt; 1</th>
<th>Direction of Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often have you experienced river flooding in the past?</td>
<td>Danger</td>
<td>4</td>
<td>2.62</td>
<td>0.623</td>
<td>33.3%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>4</td>
<td>6.2</td>
<td>0.185</td>
<td>22.2%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>4</td>
<td>9.32</td>
<td>0.054</td>
<td>0.0%</td>
<td>N</td>
<td>Increased anticipation of long and short term negative impacts among those who experienced flooding once</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>4</td>
<td>4.36</td>
<td>0.359</td>
<td>22.2%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td>When was your most recent experience with flooding?</td>
<td>Danger</td>
<td>4</td>
<td>3.68</td>
<td>0.451</td>
<td>55.6%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>4</td>
<td>13.6</td>
<td>0.009</td>
<td>33.3%</td>
<td>Y</td>
<td>Increased level of worry among those with recent experience</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>4</td>
<td>8.6</td>
<td>0.072</td>
<td>33.3%</td>
<td>Y</td>
<td>Increased anticipation of long and short term negative impacts among those with recent experience</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>4</td>
<td>2.23</td>
<td>0.693</td>
<td>33.3%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td>Have you or someone you know ever been injured in a river flood?</td>
<td>Danger</td>
<td>2</td>
<td>4.12</td>
<td>0.127</td>
<td>33.3%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>2</td>
<td>2.37</td>
<td>0.305</td>
<td>16.7%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>2</td>
<td>11</td>
<td>0.004</td>
<td>16.7%</td>
<td>N</td>
<td>Increased anticipation of long and short term negative impacts among those who knew someone injured in a flood</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>2</td>
<td>2.04</td>
<td>0.361</td>
<td>16.7%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td>Have you or someone you know ever had property damaged in a river flood?</td>
<td>Danger</td>
<td>2</td>
<td>2.82</td>
<td>0.245</td>
<td>33.3%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>2</td>
<td>7.44</td>
<td>0.024</td>
<td>0.0%</td>
<td>N</td>
<td>Increased level of worry among those who have experienced property damage</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>2</td>
<td>5.14</td>
<td>0.077</td>
<td>0.0%</td>
<td>N</td>
<td>Increased anticipation of long term negative personal impacts among those who have experienced property damage</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>2</td>
<td>9.03</td>
<td>0.011</td>
<td>16.7%</td>
<td>N</td>
<td>Increased anticipation of long term negative community impacts among those who have experienced property damage</td>
</tr>
<tr>
<td>River flooding has had a negative impact on my personal life in the past.</td>
<td>Danger</td>
<td>8</td>
<td>4.27</td>
<td>0.832</td>
<td>46.7%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>8</td>
<td>43.5</td>
<td>0.000</td>
<td>33.3%</td>
<td>Y</td>
<td>Increased level of worry among those who have experienced personal negative impacts</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>8</td>
<td>58.2</td>
<td>0.000</td>
<td>20.0%</td>
<td>Y</td>
<td>Increased anticipation of future personal negative impacts among those who have experienced personal negative impacts</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>8</td>
<td>22.2</td>
<td>0.005</td>
<td>46.7%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td>River flooding has had a negative impact on my community in the past.</td>
<td>Danger</td>
<td>6</td>
<td>42</td>
<td>0.000</td>
<td>58.3%</td>
<td>Y</td>
<td>Increased perception of danger among those who feel their community has been negatively impacted</td>
</tr>
<tr>
<td></td>
<td>Worry</td>
<td>6</td>
<td>30.7</td>
<td>0.000</td>
<td>41.7%</td>
<td>N</td>
<td>Increased level of worry among those who feel their community has been negatively impacted</td>
</tr>
<tr>
<td></td>
<td>Future Personal</td>
<td>6</td>
<td>20.9</td>
<td>0.002</td>
<td>50.0%</td>
<td>N</td>
<td>Increased anticipation of future personal negative impacts among those who feel their community has been negatively impacted</td>
</tr>
<tr>
<td></td>
<td>Future Community</td>
<td>6</td>
<td>84</td>
<td>0.000</td>
<td>50.0%</td>
<td>Y</td>
<td>Increased anticipation of future community negative impacts among those who feel their community has been negatively impacted</td>
</tr>
</tbody>
</table>
6.4.1 Associations between the Frequency Variable and Perceptions

Several associations were identified, some stronger than others. It is useful to examine each pairing individually, as patterns may be identified that are not recognized statistically. First we examine the association between frequency and danger. Frequency is defined as the number of times in the past the respondent has experienced a flood event and is aggregated into the following categories:

- Never
- Once
- More than Once

Danger is defined by the perceived level of worry. No association was identified via chi-squared analysis. The distribution of the data confirms that no significant patterns are revealed (Fig. 16).

![Frequency Vs. Danger](Image)

**Figure 16.** Comparison between frequency of past flood experience and perceived danger
No association was identified statistically between past frequency and level of worry. The majority of respondents had a low level of worry, with the only exception being those who experienced one flood event (Fig. 17). Those at both the highest and the lowest frequency levels of experience had the lowest ratio of a low level of worry, with 53.3% and 54.3% reporting no worry at all, respectively. Meanwhile, respondents who have experienced flooding once (presumably the July 2006 flood) seem more likely to be worried, with only 34.2% reporting no worry at all. For those who have a low level of worry and a high level of experience, desensitization may be a contributing factor (Richardson et al., 1987; Barnett and Breakwell, 2001). For those who have never experienced flooding but maintain a high level of worry, fear of the unknown may play a part.

![Frequency Vs. Worry](image)

**Figure 17.** Comparison between frequency of past flood experience and level of worry
The next significant indicator of the relationship between past experience and perceptions is the association between respondents’ frequency level and their belief regarding if river flooding could negatively impact their personal life in the future. A statistical association was determined with a significance level of 0.054. Again, the frequency level of ‘once’ stands out in which respondents in this category are most likely to expect some level of negative impacts in their future, with only 25.6% expecting no negative impacts from flooding in the future. That number jumps to 47.4% and 50% among those who have never experienced flooding or have experienced it more than once, respectively. The notions of fear of the unknown and desensitization come to mind again. The distribution of results is shown below in Figure 18.

![Bar Chart: Frequency vs Future Personal Impact]

**Figure 18.** Comparison between frequency of past flood experience and perceived future personal impacts.
It is appropriate to consider perceived impacts at both the individual level and the community level, as the negative impacts of a disaster may affect residents personally (such as when property is damaged) and in the community (such as when businesses are shut down). Unlike the personal level, no statistical association was found between past frequency and perceived future community impacts. The results show that the data is distributed evenly across all frequency levels (Fig. 19). Regardless of how often respondents have experienced flooding in the past, the majority expect their community to be negatively impacted to some degree in the future.

Figure 19. Comparison between frequency of past flood experience and perceived future community impacts
6.4.2 Associations between the Most Recent Variable and Perceptions

The next significant set of relationships between past experience and perceptions is the association between the respondents’ most recent experience and their perceptions of flooding. Recent experience was aggregated into the following categories:

- Never experienced flooding
- 0 – 5 years ago
- More than 5 years ago

The first comparison is between respondents’ most recent experience and perceived danger. No statistical association was found. While the results are distributed fairly evenly, there does seem to be a lack of individuals who have experienced flooding more than five years ago who do not consider them dangerous, as well as a lower than expected amount who consider them very dangerous (Fig. 20). However, the number of respondents whose most recent experience with flooding was more than five years ago is very low, only four in total, and should not be considered significant.
An association was found between individuals’ most recent experience and their level of worry. This association has a significance level of 0.009, and although no expected values were below one, 33.3% of cells did have expected counts less than five, so careful examination of the distribution of data is helpful. Distribution of responses is found in Figure 21. Of the 12.7% of respondents who reported a high level of worry, all of them had either never experienced flooding or recently experienced flooding (0-5 years ago). For those who never experienced flooding, 10.8% reported being very worried and 23.1% reported being somewhat worried. This again incites the notion of fear of the unknown. Among respondents with recent experience (0-5 years), 14.3%
reported a high level of concern, while nearly half reported being somewhat worried (the highest level of moderate concern in any category). While only four respondents reported their most recent experience to be greater than five years ago, all but one reported have no concerns about flooding. These findings are in accordance with findings that an individual’s level of worry is highest for those with recent experience with a hazardous event (White, 1964; Barnett and Breakwell, 2001), and help to demonstrate that an association does exist as the chi-square test implies.

Figure 21. Comparison between most recent flood experience and level of worry

The next association evaluated is most recent experience and perceived future personal impacts. Statistically, an association was found with a significance level of
0.072. Although 33.3% of cells have expected values lower than five, the distribution of data suggests that the association is valid. (Fig. 22). More respondents anticipated future negative personal impacts that had experienced flooding recently, 63.7% total, than those who have never experienced flooding, 50.8%. It seems that those with recent flood experience are more likely to anticipate future effects than those who have never experienced flood or who have only experienced them long ago. This is a similar association as what was found with the worry variable, and makes sense that those who anticipate future negative impacts would worry more, both of which are associated with recent experience.

Figure 22. Comparison between most recent flood experience and perceived future personal impacts
At the community level, any association between perceived future impacts and most recent experience disappears. The data is evenly distributed (Fig. 23).

![Most Recent Vs Future Community Impacts](image)

**Figure 23.** Comparison between most recent flood experience and perceived future community impacts

### 6.4.3 Associations between the Injury Variable and Perceptions

The next significant set of relationships between past experience and perceptions is the associations between whether the respondents know someone who has ever been injured in a flood and their perceptions of flooding. At times, flooding can pose significant dangers in terms of personal health and safety, and may become life-threatening. To evaluate to what extent personal injury is associated with an
individual’s perceptions of flooding, respondents were asked if they or anyone they know has ever been injured in a flood event. No respondent was ever personally injured, however 23 people reported knowing someone who had been injured. Therefore, responses were aggregated into the following categories:

- I have not been injured but someone I know has
- Neither I nor anyone I know has been injured

No statistical association was determined between injury and danger and the data appear evenly distributed (Fig. 24). However, among the 23 respondents who knew someone injured in a flood, 78.3% perceived floods to be very dangerous. Among respondents who did not know anyone who had ever been injured in a flood, that percentage drops to 56.3%. This suggests that those who know someone who was injured in a flood are more likely to perceive them as dangerous events, though this is not proven statistically.

![Injuries Vs Danger](image)

**Figure 24.** Comparison between the injury and danger variables
The next comparison is the relationship between injury and level of worry (Fig. 25). Most respondents had never been injured in a flood and do not know anyone who was. Among this group 51.3% believed floods were not dangerous and 11.3% believed they are very dangerous. Among the 23 respondents who do know someone who was injured in a flood, 39.1% believed floods were not dangerous, and 21.7% believed they are very dangerous. Despite the fact that a larger percentage of respondents who felt floods were very dangerous did know someone who was injured, the chi-squared analysis does not suggest any significant association.

![Injuries Vs Worry](image)

*Figure 25. Comparison between the injury and worry variables*
The next comparison is the relationship between the injury variable and perceived future personal negative impacts. Here we find that a strong association does exist with a significance level of 0.004, with less than 20% of cells having an expected count of less than five and no expected count is less than one. Among those who do not know anyone who has ever been injured in a flood, only 15% believe floods could have a long-term impact in their lives and 38.8% believe short-term impacts are possible. Conversely, among those that do know someone who was injured, 43.5% believe floods could have long-term impacts on their lives with an additional 30.4% perceiving short-term impacts as possible. This association is reflected in the distribution of data (Fig. 26).

![Injury Vs Future Personal Impact](image)

**Figure 26.** Comparison between the injury variable and future personal impacts
At the community level, the association between injury and future impacts disappears. The data is even distributed throughout (Fig. 27). Most respondents foresee possible negative impacts to the community in the future regardless of whether or not they knew anyone who had ever been injured in flooding.

**Figure 27.** Comparison between the injury variable and future community impacts

### 6.4.4 Associations between the Property Damage Variable and Perceptions

The next significant set of relationships between past experience and perceptions is the associations between the respondents’ experience with property damage.
damage from floods and their perceptions of flooding. The respondents were asked if they or anyone they know had experienced property damage in a flood event. Results were aggregated into the following categories:

- Either I or someone I know has had property damage
- Neither I nor anyone I know has had property damage

The first comparison, between property damage and perception of danger, shows no statistical association and the data is fairly even distributed (Fig. 28).

![Property Damage Vs Danger](image)

**Figure 28.** Comparison between the property damage variable and perceived danger

Next, property damage was compared to the individuals’ level of worry. Among respondents who never had property damaged in a flood and who do not know anyone
else who has, 67.4% reported not being worried about flooding. Conversely, 55.8% of respondents who have either had property damage, know some else who has, or both reported being either very worried or somewhat worried about flooding. Overall, 75% of the respondents have either experienced property damage during a flood or know someone else who has, yet 50% report not being worried about flooding at all. Among the half who do report some level of worry, the majority have experienced property damage either directly or indirectly. Chi-square results show a strong statistical association with a significance level of 0.024, which is mirrored in the distribution of data (Fig. 29).

![Property Damage Vs Worry](image)

**Figure 29.** Comparison between the property damage variable and level of worry
Another very strong association with a significance level of 0.077 exists between the property damage variable and respondents perceptions of possible future impacts at the personal level. Individuals were more likely to perceive long-term future impacts if they had experienced property damage in the past, 22.3% versus only 8.7% of those who had not. Among those who believed a flood could have long-term or short-term negative impacts on them in the future, 88.6% and 75.7% had experienced property damage, respectively. That percentage drops to 68.8% among those who reported never experiencing property damage from a flood. This association is represented in the distribution of results (Fig. 30).

**Figure 30.** Comparison between the property damage variable and future personal impact
This association is even stronger at the community level, with a significance level of 0.011. A full 95% of respondents who had experienced property damage in the past also foresee future negative impacts to the community. This percentage drops to 84.8% among those who have not experienced property damage; still a large majority but it seems apparent that those who experienced damages in the past are more likely to expect negative impacts to occur in the future. This association is seen in the distribution of data as well (Fig. 31).

![Property Damage Vs Future Community Impact](image)

**Figure 31.** Comparison between the property damage variable and future community impact
6.4.5 Associations between the Past Personal Impact Variable and Perceptions

The next significant set of relationships between past experience and perceptions is the associations between the respondents past personal impacts and their perceptions of flooding. The survey takers responded to the statement ‘River flooding has had a negative impact on my personal life in the past’ on a Likert scale system. The four response options were:

- Strongly Agree
- Somewhat Agree
- Somewhat Disagree
- Strongly Disagree

The first comparison to this variable is to perceived danger. No statistical association was found and the data are evenly distributed (Fig. 32). Regardless of how respondents rated their past experiences, most respondents felt that floods are very dangerous.
There does appear to be a strong statistical association between past personal impact and level of worry. The chi-square analysis suggests that these variables are associated with a significance level of < 0.001. Although 33.3% of cells have expected counts less than five and the lowest expected count on the contingency table is below one, the distribution of data implies that this association is not only valid, but quite strong (Fig. 33).
No worry is most common among those who feel flooding has not personally impacted them in the past. A high level of worry is most common among those who strongly or somewhat agree that flooding has had a negative impact on them in past. Additionally, the majority of respondents who somewhat agreed that floods negatively impacted them in the past also reported being somewhat worried about flooding. In this case, it seems apparent that for most respondents their level of worry was highly determined by past experiences at the personal level.

Next, past personal experience is compared with anticipated future personal impacts. Once again, a strong association with a significance level of < 0.001 was found.
via chi-square analysis. Although 20% of cells had expected counts below five, and the lowest expected count is less than one, the distribution of data implies that the association in valid (Fig. 34). Interestingly, 23.3% of respondents who strongly agreed that floods have negatively impacted their lives in the past, perceived flooding as not capable of imposing negative impacts on their lives in the future. In total, 43.2% of all respondents shared the perception that floods would not negatively impact them in the future, despite the fact that among this group nearly half either strongly agreed or somewhat agreed that they were negatively impacted in the past. Despite these seemingly contradictions, the majority of respondents, 64.9%, who strongly disagreed that floods had impacted them in the past also doubted a flood would impact them in the future. Conversely, the majority of respondents, 75.8%, who felt that floods did negatively impact them in the past also felt they could be negatively impacted in the future. The majority of the group of respondents, 60%, who somewhat agreed that they had been impacted in the past also believed a flood would impose short-term (as opposed to long-term) impacts on them in the future. The strong statistical association, coupled with the clear distribution of data, implies that this association was one of the strongest and most meaningful found during analysis. The ways in which respondents feel they have been impacted in the past has a strong influence on the way they believe they will be impacted in the future.
Chi-square analysis determined an association with a significance level of 0.005 between the past personal impact and future community impact. Although 46.7% of cells have expected counts less than five and the lowest expected count is less than one, the distribution of data suggests the association is valid (Fig. 35). Among those who felt they had been personally negatively impacted in the past, 95.8% also believed their community would be impacted in the future. Among those who do not feel they were personally impacted in the past, this percentage drops to 89.6%. While this difference does not seem large, it is important to consider that among all respondents, 92.4% believed the community would be impacted in the future. This mean that an above average percentage of respondents who were negatively impacted in the past, and a
below average percentage of respondents who were not negatively impacted in the past, believe their community will be negatively impacted in the future.

![Figure 35. Comparison between past personal impacts and future community impacts](image)

**6.4.6 Associations between the Past Community Impact Variable and Perceptions**

The next significant set of relationships between past experience and perceptions is the associations between the past impacts of flooding at the community level and respondents perceptions of flooding. The survey takers responded to the
statement ‘River flooding has had a negative impact on my community in the past’ on a Likert scale system. The four response options were:

- Strongly Agree
- Somewhat Agree
- Somewhat Disagree
- Strongly Disagree

The first comparison to this variable is to perceived danger. A statistical association was found with a significance level of < 0.001. Although 58.3% of cells had expected counts less than five and the lowest expected count is less than one, the distribution of data does support the association. Among those who felt floods were very dangerous, 75.9% strongly agreed and 16.7% somewhat agreed that their community was negatively impacted in the past. Among those who feel that floods are sometimes dangerous, 55.6% strongly agreed and 33.3% somewhat agreed that flooding had a negative impact on their community in the past. These figures and the distribution of data (Fig. 36) shows those who felt there community was negatively impacted in the past are more likely to believe floods are very dangerous, while those who somewhat agreed or somewhat disagreed that their community was negatively impacted in the past were most likely to feel floods were only sometimes dangerous. Among those who strongly disagreed were the majority of those who did not feel floods were dangerous.
When comparing past community impacts to individuals’ level of worry a very strong association was found with a significance level of < 0.001. While 41.7% of cells did have expected counts less than five, no expected count was less than one, and the distribution of data supports the existence of an association (Fig. 37). Among those who reported feeling very worried about flooding, 87% strongly agreed and the remaining 13% somewhat agreed that floods had negatively impacted their community in the past. Meanwhile, no respondents who disagreed that flooding negatively impacted their community in the past reported being very worried and only two reported being somewhat worried. A total of 91.2% of respondents who are not worried feel that their
communities were negatively impacted in the past. This suggests that these individuals do not feel that they are at a personal risk, but their community is. If this is the case, a similar pattern will likely exist in the next comparison between past community impacts and future personal impacts.

![Past Community Impacts Vs Worry](image)

**Figure 37.** Comparison between past community impacts and level of worry

When comparing how respondents feel their community was impacted in the past as to how they perceive their personal lives being impacted in the future, a statistical association was found with a significance level of 0.002, and although 50% of cells have expected counts less than five, no expected count was less than one, and the distribution of data supports this association (Fig. 38). Individuals who reported perceiving floods as capable of imposing long-term or short-term negative impacts on
their personal lives in the future are more likely to feel that their communities have been negatively impacted in the past. The data does in fact look similar to the prior comparison. This suggests that a large number of respondents understand their communities to have been negatively impacted in the past, but do not feel that this is reason to believe that they personally would be impacted in the future. It is likely that most of these respondents do not reside in or near the floodplain and therefore do not perceive a personal risk.

![Graph showing Past Community Impacts Vs Future Personal Impacts](image)

**Figure 38.** Comparison between past community impacts and future personal impact

A strong association exists with a significance level of < 0.001 at the community level between how respondents feel their community was impacted in the past and their perception of possible negative impacts in the future. Although 50% of cells had
expected counts less than five and the lowest expected count is less than one, the
distribution of data supports the association (Fig. 39). Because so few people felt their
community was not negatively impacted in the past or doubted it would be in the
future, it is not surprising to find low cell counts. Of those who strongly agreed that
flooding had a negative impact on their community in the past, 70.2% also perceived
floods as capable of imposing long-term threats on their community in the future.
Alternately, among respondents who strongly disagreed that flooding had imposed
negative impacts on their community in the past, 75% perceived floods as not capable
of imposing negative impacts in the future. Nearly half of all respondents strongly
agreed that their community was negatively impacted in the past and perceived floods
as being capable of causing long-term negative impacts in the future. Given the flood
event of 2006, it is not surprising that only eight people strongly disagreed that flooding
negatively impacted their community in the past. Although this is a small group to
evaluate, six of the eight respondents also perceived floods as not capable of negatively
impacting their community in the future. This pattern is in accordance with what we
would expect from a strong association between these variables.
6.5 Associations between Perceptions and Preparedness

To investigate the relationship between perceptions of flooding and preparedness, several crosstabulations are performed. The four perception variables are the same as those discussed in the previous section. There are two preparedness variables which are as follows:

- Plan of Action (Do you have a plan of action for if flooding were to occur where you lived?)
- Insurance (Do you have flood insurance?)
Ownership of flood insurance does not necessarily imply flood readiness, nor does a lack of flood insurance imply a lack of readiness, however it is a valuable variable nonetheless. Respondents with flood insurance were able to distinguish whether they were forced to purchase or if they opted to do so. It may be of particular interest to focus on respondents who have opted to purchase flood insurance, but were not required to do so. There were 15 respondents who were not sure if they had flood insurance or not. To help strengthen the validity of the chi-square tests, these responses were not included in analysis.

A summary of results is displayed in Table 9.
Table 9. Summary of crosstabulation and chi-squared analysis results of associations between the perception and preparedness variables, and legend

<table>
<thead>
<tr>
<th>Question</th>
<th>Variable</th>
<th>df</th>
<th>x²</th>
<th>p</th>
<th>%EC ≤ 5</th>
<th>Any EC ≥ 1</th>
<th>Direction of Association</th>
<th>Any EC ≥ 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you feel river floods are dangerous?</td>
<td>Plan of Action</td>
<td>2</td>
<td>3.713</td>
<td>0.156</td>
<td>33.3%</td>
<td>Y</td>
<td>Increased percentage of individuals with a plan among those with higher levels of worry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>4</td>
<td>1.642</td>
<td>0.801</td>
<td>56.6%</td>
<td>Y</td>
<td>Increased percentage of insurance ownership among those with higher levels of worry</td>
<td></td>
</tr>
<tr>
<td>Do you worry about flooding?</td>
<td>Plan of Action</td>
<td>2</td>
<td>6.916</td>
<td>0.031</td>
<td>16.7%</td>
<td>N</td>
<td>Increased percentage of individuals with a plan among those who feel their personal lives could be negatively impacted in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>4</td>
<td>11.855</td>
<td>0.018</td>
<td>44.4%</td>
<td>N</td>
<td>Increased percentage of insurance ownership among those who feel their personal lives could be negatively impacted in the future</td>
<td></td>
</tr>
<tr>
<td>Do you feel that river flooding could negatively impact your personal life in the future?</td>
<td>Plan of Action</td>
<td>2</td>
<td>7.583</td>
<td>0.023</td>
<td>0.0%</td>
<td>N</td>
<td>Increased percentage of individuals with a plan among those who feel their personal lives could be negatively impacted in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>4</td>
<td>37.302</td>
<td>0.000</td>
<td>66.7%</td>
<td>N</td>
<td>Increased percentage of insurance ownership among those who feel their personal lives could be negatively impacted in the future</td>
<td></td>
</tr>
<tr>
<td>Do you feel that river flooding could negatively impact your community in the future?</td>
<td>Plan of Action</td>
<td>2</td>
<td>9.634</td>
<td>0.008</td>
<td>16.7%</td>
<td>N</td>
<td>Increased percentage of individuals with a plan among those who feel their community could be negatively impacted in the future</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>4</td>
<td>3.067</td>
<td>0.547</td>
<td>44.4%</td>
<td>Y</td>
<td>Increased percentage of insurance ownership among those who feel their community could be negatively impacted in the future</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- 95% CI
- 90% CI
- Bold: %EC ≤ 5 = ≤20% OR No EC ≤ 1
6.5.1 Associations between the danger variable and preparedness

The first significant set of relationships between perceptions and preparedness is the associations between perceived danger and preparedness. Perceived danger is aggregated into the following categories:

- Yes, very dangerous
- Sometimes, but not always
- No, they aren’t dangerous

The first comparison to this variable is plan of action. No association was established statistically, and the distribution of data appears evenly distributed (Fig. 40). It is worth noting however that among those who do have a plan of action, 72.2% feel floods are very dangerous. The remaining 27.8% feel they are sometimes dangerous, meaning that all respondents who did have a plan also reported some level of perceived danger. While perceiving danger does not imply that the respondent would have a plan, a perception of danger does appear to be a precondition among those who have developed a plan of action.
A statistical association was not found between perceived danger and possession of flood insurance. Not surprisingly, the majority of respondents did not own a flood insurance policy since most residents of Painesville do not live in a flood designated area (Fig. 41). Those who were required to purchase a policy all perceived some level of danger, which is not surprising as these respondents would have to live in a flood designated area in order to be required to buy flood insurance. It is interesting to note that among those who opted to purchase flood insurance, although there were only 11 respondents in this category, eight perceived floods to be very dangerous and the other three perceived them to be sometimes dangerous. Similar to the previous comparison,
perception of danger does not imply that a resident would choose to purchase flood insurance, but does appear to be a precondition for doing so.

![Danger Vs Flood Insurance](image)

**Figure 41.** Comparison between perceived danger and flood insurance

### 6.5.2 Associations between the worry variable and preparedness

The next perception variable evaluated against preparedness is the worry variable. Respondents were asked if they worry about river flooding and their level of worry is aggregated into the following categories:

- Yes, very much
- Somewhat
- No, not at all
A statistical association was found with a significance level of 0.031 and with less than 20% of cells having expected counts of less than five and the lowest expected count greater than one. The distribution of data is found in Figure 42. Not surprisingly, most respondents who reported not worrying at all do not have a plan of action if flooding occurred where they live. What is surprising, however, is the finding that among individuals who are very worried about flooding, 66.7% claim they do not have a plan of action regarding a flood event. The majority of individuals who do have a plan reported being somewhat worried about floods.

Figure 42. Comparison between level of worry and plan of action
When comparing level of worry to flood insurance, an association was identified with a significance level of 0.004, and although 44.4% of cells had expected values less than five, the distribution of data does reveal a pattern of association (Fig. 43). Among the ten respondents who were required to purchase a policy, only one person reported not being worried about flooding at all. Among the 11 respondents who opted to purchase a flood insurance policy, one was very worried, six were somewhat worried, and four were not worried at all. It is interesting that four out of 11 people who choose to buy a policy were not worried, which perhaps suggests that for these individuals, the policy acts as security blanket in case flooding were to impact them in the future.

![Worry Vs Flood Insurance](image)

**Figure 43.** Comparison between level of worry and flood insurance
6.5.3 Associations between the future personal impact variable and preparedness

The next perception variable to be evaluated against preparedness is the future personal impact variable. Respondents were asked if they believe river flooding could have a negative impact on their personal lives in the future, and the responses are aggregated into the following categories:

- Yes, long-term impacts
- Yes, short-term impacts
- No, I doubt it

The first comparison is between the future personal impact variable to plan of action. A strong statistical association was found with a significance level of 0.023 with no cells having expected counts less than five. Since the majority of respondents reported not having a plan of action, it comes as no surprise that more people reported not having a plan in all three categories (Fig. 44). Despite this fact we find that a smaller percentage of people, 5.6%, reported having a plan of action among those who doubt a flood would negatively impact them personally in the future. Among those who believe a flood could have short term negative impacts on them in the future, 21.1% had a plan, and among those who believe a flood could have long-term negative impacts on them in the future, 36.4% had a plan. This pattern corroborates the finding that the two variables are associated, implying that those who anticipate future negative impacts are more likely to have a plan of action in place.
An association was also found between the future personal impacts and flood insurance variables with a significance level of < 0.001, and although 66.7% of cells had expected counts less than five, the distribution of data corroborates the association (Fig. 45). The comparison revealed that nine out of ten survey takers who were required to purchase flood insurance anticipated long-term impacts in their future, and one anticipated short-term impacts. Interestingly, individuals who opted to purchase flood insurance were evenly split in terms of how they believe floods could impact them in the future. Only three respondents who doubted that a flood would impact them in the future opted to purchase flood insurance.
6.5.4 Associations between the future community impact variable and preparedness

The next perception variable to be evaluated against preparedness is the future community impact variable. Respondents were asked if they believe river flooding could have a negative impact on their community in the future and responses are aggregated into the following categories:

- Yes, long-term impacts
- Yes, short-term impacts
- No, I doubt it
The first comparison of this variable is to plan of action. An association was determined with a significance level of 0.008 with less than 20% of cells having expected counts less than five and the lowest expected count greater than one. The distribution of data is found in Figure 46. In this case, very few respondents, only 6.8%, believe their community could not be negatively impacted by flooding in the future. Among this group, only one respondent reported having a plan of action. Among the 34.5% of people who believe a flood could have short-term negative impacts on their community in the future, only 9.8% had a plan. Most respondents, 58.8%, do believe that their community could see long term negative impacts from flooding in the future, and among this group, 28.8% had a plan of action in place. This pattern is what would be expected given the strong association found between these variables.
No association was found between future community impacts and flood insurance. The distribution of data is found in Figure 47. Despite this, it is interesting to note that all respondents who opted to purchase flood insurance do feel that flooding could negatively impact their community in the future. Recalling the fact that at the personal level, three of these respondents did not foresee negative impacts to their personal life, it can be suggested that perceptions of community impacts are more influential among residents who opt to purchase flood insurance rather than perceptions of personal impacts.
6.6 Associations between Experience and Preparedness

Various associations have been made regarding experience to perceptions and perceptions to preparedness. Such findings imply that we should also be able to identify associations between measures of experience directly to preparedness. To investigate the relationship between perceptions of flooding and preparedness, several crosstabulations are performed. The six experience variables and two preparedness
variables are the same as those discussed in the previous sections. A summary of
results is found in Table 10.
<table>
<thead>
<tr>
<th>Question</th>
<th>Variable</th>
<th>df</th>
<th>$x^2$</th>
<th>$p$</th>
<th>%EC &lt; 5</th>
<th>Any EC &lt; 1</th>
<th>Direction of Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often have you experienced river flooding in the past?</td>
<td>Plan of Action</td>
<td>2</td>
<td>4.341</td>
<td>0.114</td>
<td>0.0%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>4</td>
<td>19.617</td>
<td>0.001</td>
<td>44.4%</td>
<td>N</td>
<td>Increased percentage of required insurance ownership among those who have experienced flooding once</td>
</tr>
<tr>
<td>When was your most recent experience with flooding?</td>
<td>Plan of Action</td>
<td>2</td>
<td>4.168</td>
<td>0.124</td>
<td>33.3%</td>
<td>Y</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>4</td>
<td>11.719</td>
<td>0.020</td>
<td>55.6%</td>
<td>Y</td>
<td>Increased percentage of insurance ownership among those with recent experience</td>
</tr>
<tr>
<td>Have you or someone you know ever been injured in a river flood?</td>
<td>Plan of Action</td>
<td>1</td>
<td>0.216</td>
<td>0.642</td>
<td>25.0%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>2</td>
<td>3.418</td>
<td>0.181</td>
<td>33.3%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td>Have you or someone you know ever had property damaged in a river flood?</td>
<td>Plan of Action</td>
<td>1</td>
<td>4.942</td>
<td>0.026</td>
<td>0.0%</td>
<td>N</td>
<td>Increased percentage of individuals with a plan among those who have experienced property damage</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>2</td>
<td>3.278</td>
<td>0.194</td>
<td>33.3%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td>River flooding has had a negative impact on my personal life in the past.</td>
<td>Plan of Action</td>
<td>4</td>
<td>8.573</td>
<td>0.073</td>
<td>20.0%</td>
<td>Y</td>
<td>Increased percentage of individuals with a plan among those who have experienced personal negative impacts</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>6</td>
<td>17.47</td>
<td>0.008</td>
<td>66.7%</td>
<td>N</td>
<td>Increased percentage of insurance ownership among those who have experienced personal negative impacts</td>
</tr>
<tr>
<td>River flooding has had a negative impact on my community in the past.</td>
<td>Plan of Action</td>
<td>3</td>
<td>3.286</td>
<td>0.350</td>
<td>25.0%</td>
<td>N</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>Insurance</td>
<td>6</td>
<td>2.407</td>
<td>0.879</td>
<td>50.0%</td>
<td>Y</td>
<td>-----</td>
</tr>
</tbody>
</table>
6.6.1 Associations between the frequency variable and preparedness

The first comparison between the frequency variable and preparedness is to the plan of action variable. No association was established statistically and the distribution of data appears fairly evenly distributed (Fig. 48). At all frequency levels most respondents do not have a plan of action in place. Those most likely to establish a plan seem to be those who have experienced flooding once; 33% of survey takers at this frequency level reported having a plan. For those who have experienced flooding more than once or never 20% and 17.1% have a plan, respectively. This suggests a trend in which those who have experienced flooding are more likely to develop a plan, although increased experienced may reduce this likelihood. This is perhaps due to desensitization, or a sense of awareness regarding appropriate responsive actions without the need or desire to establish a concrete plan of action.
The next comparison between the frequency variable and preparedness is to flood insurance. An association was found with a significance level of 0.001, however 44.4% of cells have expected counts less than five. It is not surprising that an association was found since it would be expected that residents who had to purchase a policy live in a flood designated area, and are more likely to have experienced flooding than those who do not own flood insurance. Only 10% who had to purchase flood insurance had never experienced flooding, while 66.2% who do not have flood insurance have never experienced flooding. Again, it may be most interesting to focus on respondents who opted to purchase flood insurance but were not obligated to do so. In this case, the results are fairly evenly split (Fig. 49). Among the 11 people who opted
to purchase insurance, five have never experienced flooding, two have experienced it once, and four have experienced it more than once. These findings suggest that while there is an association between those who either had to purchase insurance or do not have insurance and frequency, frequency does not seem to have necessarily influenced respondents’ decision to optionally purchase insurance.

![Graph: Frequency Vs Flood Insurance](image)

**Figure 49.** Comparison between experience frequency and flood insurance

### 6.6.2 Associations between the most recent variable and preparedness

The first comparison between the most recent variable and preparedness is to the plan of action variable. No statistical association was established between the two.
The distribution of data is found in Figure 50. Only four respondents reported their most recent experience to be greater than five years ago. Among the other groups, 25.9% of respondents with recent experience had a plan, while only 14.5% of respondents with no experience had a plan. Among all the respondents who did have a plan, 75.7% had experienced flooding recently. This pattern is in accordance with findings by White (1964) and Barnett and Breakwell (2001) that those with recent experience would have higher levels of preparedness.

![Figure 50](image-url)

**Figure 50.** Comparison between most recent experience and plan of action

The next comparison between most recent experience and preparedness is to the flood insurance variable. An association was found with a significance level of 0.055.
Although the lowest expected count was less than one, and 55.6% of cells had expected counts less than five, the distribution of data supports the existence of an association (Fig. 51). Among the 11 respondents who opted to purchase insurance, ten had recently experienced flooding, and one had experienced flooding more than five years ago, suggesting that recent experience may have contributed to the decision to purchase insurance. Interestingly, among these 11 respondents, all reported having experience flooding within some time frame. However, when asked about their frequency level, five reported having no flood experience.

Figure 51. Comparison between most recent experience and flood insurance
6.6.3 Associations between the injury variable and preparedness

The next comparison is between the injury variable and preparedness. The two comparisons of interest are between the injury variable and the plan of action and flood insurance variables. No statistical associations were found between either pair of variables. In comparing injury to plan of action, the data is evenly distributed (Fig. 52). It might have been expected that knowing someone who was injured may motivate people to establish a plan of action, especially when the flood event occurred in the same community they reside in. However, we already discovered that no significant association was found between injury and level of worry. Similarly, when comparing the variables of injury and plan of action there does not appear to be any meaningful distribution of results. A slightly higher percentage of people who knew someone who was injured did have a plan, 23.8% as compared to 19.5%, but this difference was not significant enough to establish an association.
No statistical association was found between the injury and flood insurance variables. The distribution of data is found in Figure 53. In comparing injury to flood insurance, among those who opted to purchase flood insurance, only one person knew someone who was injured. This lack of association is perhaps not surprising since flood insurance covers property damage, not physical harm.

Figure 52. Comparison between the injury variable and plan of action
The next comparison is between those who have had property damaged in the past and preparedness. An association was found between the variables of property damage and level of worry, as well as level of worry and plan of action. Here the association between property damage and plan of action is directly tested. There does indeed appear to be more respondents who have a plan of action who have also

**Figure 53.** Comparison between the injury variable and flood insurance

6.6.4 *Associations between the property damage variable and preparedness*

The next comparison is between those who have had property damaged in the past and preparedness. An association was found between the variables of property damage and level of worry, as well as level of worry and plan of action. Here the association between property damage and plan of action is directly tested. There does indeed appear to be more respondents who have a plan of action who have also
experienced property damage or know someone who has (Fig. 54). The association’s significance level is 0.026 with no expected counted less than five. Although over 70% of respondents who do not have a plan have experienced property damage, nearly 90% who do have a plan experienced property damage. Among all respondents who have experienced property damage, 24.8% had a plan while among those who have not experienced property damage only 9.1% had a plan.

![Property Damage Vs Plan of Action](image)

**Figure 54.** Comparison between property damage and plan of action

Next, flood insurance is compared to the respondents experience with property damage. It is expected that those who have had property damage or know someone
who has are more likely to purchase flood insurance. This does seem to be the case for the most part (Fig. 55), however no statistical association was found above the 90% confidence interval. Everyone who was obligated to purchase insurance had experienced property damage in the past, which is not surprising given that these respondents must live in a flood designated area. Among respondents who opted to purchase flood insurance, eight out of 11 had experienced property damage or knew someone who had. However, it must also be noted that among all respondents who experienced property damage directly or indirectly, nearly 85.6% do not have flood insurance. Again, without knowing where these respondents are located relative to the floodplain, a lack of flood preparedness cannot be assumed.

![Property Damage Vs Flood Insurance](image)

**Figure 55.** Comparison between property damage and flood insurance
6.6.5 Associations between the past personal impact variable and preparedness

Next, the respondents past personal impacts are compared to flood preparedness. The first preparedness variable we compare past personal impact to is the plan of action variable. It had been determined that associations exist between past negative impacts and perceived future negative impacts at the personal and community levels, for which associations were very strong. Associations have also been found between anticipated future negative impacts and a plan of action at both the personal and community levels. Presumably then, associations will also be found between how respondents have experienced flooding in the past and whether or not they have a plan of action for the future. First we look at these variables at the personal level. An association was found with a significance level of 0.073. Although 20% of cells had expected counts less than five and the lowest expected count was less than one, the distribution of data suggests that the association is valid (Fig. 56). The highest percentage of respondents who do have a plan are amongst those who strongly agreed they were negatively impacted in the past at 39.3%, while the highest percentage of respondents who do not have a plan were among those who strongly disagreed that they were negatively impacted in the past at 87.3%. 
Next we compare past personal impact to the flood insurance variable. An association was found with a significance level of 0.064. Although 66.7% of cells had expected counts less than five and the lowest expected count was less than one, the distribution suggests an association does exist. Presumably, those who were obligated to purchase flood insurance are most likely to have experienced negative impacts from flooding in the past since these respondents live in a flood designated area. We would also expect that respondents who opted to purchase flood insurance have also experienced some level of negative impacts in the past which prompted them to do so. The results do seem to be in accordance with the hypotheses (Fig. 57). All respondents
who had to purchase flood insurance either strongly or somewhat agreed that they were negatively impacted in the past. Among those who opted to purchase flood insurance, which was only 11 respondents, five somewhat agreed and two strongly agreed that flooding had had a negative impact on them in the past.

![Past Personal Impact Vs Flood Insurance](image)

**Figure 57.** Comparison between past personal impacts and flood insurance

6.6.6 Associations between the past community impact variable and preparedness

The final experience variable to compare to preparedness is past community impacts. Because of the reasons stated in the previous section, it is expected that associations will be found between how respondents have experienced flooding in the
past at the community level and whether or not they have a plan of action for the future. Although this assumption held true at the personal level, no such association was statistically determined at the community level. The data appears to be fairly evenly distributed (Fig. 58). While 81.1% of respondents who did have a plan also strongly agreed that their community was negatively impacted in the past, this number is less suggestive that it may seem since nearly 70% of all respondents strongly agreed and among this group only 24.6% had a plan. Therefore, while being aware of the negative impacts to the community in the past does not necessarily lend itself to establishing a plan, it does however seem to be a prerequisite in most cases.

**Figure 58.** Comparison between past community impacts and plan of action
Finally we compare past community impacts to the ownership of flood insurance to examine whether or not the impacts upon the community have played a role in the decision to purchase flood insurance. Among the 11 respondents who opted to purchase a policy, eight strongly agreed and two somewhat agreed that flooding had a negative impact in their community in the past (Fig. 59). This suggests that the negative impacts from flooding imposed on the community may have prompted some to purchase flood insurance in case a similar event were to occur in the future. Despite this finding, no association was able to be determined statistically.

![Past Community Impact Vs Flood Insurance](image)

**Figure 59.** Comparison between past community impacts and flood insurance
6.7 Qualitative Analysis

Several questions were presented in forms other than the single answer multiple choice type, and therefore are not suitable for crosstabulation. Three survey questions were multiple choice, but respondents were prompted to choose as many responses that applied. Five questions were opened ended questions and must be evaluated qualitatively.

6.7.1 Multi-Answer Multiple Choice

The three multiple choice questions that were lent to multiple answer options addressed what sources respondents got flood information from, who they felt was responsible for informing residents of an imminent flood, and who they believed was responsible for alleviating flood damages. While there was a total of 185 survey respondents, the raw counts for these questions totaled more than 185 because most respondents chose more than one response. Results of the multi-answer questions are displayed in Tables 11-13.
Table 11. Response tallies regarding source information, multiple choice

<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>How would you know if river flooding were likely to occur in the area where you live?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Television</td>
<td>150</td>
<td>81.1%</td>
</tr>
<tr>
<td>Radio</td>
<td>93</td>
<td>50.3%</td>
</tr>
<tr>
<td>I would notice environmental changes</td>
<td>72</td>
<td>38.9%</td>
</tr>
<tr>
<td>From friends and neighbors that knew about it</td>
<td>70</td>
<td>37.8%</td>
</tr>
<tr>
<td>Local/Regional government officials</td>
<td>67</td>
<td>36.2%</td>
</tr>
<tr>
<td>Internet</td>
<td>59</td>
<td>31.9%</td>
</tr>
<tr>
<td>I'm not sure how I would know</td>
<td>12</td>
<td>6.5%</td>
</tr>
<tr>
<td>Total</td>
<td>523</td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents selected multiple answers

Television is clearly the number one source for the majority of respondents in terms of how they would become informed of flood conditions. Slightly over half reported radio as an informative source, and over a third said that noticing environmental changes, talking with friends and neighbors, and local and regional government would all be ways in which they would become aware of flood conditions.
Table 12. Response tallies regarding the responsibility to inform, multiple choice

<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whose responsibility is it to inform residents of an imminent river flood?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local/Regional government officials</td>
<td>157</td>
<td>84.9%</td>
</tr>
<tr>
<td>Television</td>
<td>125</td>
<td>67.6%</td>
</tr>
<tr>
<td>Radio</td>
<td>96</td>
<td>51.9%</td>
</tr>
<tr>
<td>Internet</td>
<td>52</td>
<td>28.1%</td>
</tr>
<tr>
<td>Friends and neighbors who have heard about it</td>
<td>52</td>
<td>28.1%</td>
</tr>
<tr>
<td>It is the individual's responsibility to know</td>
<td>36</td>
<td>19.5%</td>
</tr>
<tr>
<td>Total</td>
<td>518</td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents selected multiple answers

It is interesting to note here the large percentage, 84.9%, of people who believe it is the responsibility of local and regional government officials to inform residents of an imminent flood. However, in the previous question that only 36.2% of respondents actually do feel that this source is where they would get their flood information. Given this finding, there seems to be a surprising disconnect between actual government behavior and people's expectations. Inversely, over 80% of respondents reported receiving flood information from television programming, yet a smaller percentage believed it to be the responsibility of television to deliver such information. Less responsibility is also afforded to friends and neighbors as compared to the percentage of respondents who actually do turn to such people as sources of information, 28.1% compared to 37.8%, respectively.
Here again government is reportedly perceived to have a high level of responsibility in terms of assuaging damages. More respondents felt that this responsibility fell to the government than to insurance companies or the property owner. Slightly less than a third of respondents felt relief organizations were responsible for damages, which is perhaps not surprising given the lack of presence of the Red Cross in Painesville during and after the 2006 flood event.

### 6.7.2 Open-Ended Questions

Five survey questions were open-ended. This portion of analysis is modeled after the procedure utilized by Knockee and Kolivras (2007) in surveying residents of southwest Virginia on their flash flood awareness. A set of common themes and
phrases were identified for each open ended question and the frequency with which respondents used those themes was evaluated. This gave respondents an opportunity to express the way in which they prepare for and think about flooding in their own words. Keywords or phrases that were used five times or more were included in the final tallies. Results of the open-ended questions are found in Tables 14-18.

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you wanted more information on flood risks for your area, where would you look for this information?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Keywords/Phrases</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local / Regional Government</td>
<td>67</td>
<td>36.2%</td>
</tr>
<tr>
<td>Internet</td>
<td>49</td>
<td>26.5%</td>
</tr>
<tr>
<td>TV</td>
<td>20</td>
<td>10.8%</td>
</tr>
<tr>
<td>Not Sure</td>
<td>20</td>
<td>10.8%</td>
</tr>
<tr>
<td>Library</td>
<td>14</td>
<td>7.6%</td>
</tr>
<tr>
<td>FEMA / USGS / NOAA / Federal Government</td>
<td>12</td>
<td>6.5%</td>
</tr>
<tr>
<td>Engineers Office</td>
<td>10</td>
<td>5.4%</td>
</tr>
<tr>
<td>Insurance Company</td>
<td>7</td>
<td>3.8%</td>
</tr>
<tr>
<td>Radio</td>
<td>6</td>
<td>3.2%</td>
</tr>
<tr>
<td>Neighbors / Friends / Family</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>210</strong></td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents included multiple keywords

The responses shown in Table 14 show that the sources people turn to for information regarding flood risks are varied. This open-ended question asks respondents where they would obtain information regarding flood risks. Such
information could include floodplain data, river forecasts, or weather conditions, though these examples where not provided to survey takers. A similar multiple-choice question was also included (see Table 11) regarding how residents would know if a flood were likely to occur in the area where the respondent lives. While these questions are not exactly the same, they both seek to understand where respondents look for information regarding flooding. Therefore, it is worth comparing the results of these two questions.

The percentage of people who reported local or regional government as a source of information (which included responses such as city hall, county officials, etc.) in the open-ended question was exactly the same as in the multiple choice question at 36.2%. Fewer people reported television as an information source in the open-ended question, only 10.8% as compared to 81.1% in the multiple-choice question. Large differences also existed between the open-ended and multiple-choice questions for the responses of radio (3.2% versus 50.3%, respectively), and neighbors/family/friends (2.7% versus 37.8%, respectively). Much of this difference may be due to the nature of open-ended questions, where respondents are able to answer in any way they choose, and depends upon what they conjure up in their mind without being presented with answer options. The multiple choice questions are probably a more accurate depiction of the number of respondents who utilize each source of information among the specific options, while the open-ended question provide a glimpse into the wide array of information sources people may access to obtain flood data.
Table 15. Response tallies regarding flood triggers, open-ended

<table>
<thead>
<tr>
<th>Question</th>
<th>Keywords/Phrases</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rain / Rainfall / Precip</td>
<td>153</td>
<td>82.7%</td>
</tr>
<tr>
<td></td>
<td>Heavy / Excessive</td>
<td>104</td>
<td>56.2%</td>
</tr>
<tr>
<td></td>
<td>Snow</td>
<td>41</td>
<td>22.2%</td>
</tr>
<tr>
<td></td>
<td>Melt</td>
<td>40</td>
<td>21.6%</td>
</tr>
<tr>
<td></td>
<td>Ice</td>
<td>29</td>
<td>15.7%</td>
</tr>
<tr>
<td></td>
<td>Storm</td>
<td>22</td>
<td>11.9%</td>
</tr>
<tr>
<td></td>
<td>Thaw</td>
<td>13</td>
<td>7.0%</td>
</tr>
<tr>
<td></td>
<td>Dam</td>
<td>7</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Tornadoes</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>414</strong></td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents included multiple keywords

Based on the responses in Table 15 it is clear that many respondents have a clear idea about what type of events would cause a flood. Over 80% included some keyword referring to precipitation, with 56.2% also referring to heavy or excessive rainfall. Winter weather events were not uncommon keywords with over 20% of respondents referring to snow and melt as flood triggers, and ice and thaw were mentioned several times as well. Of course, floods may be influenced by circumstances other than weather conditions as well, such as topography, mudslides, a saturated water table, or dam failures. The keyword dam did appear, but only among 3.8% of respondents.
Interestingly, 2.7% of respondents mentioned tornadoes as an event which could cause a flood.

Table 16. Response tallies regarding response actions, open-ended

<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>What type of actions would you take if you expected your home to flood?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leave / Evacuate to Higher Ground</td>
<td>93</td>
<td>50.3%</td>
</tr>
<tr>
<td>Move Belongings to 2nd Floor / Attic / Other Location</td>
<td>44</td>
<td>23.8%</td>
</tr>
<tr>
<td>Nothing, N/A</td>
<td>18</td>
<td>9.7%</td>
</tr>
<tr>
<td>Shut Off Utilities</td>
<td>10</td>
<td>5.4%</td>
</tr>
<tr>
<td>Secure Pumps</td>
<td>8</td>
<td>4.3%</td>
</tr>
<tr>
<td>Not Sure</td>
<td>6</td>
<td>3.2%</td>
</tr>
<tr>
<td>Sandbag</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>184</td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents included multiple keywords

Just about half of the respondents said they would leave their homes if they expected it to flood. About a quarter mentioned relocating personal items to a safe location. Fewer than 10% said they would do nothing, or felt this question did not apply to them, and 3.2% said they would not know what to do. Small percentages mentioned taking actions to prevent dangerous situations or hamper the flooding, such as turning off utilities, securing pumps, or sandbagging.
Table 17. Response tallies regarding response concerns, open-ended

<table>
<thead>
<tr>
<th>Question</th>
<th>Phrases/Themes</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>What concerns you the most, if anything, about river flooding in your area?</td>
<td>Property Damage</td>
<td>42</td>
<td>22.7%</td>
</tr>
<tr>
<td></td>
<td>Access / Road Closings</td>
<td>33</td>
<td>17.8%</td>
</tr>
<tr>
<td></td>
<td>Physical Harm to People / Loss of Life</td>
<td>26</td>
<td>14.1%</td>
</tr>
<tr>
<td></td>
<td>Nothing, N/A</td>
<td>26</td>
<td>14.1%</td>
</tr>
<tr>
<td></td>
<td>Well Being of Residents</td>
<td>9</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>Development in Floodplains</td>
<td>8</td>
<td>4.3%</td>
</tr>
<tr>
<td></td>
<td>Contamination / Sewage Backup</td>
<td>7</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Economic Impact</td>
<td>7</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Not Being Able to Leave in Time</td>
<td>6</td>
<td>3.2%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>164</td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents included multiple keywords

The variety of responses provided regarding concerns relating to floods shows that people are making connections with some of the many adverse impacts and side effects that floods can generate. Other responses not included in Table 17 because of a low frequency rate included concerns about pets, nighttime flooding, interruption of utilities, and cleanup requirements. The results suggest that a greater number of people are concerned with negative impacts that would directly affect their property or lives than other types of impacts such as affected utilities and cleanup. A major concern among respondents was damaged roadways and several people noted the difficulties
they had getting to and from work or accessing resources (such as the grocery store) because of long lasting road closures during and after the flood of 2006.

Table 18. Response tallies regarding how the ‘06 has change perceptions and preparedness, open-ended

<table>
<thead>
<tr>
<th>Question</th>
<th>Keywords/Phrases</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you lived in Painesville during the flood of 2006, how has that experience changed the way you think about and prepare for floods and other natural hazards, if at all?</td>
<td>No Change</td>
<td>47</td>
<td>25.4%</td>
</tr>
<tr>
<td></td>
<td>Increased awareness of weather conditions</td>
<td>18</td>
<td>9.7%</td>
</tr>
<tr>
<td></td>
<td>Created plan of action/compiled emergency kit</td>
<td>17</td>
<td>9.2%</td>
</tr>
<tr>
<td></td>
<td>Increased concern over building in floodplains</td>
<td>12</td>
<td>6.5%</td>
</tr>
<tr>
<td></td>
<td>Increased concern over access</td>
<td>11</td>
<td>5.9%</td>
</tr>
<tr>
<td></td>
<td>Monitor water levels</td>
<td>9</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>Took measures to protect home from flooding</td>
<td>9</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>Increased awareness of community response efforts</td>
<td>7</td>
<td>3.8%</td>
</tr>
<tr>
<td></td>
<td>Reviewed/updated insurance policies</td>
<td>5</td>
<td>2.7%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>135</td>
<td></td>
</tr>
</tbody>
</table>

n = 185, some respondents included multiple keywords

Given the scale of destruction that occurred during the flood of 2006, it is somewhat surprising that fewer than expected reported any significant change in the way they think about and prepare for floods and other natural hazards. A quarter of respondents reported no change in their perceptions or behaviors, and less than 10% reported changing in any one category listed in Table 18. However, comments made by several respondents may shed light upon why this is so. The sheer magnitude of this
500 year flood event was by all means uncommon, at least on the timescale of a human life. Some people made it clear through their comments that they do not expect to have to deal with anything like the flood of 2006 ever again, and therefore do not feel it is necessary to alter any behaviors. Examples of such responses are as follows:

“That was the exception- do not expect again.”

“Minor damage, while widespread, is extremely unlikely to recur because the flood was such an unusual event.”

“I don’t foresee numerous ‘July 06’ floods occurring. No one can predict any uncontrollable natural hazard. Controlling’s an illusion!”

Others claimed their perceptions of natural hazards were indeed impacted although this did not necessarily relate to a change in behavior. Another respondent claimed:

“It did change my thinking about being prepared, but have not acted on it.”

A few people felt that the flood was beneficial in ways. One resident who voluntarily identified as living on Steele Avenue, which is located in the floodplain and among the worst hit areas, recognized the changes made to a bridge that had exacerbated the flooding in 2006:

“Some of us down here feel that the bridge at Route 84 and the Grand River that was rebuilt took away the dam effect it had. They put up more smaller supports in which now lets more water flow under it which allowed us to get flooded.”
And for some, the flood was an opportunity for reflection:

“In many ways the flood was a blessing for our family. It made us realize that things aren’t important.”

Some of the most passionate responses came from those who were clearly frustrated with the fact that so many people who suffered losses were residentially located within the floodplain. These responses suggest the sentiment that vulnerability is an individual’s responsibility:

“If people were more responsible in choosing the location of residences, there would be little need for concern.”

“If you are stupid to buy a house next to a river you should get flooded with no help from anyone!!”

Frustrations with the recovery effort became apparent as well:

“I now know the government isn’t going to help me in any way.”

“I had a storage unit full of everything I owned and had insurance but flood wasn’t covered and FEMA said there was nothing they could do. It was a joke. I lost everything.”
7.1 Demographic Associations

A surprising finding of this study is the association of education and income levels with respondents’ perceptions and preparedness. Not surprisingly, income and education were associated above the 95% confidence level, exhibiting a pattern of increased incomes among those with higher levels of education. It was expected that those with higher levels of education and income would be more likely to have a plan of action in place. However the opposite turned out to be true. The majority of survey takers who reported having a plan of action in place if a flood were to occur where they lived did not have a college degree and had an annual household income of less than $50,000. Additionally, those with lower levels of education and lower household incomes were more likely to worry about floods, perceive them as dangerous, and were more likely to anticipate accruing negative impacts in the future. A possible explanation of this finding is that those with lower income and education levels are likely to have restricted access to certain resources, such as reliable transportation. For example, an individual without a vehicle may be more apt to create a plan of action ahead of time, knowing that during a hazardous event they will have to rely on other means of getting to safety other than personal transport. Another rationalization for why those with
lower income and education levels tended to be more worried about and prepared for future impacts is that this subset of the population may in fact be more susceptible to damages. This idea that the low income subset of a given population is disproportionately exposed to environmental hazards is not new. Studies in environmental justice date back to the early 1980’s (Mohai, 1992) and grew into a nationwide movement by the early 1990’s (Cutter, 1995).

Homes located in a flood designated area will generally have a lower property value than those not in a flood zone, all other considerations being equal. Therefore, those with higher incomes will have more opportunities to locate themselves away from a flood zone. Certainly individuals living in a flood zone have more reason to be concerned about flooding than those who do not. To help determine if a social inequity in the exposure to environmental risk exists in Painesville, in this case vulnerability to flooding, income data relative to location in or out of the floodplain was evaluated. Survey takers were asked to identify their annual household income as one of five ranges:

1- Less than $25,000
2- $25,001 - $50,000
3- $50,001 - $75,000
4- $75,001 - $100,000
5- $100,001 and higher

The average income response for those residing outside of the floodplain was 3.08, which lies within the $50,001 - $75,000 range. The average income response for
those residing inside the floodplain was 1.77, which lies within the $25,001 - $50,000 range. Assuming all incomes are evenly distributed throughout each income range it is possible to identify the average income among respondents residing within the floodplain versus outside of the floodplain as $31,750 and $64,500, respectively (Fig. 60).

![Figure 60. Average income among respondents inside the floodplain and outside the floodplain, assuming an even distribution within income ranges](image)

Given that income and education data were found to be associated, the above chart would lead us to believe that average level of education is lower inside the floodplain than outside. Figure 61 displays that this is in fact the case.
This finding suggests that lower income residents in Painesville have an increased vulnerability to floods and the related adverse impacts relative to higher income residents. This helps explain why respondents with lower education levels and associated lower income levels reported higher levels of worry, perceived danger, anticipated future negative impacts, and were more likely to have established a plan of action for if flooding were to occur where they live. This finding may be an important guiding factor for local and county officials when developing mitigation, response, and recovery plans. Not only are lower income residents disproportionately exposed to floods in Painesville, but they are less likely to have access to resources which can make all the difference during hazard events. Planners should bear in mind that this subset of the population may need additional assistance during times of evacuations.

**Figure 61.** Percentages of education levels inside and outside of the floodplain
An association also existed between the age and worry variables, with a significance of 0.036. In this case, respondents who were middle aged adults, within the age range of 35 to 74, had an increased reported level of worry. While the survey did not provide information regarding assets, it is likely that this subset of the population has more potential to accrue damages during a hazard event then do the younger or older groups. According to 2000 census data, 77.3% of homes in Lake County are owned by individuals aged 35-74. It is likely that this group has a higher level of worry regarding flooding because this group may have more to lose than do others.

7.2 Associations Between Experience and Perceptions

In terms of frequency of exposure to flooding an interesting significant statistical association found was that those who experienced flooding once, and only once, were more likely to anticipate personal negative impacts from flooding in their future. Prior research has suggested that individuals are less likely to perceive an event as a probable occurrence if they have never before experienced a similar event (Rogers, 1997; Tversky and Kahneman, 1974), which may explain why more people who have never been in a flood are less likely to feel that they could be impacted by one in the future. Of course it is also likely that some of these respondents live far enough from any designated flood zone that they may be correct in their assumption. Other research has suggested that a high frequency of exposure to an event can lead to desensitization (Richardson et al.,
1987), which may explain why those who have experienced flooding multiple times are less likely to believe they could be negatively impacted in the future relative to those who experienced flooding only once.

In terms of the timing with which people have experienced a flood event, it was expected that those with recent experience would be more concerned, based on findings by White (1964) and more recently Barnett and Breakwell (2001). Statistical associations between timing and perceptions did suggest that those with recent experience with flooding (less than five years ago) were more worried. Recent experience was also associated with perceived future personal negative impacts. Those with recent experience were more likely to anticipate both long-term and short-term impacts in the future. Every respondent who reported their most recent experience to be greater than five years ago also answered that they doubted a flood would negatively impact them personally in the future. This pattern of decreased worry with passing time is an important pattern to recognize, especially as more and more time passes since the region’s most recent devastating flood event in 2006, which took place four years prior to this distribution of the survey.

The only thing that the injury variable associated with statistically was the anticipation of future personal impacts. People who knew someone who had been injured in a flood were much more likely to feel that floods could have both long-term and short-term negative impacts on their personal lives in the future.
Property damage on the other hand was associated with several perception variables. Those who have experienced property damage in the past tended to have increased levels of worry, and were more likely to perceive both their personal lives and their community as likely to experience long term negative impacts from flooding in the future. These findings advocate that individual perceptions of floods are influenced by prior experience, and that worry and concern for the future is increased among those who have suffered damage in the past.

Along with property damage, those who claim they have been personally negatively impacted by flooding in the past (which is likely to include property damage) tend to have higher levels of concerns towards flooding. Worry and anticipation of future negative impacts both increased among those who had experienced negative impacts in the past. This is in keeping with the idea that the perceived probability of a threat will increase once a similar event has already occurred (Rogers, 1997; Tversky and Kahneman, 1974). The association between past and future personal impacts was quite strong, advocating that people tend to believe that what will happen to them in the future is going to be similar to what has happened to them in the past.

While responses varied regarding how people felt they had been personally impacted in the past, the vast majority, 90.2%, felt that their community had experienced negative impacts. Very strong associations exist between the past community impact variable and perceptions. Worry, perceived danger, and anticipations of future personal and future community negative impacts were all higher
among those who felt their community was previously and negatively impacted. An interesting and unintended finding is the fact that the only variable danger was associated with was past community impacts. Personal experience was in no way found to be associated with the perception of danger, nor was danger in any way associated with preparedness. This invokes the possible explanation that the perception of danger is more connected with past experience of the larger population rather than with our individual experiences. Therefore, if policy makers want residents to perceive the dangers of flooding, it may be more beneficial to convey this view in terms of dangers in relation to the entire community, rather than dangers in relation to any individual.

7.3 Associations Between Perceptions and Preparedness

Strong associations exist between the preparedness variables and level of worry. Those with higher levels of worry are more likely to have a plan and to own flood insurance. Although no statistical association was found between the danger and preparedness variables, it is worth noting that every respondent who had a plan as well as every respondent who owned flood insurance also felt that floods were either very dangerous or sometimes dangerous. Therefore, it seems that the perception of danger does not necessarily lead to greater preparedness, but does seem to be a precondition.

In terms of how people believe they could personally be impacted in the future, those who anticipate negative effects are more likely to have increased preparedness, in the form of both developing a plan and owning flood insurance. Among those who
believe their community could be impacted negatively in the future, an increased percentage of people had a plan of action.

7.4 Associations Between Experience and Preparedness

An association suggested that those with recent experience are more likely to own flood insurance. However, no statistical association was found between timing and the preparedness variable of plan of action. Despite this, it is worth noting that among all respondents who did have a plan, 75.7% had recently experienced flooding, while no respondents whose most recent experience was more than five years ago had a plan. This corroborates White’s (1964) findings that the effect experience has with preparedness diminishes with time.

Weinstein (1989) found that preparedness actions increased when damages were severe, and the findings of this study agree when considering the plan of action variable. Among all respondents who reported having a plan of action, 90% reported either having personally experienced property damage or knowing others who have. Although no statistical association was produced between the property damage and insurance variables, all respondents who had experienced property damage were obligated to purchase flood insurance, and eight out of the 11 who chose to do so had experienced property damage. Given these findings, property damage seems to be a
significant factor is the generation of the perception regarding concerns over flooding, and also increases the likelihood that an individual will take protective measures.

Both preparedness variables were statistically associated with past personal negative impacts. The highest percentage of respondents who do have a plan are amongst those who strongly agreed they were negatively impacted in the past at 39.3%, while the highest percentage of respondents who do not have a plan were among those who strongly disagreed that they were negatively impacted in the past at 87.3%. All respondents who had to purchase flood insurance reported that they had been negatively impacted in the past. Among those who opted to purchase flood insurance seven of the 11 respondents agreed that flooding had had a negative impact on them in the past. This again corroborates Weinstein’s (1989) findings that preparedness increases when negative impacts have occurred in the past.

There were no statistical associations between past community impact and individual preparedness. Although many people who agreed that the community was negatively impacted had low levels of preparedness, most people who did have a plan or insurance also agreed that their community was negatively impacted in the past. Therefore, while being aware of the negative impacts to the community in the past does not necessarily lend itself to establishing a plan or purchasing insurance, it does seem to be a prerequisite in most cases.
7.5 Multiple-Response and Open-Ended Questions

A series of multiple answer and open-ended questions exposed an interesting discrepancy between the extent to which residents rely on local and regional government officials for information regarding flooding and the level of responsibility these same organizations are charged with in terms of informing residents about floods and alleviating damages. The expectations of citizens seem to go beyond the reality of how much they actually turn to government sources for information. Government was even ranked higher than insurance companies and property owners regarding who is responsible for assuaging flood damages. On the other hand, several passionate quotes from respondents suggested that not everyone shares the perception that government is the responsible party for relieving damages, and that individuals who live in a floodplain should be held solely responsible for flood damages without help from others. In an inverse situation, over 80% of respondents identified television as a source of information that would inform them of an imminent river flood, although only 67.6% actually felt that television sources were responsible for providing this information. This speaks to the disconnect that can exist between officials and the general public when perceptions of risks and hazard situations are not mutual between all parties.

Most people were able to identify at least one keyword relating to events which may cause flooding. Over 80% included rain or precipitation as causative mechanisms with 56.2% specifically mentioning excessive or heavy rainfall. Winter weather events
such as snow, snow melt, and ice were identified as well, but by less than 25% of respondents in each case, and only 15.6% referred to ice or ice jams as a causative mechanism. This gives an indication that the majority of respondents are making connections regarding how flood events might be triggered by precipitation. However, winter weather events, and especially non-weather related flood triggers, such as dam failures, or flow constrictions resulting from topography or construction were underrepresented. This lack of recognition of the full range of flood triggers could lead to increased adverse impacts to life, property, and public safety during future flood events.

Over half of respondents said they would evacuate if they expected their home to flood and just under a quarter said they would move their belongings to the 2nd floor or another location. This is an interesting finding since so many people who had flood damage in their homes during the 2006 flood did not leave, and many had to be evacuated from their roofs. This could mean that people did not expect the level of flooding that occurred in 2006, or that they have reconsidered potential evacuation plans in light of the experience of 2006.

Major concerns over flooding included property damage, ability to access roads, and loss of life. When the July 2006 flood occurred, several roads were closed for extend periods of time, resulting in prolonged disruption of daily activities for many residents regardless of where they reside relative to the floodplain. When asked what concerns respondents the most about potential flooding, a recurring theme was a sense
of anxiety regarding road closures in the event of a future flood. Other secondary concerns included issues relating to contamination, clean up, economic impacts, safety of animals, and utilities.

Despite several themes regarding concerns of future flood events, many respondents, over 25%, reported that the July 2006 flood had no impact on the way they think about and prepare for floods. Additionally, fewer than 10% of respondents reported behavioral changes in any one identified theme. The fact that the flood was so catastrophic seems to have deterred some residents from considering how they would react to future hazardous events. Because of the magnitude of the flood and the low frequency interval, many seem to perceive this event as a freak of nature. While there is a certain degree of merit to this judgment, it suggests that hazardous events are perceived and considered separately from one another. For example, there is a nuclear power plant about five miles from Painesville and no respondents expressed concern or alluded to the fact the one hazard (the flood) made them think about how they might prepare for a different hazard (a nuclear event). Granted a nuclear meltdown is an unlikely event (as is a 500 year flood) but there are other hazards that commonly threaten northeast Ohio that have much more potential to affect the lives of the survey respondents. Such hazards include damaging snow, ice, tornadoes, lightning, wind, as well as human induced hazards such as the train derailment that occurred in Painesville in 2007. Not a single respondent suggested that the flood of 2006 prompted them to consider how they would respond to other types of hazards in the future. Although
some connections were being made regarding the 2006 flood and future flood readiness and preparations, there does not seem to be any clear mental connection between the 2006 flood and future hazard readiness and preparations in general.

7.6 Conclusion

The goal of this study was to assess in what ways experience with a hazard was associated with perceptions and preparedness. While there are significant findings that shed light upon the influence experience has on the variation of risk perceptions and preparedness levels between individuals, there are limitations as well. More in depth analysis could be attained from personal interactions with respondents via interviews or focus groups, which would help strengthen the understanding of the significant associations that were uncovered. While it was helpful and somewhat revealing to identify respondents’ location as either inside or outside of the 100-year floodplain, additional information relating to the degree of variation of risk perceptions inside versus outside the floodplain could add an additional component to this research and help deepen the understanding of the significant associations.

This study has shown that a lower level of concern and anticipation of future impacts exists among respondents who have never before experienced a flood, experienced flooding multiple times, and who do not have recent experience with flooding. Low levels of risk perceptions as well as lack of recent experience, lack of experience or of overexposure to flooding, and lack of negative impacts have all been
associated with decreased preparedness. As time goes on, and the 2006 flood event fades in memory, it will be important for city and county officials to anticipate a decreased level of concern and an associated decrease of premeditated preparedness actions among the public. Public outreach may be a vital component to help inform and remind residents of the importance of knowing how to react and respond during flood events. This may be especially important in the Painesville region as minor flooding is a common occurrence, and increased exposure with little or no damages may cause desensitization which in turn can lead to a decrease in preparedness. Because this study has found associations that advocate that people tend to base their anticipation of future impacts from flood events on the ways in which they and the community were impacted in the past, it could be useful for planners to place emphasis on the losses suffered in the past in an attempt to help residents stay connected to the potential impacts of flooding in the region. It would be interesting to repeat this study in the same area at a future date, especially if no major flood event were to occur beforehand, in order to help determine if risk perceptions will have further decreased over time.

Although not an initial goal of this study, results revealed an interesting dichotomy regarding individual variations of perceptions of the responsibilities of disaster relief. Government ranked highest in terms of who is ultimately responsible for assuaging flood damages. However, several respondents expressed the opinion that if you live in a floodplain and become negatively impacted by a flood event, that you should be held solely responsible for such damages. A continuation of this research
should include an investigation of the risk perceptions of natural hazards relief responsibility, and variations of such perceptions relative to residents’ location to a hazard prone area.

Because the findings suggest that the perception of danger is associated only with the past experience of the community, and not of the individual, future research would benefit from maintaining a focus on the target of risk perception. People tend to overestimate the risk of an entire population, yet underestimate their own risk (Sjoberg, 2000). While no association existed between the danger variable and preparedness, every respondent who did have a plan, and every respondent who owned insurance, also felt floods were dangerous. Knowing this, if policy makers believe public safety will increase if residents perceive floods as dangerous events, it may be more beneficial to convey this view in terms of dangers in relation to the entire community, rather than dangers in relation to any individual. This study incorporated risk targets to a degree by separating past and future impacts into personal and community variables. Variations between these variables lend themselves to further investigation. For example, continued research could separate the worry variable into two separate variables that address if respondents worry about personally being impacted by floods, and if they worry about their community being impacted by floods. This would be worth studying to help determine if respondents tend to underestimate their own risks, even if they are able to acknowledge risks to the community at large, which I imagine would likely be the case.
In addition to the original goals of this study, this research illustrates two important aspects of risk perceptions: 1) that a dichotomy exists regarding whom is responsible for the relief and recovery of hazards damages, and that this dichotomy may be influenced by relative location to a hazard prone area, and 2) that there are complex relationships between risk perceptions and risk targets. Both of these were unintended outcomes of this research and deserve further investigation.

While the ability of experts to determine the real risk of any hazard is vital for mitigation, that information is useless if it is not communicated to the public effectively and appropriately. Understanding the way people anticipate behaving during a hazardous event is an important process for developing mitigation strategies and maintaining useful communication between experts, policy makers, and the public. This study was able to demonstrate that flood experience is associated in several ways with individual perceptions and preparedness, and also that preparation and mitigation tactics implemented by local and regional officials are impacted by experience as well. While experience has long been considered an important aspect to the generation of risk perceptions, it is often considered as a single variable. This study is unique in that it examined multiple aspects of experience in reference to differing metrics of risk perceptions and preparedness. In addition, this research shed light upon how residents of Painesville anticipate reacting to a flood, where they look for information, and what events are considered causative mechanisms that could trigger a flood event. The understanding of perceptions and preparedness levels that comes out of this research
should be considered as policy makers and local officials address issues relating to forecasting, warning, communication, and mitigation tactics. Based on the findings, public education and outreach should focus on improving the understanding of causative mechanisms of flooding, individual and community risk, and response actions. For these reasons, this study has the potential to aid policy makers in the creation of optimal public safety planning policies that will benefit not only the survey respondents of Painesville, but similar locations as well, such as other small to mid-sized developed areas that are prone to flooding.
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APPENDIX A

Dear Respondent,

I am a graduate student completing a thesis on flood risks and I invite you to participate in a study on the experiences, perceptions, and preparedness of flooding. The results of this survey will be used to understand how flooding has impacted lives in your area. If public officials can better understand how people feel about flood risks, and what their major concerns are, then optimal planning can benefit you in the event of a future flood, such as the one that occurred in July of 2006 in Northeast Ohio.

This study addresses river flooding along the banks of the Grand River in Northeast Ohio. However, any experiences you have had with river flooding, in this region or elsewhere, should be considered when completing this survey. Any experiences or sentiment associated with other types of flooding (such as burst pipes) should not be considered when answering this questionnaire.

Inside is a questionnaire that asks about how you have experienced floods in the past, and how you anticipate experiencing them in the future. Even if you have never experienced flooding, your input is important and I encourage you to complete the survey. Please look over the survey and, if you choose to do so, complete it and send it back to me.

Individual responses will remain anonymous. I will not share any information that identifies you with anyone outside of my research group, which consists of my advisor, Dr. Thomas Schmidlin, and me.

I hope you will take the time to complete this questionnaire. Regardless of whether you choose to participate, please let me know if you would like a summary of my findings. To receive a summary, please send me an email at clongo3@kent.edu.

If you have any questions or concerns about completing the survey or about being in this study, you may contact me at clongo3@kent.edu. The Institutional Review Board (IRB) at Kent State University has approved this study. If you have any concerns about your rights as a participant in this study you may contact the IRB Office directly via telephone at 330-672-2851.

Please return the survey in the enclosed envelope within three weeks of receipt. Thank you for your time and participation.

Sincerely,

Christina A. Longo
Department of Geography
Kent State University
clongo3@kent.edu
Dear Residents,

On behalf of the Board of the Painesville City Manager’s Office, I would like to support the research that is being conducted by Ms. Christina Longo as part of her Master’s Thesis of examining the impact of river flooding in our region.

Ms. Longo’s work will help us understand how people in Northeast Ohio have been affected by flood events in the past, and how we can most effectively mitigate potential flood hazards in the future.

I encourage you to complete the enclosed survey and look forward to reviewing the final results of her work.

Sincerely,

Rita McMahon
Painesville City Manager
APPENDIX C

1. What is your sex?
   □ Male
   □ Female

2. What is your age?
   _________

3. What is your race or ethnicity?
   □ American Indian
   □ Asian
   □ Black
   □ Hispanic/Latino
   □ White
   □ More than one race
   □ Other/Prefer not to say

4. What is your highest level of education?
   □ Some schooling
   □ High school or equivalent
   □ Some college
   □ 2 year degree or certificate
   □ Bachelor’s degree
   □ Graduate degree
   □ Other/Prefer not to say

5. What is your annual household income?
   □ Less than $25,000
   □ $25,001 - $50,000
   □ $50,001 - $75,000
   □ $75,001 - $100,000
   □ $100,001 or higher
   □ Prefer not to say

6. What is the nearest street intersection to your home? (This information will not be shared)
   ________________________________________________________________

7. Do you live in a floodplain?
   □ Yes
   □ No
   □ Not sure

8. How often have you experienced river flooding in the past?
   □ Never
   □ Never personally, but I know others who have
   □ Once
   □ 2 - 3 times
   □ 4 - 5 times
   □ More than 5 times
9. When was your most recent experience with river flooding?
   ☐ Less than a year ago
   ☐ 1 - 5 years ago
   ☐ 6 - 10 years ago
   ☐ More than 10 years ago
   ☐ Never experienced flooding

10. Do you feel river floods are dangerous?
    ☐ Yes, very dangerous
    ☐ Sometimes, but not always
    ☐ No, they aren’t dangerous

11. Have you or someone you know ever been injured in a river flood?
    ☐ I have been injured, but no one I know has
    ☐ Both I and someone I know have been injured
    ☐ I have not been injured, but someone I know has
    ☐ Neither I nor anyone I know have been injured

12. Have you or someone you know ever had property damaged in a river flood?
    ☐ I have had property damaged, but no one I know has
    ☐ Both I and someone I know have had property damaged
    ☐ I have not had property damaged, but someone I know has
    ☐ Neither I nor anyone I know have had property damaged

13. River flooding has had a negative impact on my personal life in the past.
    ☐ Strongly agree
    ☐ Somewhat agree
    ☐ Somewhat disagree
    ☐ Strongly disagree

14. River flooding has had a negative impact on my community in the past.
    ☐ Strongly agree
    ☐ Somewhat agree
    ☐ Somewhat disagree
    ☐ Strongly disagree

15. Do you worry about river flooding?
    ☐ Yes, very much
    ☐ Somewhat
    ☐ No, not at all

16. Do you feel that river flooding could negatively impact your personal life in the future?
    ☐ Yes, a flood could have long-term negative impacts on my life
    ☐ Yes, but only short-term negative impacts
17. Do you feel that river flooding could negatively impact your community in the future?
- Yes, a flood could have long-term negative impacts on my community
- Yes, but only short-term negative impacts
- No, I doubt a flood would negatively impact my community

18. How would you know if river flooding was likely to occur in the area where you live? (Choose all that apply)
- Television
- Internet
- Radio
- I would notice environmental changes
- Local / Regional government officials
- From friends and neighbors who knew about it
- I'm not sure how I would know
- Other (please specify)

19. Whose responsibility is it to inform residents of an imminent river flood? (Choose all that apply)
- Television
- Internet
- Radio
- Local / Regional government officials
- Friends and neighbors who have heard about it
- It is the individuals’ responsibility
- Other (please specify)

20. Whose responsibility is it to alleviate damages from river flooding? (Choose all that apply)
- The government
- Insurance companies
- The property owner
- Relief organizations
- Other (Please specify)

21. If you have flood insurance, did you have to purchase a policy or was it optional?
- I had to purchase a policy
- It was optional, and I decided to purchase a policy
I do not have flood insurance
I’m not sure if I have flood insurance

22. Do you have a plan of action if river flooding occurred where you live?
☐ Yes, I have a plan and I have discussed it with my family / housemates
☐ Yes, I have a plan but I have not discussed it with my family / housemates
☐ Yes, I live alone and I have a plan
☐ No, but I know what I would do during a flood
☐ No, I’m not sure what I’d do during a flood

23. If you wanted information on flood risks for your area, where would you look for this information?

24. What type of events would you expect to cause a flood?

25. What type of actions would you take if you expected your home to flood?

26. What concerns you the most, if anything, about river flooding in your area?
27. Did you live in or around the Painesville area during the July 2006 flood event?
   ☑ Yes
   ☐ No

28. If yes, how has that experience changed the way you think about and prepare for
    floods and other natural hazards, if at all?