IMPACT OF FLOODING ON RESIDENTIAL PROPERTY VALUES: A REVIEW AND ANALYSIS OF PREVIOUS STUDIES

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ABSTRACT

This study reviewed existing academic literature on hedonic price models of the floodplain real estate market. In addition, two hedonic price model cases were studied to answer some of the questions raised in the literature review. Empirical findings from the extensive review revealed that the understandable concerns of residential property owners at risk of flooding regarding long term loss of property value are largely unfounded. Price discounts are observed for some recently flooded areas but they are temporary. The output from this study makes a contribution to the understanding of the impact of flooding on house prices, allowing for better valuation advice. The output from the study also makes a methodological contribution in extending concepts relating to the relationship between flooding, insurance and house prices. This development is anticipated to facilitate refinement and updating of the empirical findings with reduced effort in the light of future events. What remains to be investigated is whether these relationships exist in different places, with different flood regimes and different institutional arrangements for dealing with floods Future research should equally lengthen the time period of analysis in order to determine how the flood influences housing prices in the 100-year floodplain in different regions with difference antecedents over time.

Keywords: *Flooding, Hedonic Price Model, Natural Hazards, Property Value and Residential Accommodation*

INTRODUCTION

Floods are natural phenomena that occur when streams, rivers, and lakes overflow their banks. In the context of natural disasters, floods are defined by the amount of damage they cause to people or property (West, 2010). If people did not inhabit flood-prone areas, the natural phenomena of a river exceeding its notional capacity and overflowing into the surrounding areas, often referred to as floodplains, would preclude floods from being labeled a natural disaster (Montz, 1992b). However, flood-prone areas are attractive for human settlements for a variety of reasons. Some of the reasons are transportation, readily available water supplies, power production, rich soils for agriculture, and for the simple beauty of the surrounding areas. In short, people populate the flood-prone areas for human convenience (Eleuterio, 2012).

Floods are the world's greatest natural disaster as asserted by West (2010). According to the U.S. Geological Survey, floods cause an average of $6 billion of property damage, claim 140 lives, and prompt more Presidential disaster declarations per year than any other

hazard. Floods cause an average of $6 billion in property damage and kill approximately 140 people in the U.S. every year. Major floods not only cause direct damage to the areas affected, they also have a cascading effect due to the decrease in property values in the affected areas, disruption of transportation systems, food and water supplies, and other economic damages to local businesses and agriculture. For example, the total damages from the U.S. 1993 floods are estimated at 18 billion.. Property damages exceeded $1 billion of the $3.4 billion of damage in the state, and agriculture damages accounted for an estimated $1.9 billion (West, 2010).

In 2008, floods destroyed twenty percent of Iowa's total grain crop and economic losses alone are preliminarily estimated to exceed $2 billion. Realizing floods are a natural phenomenon that cannot completely be avoided, flood mitigation and response is an important national endeavor that strives to minimize the overall impact of floods and decreasing national costs associated with response and recovery.

Yeo (1997) observed that a number of studies demonstrate that floods adversely affect residential property values. After flooding, average values fell by 19–26% at Oak Grove (Muckleston, Turner and Brainerd, 1981; Muckleston, 1983), 30% at Wilkes-Barre (Montz and Tobin, 1990; Tobin and Montz, 1994), 19% at Linda/ Olivehurst (Montz and Tobin, 1988; Tobin and Montz, 1988, 1994, 1997), 9% at Te Aroha (Montz, 1992a, 1992b, 1993) and 60% at Nyngan (PRC, 1992; Lambley and Cordery, 1991, 1993, 1997). A slight decrease was observed for Sydney's Georges River district after the 1986 flood (PRC, 1992; Lambley and Cordery, 1991, 1993, 1997). There are several other examples, however, where flooding was not found to decrease residential property values. This was the case after the 1986 flood at Des Plaines (Tobin and Montz, 1990, 1994). After flooding at Cambridge in 1974 and at Paeroa and Thames in 1981, property values increased. No decrease occurred after flooding of Sydney's Georges River district in 1988 (PRC, 1992; Lambley and Cordery, 1991, 1993, 1997). A study at Houston, Texas, found that flooding in 1979 had no direct impact on values of flooded houses, which declined only when flood insurance rates increased substantially.

Yeo (1997) further argued that many studies have found that properties situated in designated floodplains are valued less than comparable properties situated outside the floodplain (usually by 4–12%). One study favored a figure of –11% for highly flood prone properties in Sydney's west, though flood prone properties in the largest data set (Toongabbie) were valued only 4% less than comparable properties situated above the 100-year flood level (PRC, 1992; Lambley and Cordery, 1991, 1993 and 1997). Annual sales data revealed a 25% fall in floodplain property values in the Georges River catchment in 1984, which was interpreted as a response to the release of floodplain maps. The data are of a coarse resolution, however, and show other downturns that presumably were not associated with disclosure.

It is difficult to isolate the effects of disclosure due to the depressed state of most property markets in 1984. Other studies have found no significant difference between values of properties situated in and out of designated floodplains. Several studies have found that floodplain designation or subsequent regulation have had no adverse effect on property values (e.g. at sites in Ontario). Indeed, at Oak Grove, Te Aroha and Bergen County, New Jersey, properties so designated increased in value at rates exceeding those that were not designated (Babcock and Mitchell (1980), Schaefer (1990), Shrubsole, Green and Scherer (1997). This may reflect extraneous influences such as the premium placed on waterfront

property. A finding that floodplain designation has little effect on property values matches the finding of (some) research of earthquake hazards in California, where it was concluded that surface fault rupture zonation and its disclosure by real-estate agents had no negative impact on house price levels.

LITERATURE REVIEW AND THEORETICAL UNDERPINNING

Impact of Natural Events on Property Values

Montz (1992a) established that much has been written about the impact of natural events on property values, with most studies focusing on flood and earthquake hazards in the United States (Brookshire, Thayer, Tschirhart and Schuize, 1985); Donnelly, 1989; Montz and Tobin, 1988; Scawthorn, lemura and Yamada, 1982; Tobin and Newton, 1986). It might intuitively be expected that the occurrence of a natural event such as a flood, would devalue affected properties, and that any measures taken to protect areas from the event would have a positive impact on property values. The results of research support these contentions, over the short term (Montz, 1992a). However, as time from the event increases, the impact of the event diminishes to become insignificant, and eventually there may be no discernible impact at all. In addition, the impacts are not spatially uniform across an affected area.

The questions arises, then, as to whether or not the length of the 'interruption' in normal market forces affects flooded properties over the long term, in comparison to other properties. Evidence from research undertaken in the United States on flooding and property values indicates that characteristics of the community's flood experiences combineed with urban economic factors to explain recovery (Montz, 1992a). For example, in several case studies, after an initial decline, selling prices for houses returned to and sometimes exceeded pre-flood levels in communities experiencing rare flooding. However, length of recovery periods varied significantly (Montz and Tobin, 1988; 1990). The initial drop in value and the length of the recovery periods were greatest for those properties flooded to greater depths.

On the other hand, in an area of frequent flooding, property values for flooded properties reflected the number of times they had been flooded, but the entire market exceeded pre-flood levels rather quickly (Tobin and Montz, 1990). What remains to be investigated is whether these relationships exist in different places, with different flood regimes and different institutional arrangements for dealing with floods (Montz, 1992a).

In a study conducted by Montz (1992a, 1992b, 1993) at Coromandel, New Zealand, sales data were used to assess the effects of record flooding at Paeroa in 1981, a severe landslip and flooding at Te Aroha in 1985 and flooding at Thames in both 1981 and 1985. The impacts of later disclosure via hazard maps at Te Aroha and Thames were also evaluated. For the non-flood area of Paeroa, prices after the flood were significantly higher than before, but this was not sustained beyond four years. Houses that were flooded to greater depths appreciated more after the flood due to their low pre-flood values and the value added by repairs and renovation as they rightly perceived.

At Te Aroha, immediate post-event selling prices were significantly lower than pre-event prices (-9%) for all properties in the town (including non-hazard) for up to four years. At Thames, property values increased after the 1981 flood, though not significantly for flooded houses. There were no significant differences in before/after selling prices for the 1985

flood. There is little apparent difference in trends experienced in and out of the floodplain. Disclosure had little impact on the real estate markets in Te Aroha or Thames. No downturns are attributable to the release of flood hazard maps. Spatial patterns were the opposite of what might be expected in Te Aroha, high-hazard houses sold for more after designation, and in Thames it was the houses that were not designated as flood prone that decreased in value.

The effect of flooding and flood disclosure on sales prices has been investigated in Sydney and Nyngan, NSW, Australia by three Australian studies (i.e. PRC, 1992; Lambley and Cordery, 1991, 1993 and 1997). One of these studies evaluated the impact of floodplain mapping and flood events in the Georges R. catchment, and another evaluated the impact of a levee-breaking flood at Nyngan in 1990. There is weak evidence to suggest that between 1987 and 1991, properties situated on highly flood-liable land in the Upper Parramatta R. catchment (separate to the Georges R. catchment) had reduced sale prices (-11%) when compared to properties situated above the 1 in 100 year flood level.

There is some evidence to show that the prices of flood prone properties in the Georges R. catchment fell by 25% in 1984 but recovered in 1985. This has been linked to the release then withdrawal of floodplain maps, though the depressed state of property markets may have been influential. There is some evidence to show that prices of flood-liable property fell 2 or 3 months after the 1986 Georges R. flood, but this was not sustained. There was no decline after the 1988 flood. From 1984 to 1992, the average value of flood prone properties in the Georges R. catchment fell slightly, relative to a flood free control group. The average price for a house in Nyngan fell from $50,000 before the flood to $20,000 eight months after the flood (-60%), but recovered within a year.

Past Studies on the Impact of Flooding on Property Values

A pervasive feature of global inquiry into the effect of flood disclosure on property values is the contradictory nature of the results, often acknowledged in the literature. Reasons for these contradictions are explored below. But one finding on which there appears to be little disagreement is this: a flood event, rather than floodplain designation, is likely to have a greater effect on property values. This is supported by the Oregon case study. Even studies that demonstrate an adverse response to floodplain regulation have found that flood events trigger an even more adverse response. This corresponds with a number of perceptual studies, which found that assessors, realtors and lenders thought flood events had more impact than floodplain regulations in determining property prices and lending decisions (Damianos, 1975).

A study of assessed land values in Oak Grove, Oregon, USA conducted by Muckleston, Turner and Brainerd (1981) and Muckleston (1983) over a 23-year period demonstrates the effects of a major flood in 1964 and the enforcement of floodplain regulations from 1971. The flood had a depressing effect on land values, particularly for waterfront lots (-19% to -26%), but also for lots that apparently were not flooded (-3%). This depressed effect lasted for 5-8 years. The enforcement of floodplain regulations had no dampening effect on residential land values; indeed, the mean appreciation rates for regulated river front lots increased significantly more rapidly than those for unregulated lots.

A study of list and sold prices over a 4-year period by Tobin and Montz, (1990, 1994) at Des Plaines, Illinois, USA reveals the influence of frequent, low-magnitude floods (in October 1986 and August 1987) on property values in a suburb of Chicago. The first flood had a

minor effect on property values, with small increases (8%) in sold prices for flooded areas (perhaps due to the value added by repairs and renovation) and small decreases (-7%) for non-flooded areas. The second flood (which was less extensive) had a more pronounced effect on property values, with corresponding decreases in sold prices for both flooded and non-flooded property (-15% to -21% from the preceding quarter). Houses that were flooded twice experienced a slow recovery (> 2 years for sold prices to recover to pre-flood values), and houses that were not flooded at all experienced a greater overall increase in value than flooded houses in Linda and Olivehurst, California.

In a study conducted by Montz and Tobin (1990) and Tobin and Montz (1994) at Wilkes-Barre, Pennsylvania, USA about list and sold prices over a 5-year period, it reveals the influence of a catastrophic, levee-breaking flood in 1972. About two-thirds of the city was inundated, in places to depths of more than 4 metres. The flood caused an immediate decline in prices across the city, though the decline in sold prices for non-flooded property was neither as severe (-11%) nor as prolonged (6 months) as for flooded properties (-30%, 2 years). The most severe decline in values (almost -40% for the first 6 months) and the longest recovery (30 months) was experienced by properties flooded to the greatest depths (> 4 metres – sufficient to flood second storey). Flooded properties were worth more than non-flooded properties, before and after the flood, due to larger floor areas and the value of improvements from repairs and renovation as a matter of fact.

Montz and Tobin (1988), Tobin and Montz (1988, 1994 and 1997) conducted a study of list and sold prices over a 13-year period in Linda and Olivehurst, California, USA. Their findings demonstrate the influence of a catastrophic, levee-breaking flood in 1986, which was characterized by depths of up to 3.5 metres, high initial velocities, and durations ranging from less than 2 days to more than 2 weeks. The flood caused an immediate decline in sold prices in flooded areas, by an average of -19% for the 6 months after the flood. Even sold prices for non-flooded areas showed a decline after 1 year. Those properties flooded to the greatest depths experienced the most severe downturns (-60% for the first quarter after the flood) and the slowest recovery (in excess of 10 years, partly due to abandoned houses serving as continuing visual reminders of the damage). Slightly flooded (0.5 metres) and non-flooded houses experienced less severe downturns (up to –20%) and a somewhat faster recovery (4–6 years) as a matter of fact.

A number of studies by Babcock and Mitchell (1980), Schaefer (1990), Shrubsole, Green and Scherer (1997) have investigated the influence of flooding and flood disclosure at sites in Ontario Province, Canada. Their analysis of sales prices and assessment values revealed no significant differences between flooded and non-flooded areas either before or after a major flood at Cambridge in 1974. Sales prices were significantly higher after the flood. There was no significant difference in perceived property values between flooded and non-flooded areas in 1978. Modeling of influences on property values at North York identified no significant relationship between floodplain designation/regulations (from 1982) and selling price of homes situated within regional flood lines. Analysis of asking price, selling price, assessed value and days on market for houses in London between 1978 and 1989 found no significant difference between houses situated in and out of the designated floodplain. This corresponds with the perception of most interviewed residents that floodplain regulation had no economic impact on property values.

Summary of Studies on the Influence of Flooding on the Value of Real Estate

Kropp (2012) buttressed that the risk of flooding has always been present for buildings close to rivers or coasts, but it has been growing in recent years. Major floods all over the world over the past decade have shown that flooding is a significant environmental hazard. New Orleans (USA) in 2005, Pakistan in 2010 or Thailand in 2011 are only some examples that illustrate the risk for infrastructure, local economy, housing, living conditions and not to forget for human lives as well as the substantial costs of damaging natural and built environment, of cleaning up and the following renovations run into billions.

There is several literatures on the influence of flooding on the market value of real estate. Most of the publications are based on events and data from North America, the number for European research is more limited. Research goes back to the 60's. Table 1 below gives an overview about existing subject related literature back to the year 2001.

Table 1: Summary of Studies on the Influence of Flooding on the Value of Real Estate

Author	Year	Study Area	Method	Result
Harrison et al.	2001	Florida, USA	hedonic model	floodplain location results in a discount between $985 to $2.100
Eves	2002	Sydney, Australia	comparison of mean prices of objects influenced by flood and objects flood free (t-test)	short term discount
Bin and Polasky	2004	North Carolina, USA	hedonic model	floodplain location lowers real estate values by 5,7 %
Troy and Romm	2004	California, USA	hedonic model	floodplain location lowers real estate values by 4,2 %
Hallstrom and Smith	2005	Florida, USA	repeat sales	decline of 19 % of housing prices in flood zones
Lamond and Proverbs	2006	UK	regression	no significant long term impact
Bin and Kruse	2006	North Carolina, USA	hedonic model	floodplain location lowers real estate values by 5-10 %
Bin et al.	2008	North Carolina, USA	hedonic model & spatial data	price discount depends on flood rate, lies between 6,2-7,8 %
Pope	2008	North Carolina, USA	hedonic model	floodplain location lowers real estate values by 3,8-4,5 %
Lamond et al.	2009	UK	repeat sales	temporary impact of flooding on property values, normal market value after 3 years
Pryce et al.	2011	different areas	analyzing housing prices in combination with findings of behavioral economics and sociology risks	uneven pattern of inertia followed by rapid tipping-point declines

Source: Adopted from Kropp (2012)

Main objective of the conducted studies is the price effect of a particular flood event or in general the risk of flooding (for example by designation of floodplain). Various methods from regression, repeat sales analysis to the hedonic approach (most often) were used to gather results. The studies reveal that the location of real estate in a floodplain result in lower real estate values compared to objectives outside of a floodplain. As it could be seen in Table 1, the rate of the discount varies in a wide range. Some studies also revealed that there is no negative effect or even a positive effect on the value of real estate (Babcock and Mitchell, 1980; Tobin and Montz, 1989). The authors explain their findings as a result of investments after a flood event that results in significant improvements in the quality of the

real estate. Lamond (2009) figured out that flooding has only a temporary impact on property values and that after three years price has returned to their normal market level.

Changes in Property Values Due to Occurrence of Flooding

In the U.K., according to Kelman (2002), the Flood Hazard Research Centre (FHRC) at Middlesex University, London has completed studies estimating the vulnerability of U.K. residences to floods in monetary terms. FHRC calculated curves of monetary damage as a function of slow-rise flood depth. Their first major publication (Penning-Rowsell and Chatterton, 1977) systemised the assessment of the benefits of flood alleviation for both urban areas and agricultural land using synthesised data for direct flood water damage.

In the word of Palmquist, (1982), tracking of changes in housing prices over time indicates wide fluctuations in response to local, regional, and national economic trends. Of importance to Palmquist's analysis, however, is the significance of changes in value as they are seen before and after flood events. Houses that were sold twice, once before and once after the flood, were used for the t-tests and the repeat sales analyses in Palmquist (1982) study. This includes 78 of the 208 houses sold more than once during the study period. The t-tests were run several times, first using all houses that were sold before and after, and then using subsets based on extent of flood experience. In addition, Palmquist (1982) states that assuming that the effects of the flood will wane over time, two time periods were utilized.

The first looks at sales within four years of the flood and the second deals with the entire study period. Given that flood protection works will have been mostly completed by this time, there may be a permanent alteration in perceptions of hazardousness. All of the results are shown in Table 2. In the four year period following the flood, 'after' house prices were significantly different from 'before' prices in the community as a whole and in the non-flood area. It is the latter which is of particular interest. In this case, 'after' flood prices were significantly higher than 'before' flood prices, suggesting that the flood did, in fact, have an impact. However, this effect is lost over time. Indeed, when looking at the entire study period, in only one case is there a notable difference, and that is with houses that had water in them. Thus, the trend seems to have switched with houses that incurred the greatest damage selling for significantly more long after the flood than before.

However, given a probability level of 0.06, the significance of the difference in prices must be interpreted with caution. In contrast to the comparison of absolute selling prices, repeat sales analysis evaluates the ratio of 'after' flood selling price to 'before' flood selling price for the same house. Although this technique has been applied to measure the effect of permanent disamenities, such as a highway (Palmquist, 1982) or toxic waste disposal sites (Kohlhase, 1990), it is being used here because it is assumed that equilibrium price levels were established after the flood owing to the soon-to-be-completed Waihou Valley Scheme.

Table 2: Results of Matched Pairs (T-Tests) of Sales for Paeroa, Within Four Years of the 1981 Flood

Area	*Before flood selling price*[1]	*After flood selling price*[1]	*Difference*	*T-Value*	*Probability*
Town (N=34)	37422	40552	3130	−2.84	0.008
Flooded Area[2] (N=10)	28117	30730	2613	−1.48	0.174
Water in House (N=7)[3]	28969	32224	3255	−1.46	0.194
Nonflood Area (N=24)	41299	44644	3345	−2.40	0.025

Source: Palmquist (1982)

Turning our attention to flood damage, the most detailed U.K. studies on damage and loss for residences in floods have considered almost exclusively depth-damage curves (Kelman, 2002). The flood depth is assumed to rise slowly so that damage occurs only due to water touching the damaged item or structure and not due to any physical force, pressure, or energy imparted to an item, component, or structure. Duration is specifically considered in many U.K. studies, but justification is not provided for the duration times considered (Kelman, 2002).

Penning-Rowsell (1981) states, without supporting evidence, that: The part played by flood water velocities in producing damage is assumed to be small except in rare cases of structural failure. The more minor effects of velocity are generally measured by the depth variable (Kelman, 2002). He further suggests that duration is as unimportant, although sediment loading "affects cleanup costs" and sewage contamination "has been assumed to affect damage values" (PenningRowsell, 1981). Meanwhile, Green and Parker (1994) write "Assuming that damage data is standardised for depth then, for direct damages, velocity and sediment loads appear to [be] the next most critical determinants".

The Hedonic Valuation Method used in Previous Studies on Flooding and Property Value Effect

The influence of flooding on residential housing values has been analyzed in various communities throughout the United States using a variety of techniques, the most common of which is the Hedonic Valuation Method (HVM). The HVM is based on the idea that goods with market prices, such as houses, can be thought of as a collection of various characteristics or amenities. It is this combination of characteristics which makes up the value of the good and defines what a prospective buyer is willing to pay for that good. Through the use of the HVM, it is possible to quantify the values of individual characteristics whose aggregate value makes up the value of the good as a whole. The results of past studies have been site specific as many of the factors that influence housing values (especially non-structural characteristics) vary greatly from one community to the next. For this reason, a study quantifying the influence of flooding specifically in other similar communities is considered worthwhile.

The Hedonic Valuation Method (HVM) is based on the idea that goods with market prices, such as houses, can be thought of as a collection of various characteristics or amenities. As

Andreas (1984) suggests, the term "hedonic" refers to a method in which a complex commodity is dissected into the sum of the values of its various components. It is this combination of characteristics or components which makes up the value of a good and defines what a perspective buyer is willing to pay for that good.

These characteristics do not always have readily accessible values associated with them because they are not sold individually. However, it is possible, through the use of hedonic price models, to quantify the implicit prices of the various characteristics from the observed market value of the good as a whole (Doss and Taff 1993).

The impacts of flooding on housing values have been analyzed from various perspectives. Some researchers have looked at the influences of floodplain location, designation, and regulation on housing values (Damianos and Shabman 1976, Donnelly 1989, Muckleston 1983, Schaefer 1990, and Zimmerman 1979). Others have studied the impact of actual flood events on housing values (Babcock and Mitchell 1980, and Tobin and Montz 1988). Some of these studies have used a HVM model (Donnelly 1989, Damianos and Shabman, 1976, and Schaefer 1990) to estimate the effects of flooding on housing and property values. Others have chosen different methods such as analyzing changes in mean values of homes in affected areas (Babcock and Mitchell 1980, Muckleston 1983, Tobin and Montz 1988, and Zimmerman 1979). Though the focus and objective of these studies were similar, many of their results were either contradictory or inconclusive perhaps due to different study locations.

The Hedonic Valuation Method (HVM) was used by Fridgen and Shultz (1999) to quantify the influence of the threat of flooding on housing values in Fargo-Moorhead by regressing values of homes sold between January 1995 and August 1998 with their various characteristics. These characteristics included structural, neighborhood, environmental, and flood-related amenities. The 100-year floodplain was shown to have a statistically significant and negative influence on housing values (houses in the 100-year floodplain are on average expected to be worth $8,890 less than similar houses outside the 100-year floodplain). About 81 percent of this price reduction is a result of FEMA flood insurance requirements for homes in the 100-year floodplain. The remaining 19 percent price reduction is expected to be a result of fear or anxiety associated with flooding risks.

Houses in the 100-year floodplain sold after the 1997 flood also had a statistically significant and negative influence on housing values. Such homes on average were sold for $10,241 less than similar homes outside the 100-year floodplain and sold before the 1997 flood. The influence of the 100-year floodplain decreased housing values by $8,890, while the specific impact of the 1997 flood event was derived to be $1,351. This is the difference between the threat of flooding after the 1997 flood, which is $10,241, and the overall threat of flooding, $8,890. This additional depreciation is probably the result of Home buyers' increased awareness for the risks associated with flooding following this major flood event.

MAJOR FINDINGS AND CONCLUSION FROM EXTENSIVE REVIEW OF PAST STUDIES AND

While the experiences of the past researches are different, there are several common trends that can be seen in the results of other studies. It is intuitively obvious that the occurrence of an event such as a flood or landslip would cause property values to decrease because of the damage that must be repaired. In addition, it might well be expected that all property

values, not just those in the flooded areas, would be affected because attention is focused on the impacts of the event. In fact, this was found to some extent in all studies reviewed, but the impact was temporary.

For instance, properties not flooded experienced significant increases in selling prices for a time following the flood, while flooded properties did not. Eventually flooded properties increased in value, relative to their pre-flood prices. The entire findings of past studies experienced a decline in selling prices following the landslip event, though the decline was less marked in the most hazardous areas. Thames provides the distinct exception to this trend. Indeed, following the 1981 flood, there is no evidence of a decrease in values. Following the 1985 flood there is, though the entire community was experiencing a downturn that was most apparent with non-flooded properties.

In some instance, these results of the past studies appear to be contradictory. However, findings elsewhere suggest that, at least in some case study communities, flooded properties sell for more than pre-flood values following a flood, and indeed experience a greater proportional increase than non-flooded properties, partly due to pre-flood values as well as to repairs and renovation following an event (Tobin and Montz, 1990; Montz and Tobin, 1990). The repairs made to damaged houses increase their value over time, especially if the event is seen to be a once-in-a-lifetime event either because of its recurrence interval or because of protection works.

Of course, this is not to say that the owner of the affected house experiences a windfall, or any profit at all, given the money that was required to make the repairs. In some case study areas, the market is so influenced by supply-demand considerations, with many people moving outside the community. This influence property values very likely overshadows any caused by the flood event. Indeed, the decrease in property value due to flooding may as easily have been caused by non-flood factors. In the end, the immediate depreciating impacts of floods and landslips are minimized as damage is repaired and houses are upgraded. Given that these impacts are not long-lasting, it appears that hazardousness is not an important consideration in house buying decisions.

The nature of physical vulnerability of residences to floods has been described and past studies on the topic have been examined. These studies provide useful results on an important aspect of vulnerability, but leave a gap in the understanding of vulnerability with respect to the most potentially damaging aspects of floods. As well, an explanation of how damage, either with or without failure, occurs to residences in floods is rarely provided (Kelman, 2002). This extensive review, among others, can make an original contribution to research by proposing solution and tackling this knowledge gap.

FUTURE RESEARCH NEEDS

Because the results of HVM studies are site specific, the results of Fridgen and Shultz's (1999) study may not be transferable to other flood prone areas. Also, future researchers need to take a closer look at homebuyers' perceptions and knowledge of the 100-year and 500-year flood lines in similar study areas. This should include an analysis of both recent homebuyers and long-term residents.

To further understand the perceptions of these individuals related to flooding, a survey would be required asking homeowners about their knowledge and perceptions of the risks associated with flooding. In addition, the survey could inquire about their knowledge of flood insurance and how they perceive the influence of flood insurance as affecting the

value of their homes. Finally, future research should lengthen the time period of analysis in order to determine how the flood influences housing prices in the 100-year floodplain in different regions with difference antecedents over time.

In particular, damage and losses beyond slow-rise flood depth need to be investigated in detail. Such damage may result from energy transfer, forces, or pressures leading to effects on residences including structural failure, doors being forced open, glass breaking, roofs collapsing, or foundations being undermined. This represents the current gap in knowledge with respect to damage and losses to residences from floods, especially in the U.K. (Kelman, 2002).

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