THE IMPACT OF HAZARD AREA DISCLOSURE ON PROPERTY VALUES IN THREE NEW ZEALAND COMMUNITIES

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**Natural
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Natural Hazards Research and Applications Information Center
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PREFACE

This paper is one of a series on research in progress in the field of human adjustments to natural hazards. The Natural Hazards Working Paper Series is intended to aid the rapid distribution of research findings and information. Publication in the series is open to all hazards researchers and does not preclude more formal publication. Indeed, reader response to a publication in this series can be used to improve papers for submission to journal or book publishers.

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SUMMARY

The research described in this report evaluates the impact of hazard disclosure on property values in several communities in New Zealand; findings suggest that disclosure has little effect. In one area, properties whose value decreased following disclosure were those outside of the designated hazard area--the opposite of what might be expected. Properties in the most hazardous areas experienced the least effect from disclosure, their values actually increasing more than properties in less hazardous areas. Moreover, hazardousness did not appear to be an important consideration in house buying decisions, nor did it adversely impact repeat sales of houses. Thus, local economic factors may be more important than disclosure in effecting property value, or they may mask disclosure-related impacts. Again, the perception that disclosure lowers property values for designated properties is not supported.

All of the communities studied have some form of protective structural controls whose existence may provide a false sense of security and cause residents to minimize the probability of hazard occurrence even with disclosure. Thus, the role of structural controls must be considered in conjunction with disclosure.

Information about the hazardousness of a prospective property becomes part of a buyer's knowledge base about the property along with its size, shape, relative location, proximity to shops, schools, work, and the like. Hazardousness information may not, however, prove the deciding factor in a buyer's decision to purchase, unless there are additional factors involved such as a buyer's previous experience with the hazard. It is important that disclosure be seen in the context of all the information that buyers receive about a property. In this context, disclosure appears to have no impact on the market and can only serve to minimize losses to hazards over the long term, losses that were often found to occur beyond the designated hazard areas.

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INTRODUCTION

The policy of designating a location as hazard-prone and disclosing that information publicly, usually through maps and associated land-use policies, has been both promoted and condemned. Promotion comes from those who believe these actions will increase awareness of the potential for a natural event in a community and thereby allow residents to make informed locational decisions (Ericksen, 1986). Opposition has come from the business sector as well as policy makers, at local and regional levels, who argue that such disclosure will have a negative effect on property values by "marking" some properties, and even neighborhoods, as particularly hazardous. The results of research on the topic, undertaken mostly in the United States, vary, but suggest that neither hazard disclosure nor the occurrence of a hazardous event have any long-term impact on property values or buyer behavior (Montz, 1987; Montz and Tobin, 1988; Tobin and Montz, 1988; Palm, 1981). Because of distinct differences in the physical and economic environments that come together to define such an impact, these results cannot be applied directly to the experience in New Zealand. This research, then, was undertaken to evaluate the impact of hazard disclosure on property values in several communities in New Zealand.

Designation and subsequent disclosure of the hazardousness of an area can take a variety of forms and can be based on the results of models, the spatial extent of previous events, the existence and location of characteristic landforms and other environmental indicators, or any combination of these. Clearly, the occurrence of a natural event, such as a flood, is a form of disclosure because the occurrence of an event and the policy responses that immediately follow are directed to specific locations based on some notion of hazardousness. However, this does not necessarily have the same impact as other forms of disclosure unless the event serves as the impetus to designate areas based on their hazardousness and to enact regulations relating to the use of such lands. It is imperative, however, to investigate the impact both of events and of other forms of disclosure because the impact of one can influence the impact of the other. For example, disclosure following an event might be found to have an impact on property values, when in fact, it is the impact of the event that is still being experienced. Thus, while the impacts of disclosure can be evaluated separately from the impacts of the event, they may not be independent of one another. On the other hand, disclosure may be far removed in time from an event so that the separate impacts of each are easily investigated.

REGULATION AND HAZARD DISCLOSURE IN NEW ZEALAND

Regulation of development in hazard areas, especially those prone to flooding and erosion, has been undertaken under both the 1977 Town and Country Planning Act and the 1974 Local Government Act which include provisions for identification and regulation of land subject to hazards. Although these laws have been superseded by the 1991 Resource Management Act, "the implementation of rules for the avoidance or mitigation of natural hazards" (Part IV, Section 31) continues to be under the purview of district councils. Thus, previous practice regarding hazardous areas is allowable under the new legislation.

For flood hazards, the form of regulation most often implemented involves requirements for new buildings (or extensions to existing buildings) to be elevated above a specified flood level, such as the one-hundred year flood, or where stopbanks exist, elevated a specified measure above the design level of the stopbanks. In some communities, for instance, residences must be elevated 300 mm above design flood level, and building permits are not issued unless this is shown in the plans. Thus, the building inspector has responsibility for enforcing the regulations. This, however, is not considered to be disclosure because it is neither public nor does it apply to anyone other than those building or putting an addition on their house. (Indeed, in at least one community, it does not apply to industrial buildings because of operational difficulties with machinery that such an elevation requirement was seen to cause.) Further, it may be that the elevation requirements provide a false sense of security to residents, who now see their houses as flood-proof when they are not. Subsequent owners of the house may not realize that the structure is elevated for flood protection purposes. On the other hand, these regulations are indicative of the extent to which hazards are considered in development decisions. Further, implementation of the regulations requires that flood hazard zones be known and mapped. Publication and public availability of the maps are needed to bring about disclosure, as the term is used here.

The issue is not simply one of disclosure versus nondisclosure, but rather involves the detail in which such disclosure might be made. Those opposing disclosure believe that there are serious property value implications for those whose property is labelled as a flood risk (Piako Post, 1989). For this reason, and the possibility of related legal action, some district and regional planners have been reluctant to delineate hazard zones on a property by property basis. Instead, where they exist at all, relatively small scale maps of entire communities are used to depict the hazard area. Only when specific site information on a property is required will any detailed investigations into the hazardousness of the site be undertaken.

Despite the opposition noted above, some communities in New Zealand have taken the initiative and have developed maps and policies that relate to the hazardousness of specific locations. These typically go beyond the building elevation requirements presented above and may regulate, restrict, or prohibit development, depending upon the hazard category in which the property lies. In Te Aroha, a land suitability map has been constructed, based on six categories of hazardousness, with different restrictions applying to different categories. For instance, development with specific building requirements is allowed in areas subject to possible overland flow, while development of land in the Waihou River floodway or at the head of debris fans is prohibited (Te Aroha Borough Council, 1989). In a similar vein, the Thames-Coromandel District Council has developed a series of policy maps showing natural hazard areas, and these maps are tied into policies and ordinances for development (Thames-Coromandel District Council, 1991). These examples suggest that disclosure need not be advertised, but rather that public documents not only recognize the existence of a hazard but also delineate areas subject to it. Development regulations may or may not accompany the maps. Subsequent development and purchasing decisions can then be made with a full range of information about a site.

THE RESEARCH QUESTIONS

The overriding concern of this research is to determine if hazard disclosure has an impact on residential property values. In order to determine this impact, however, it is necessary to examine spatial and temporal dimensions of the housing market in the case study communities. In particular, several questions must be addressed.

First, it is necessary to determine if the housing stock is different in different hazard zones. Since characteristics of houses, such as age, section size, and square footage, are important factors in explaining selling prices of houses, variations must be taken into account. It may be the case, for instance, that houses in the most hazardous zone are among the oldest in the community, a factor that would certainly have an impact on prices, irrespective of location.

Second, flood hazard experience must be considered. Research in the United States has shown that both severe and frequent floods have an immediate impact on selling prices and that it takes some time for the market to recover (Tobin and Montz, 1990). While subsequent recovery to levels at or above preflood levels was eventually achieved, the floods had a distinct interrupting effect. Therefore, it is necessary to document, to the extent possible, the impact of flood events, separate from the impact of disclosure, on the housing market.

Finally, selling prices for houses rise and fall over time in response to a variety of local, regional, and national economic factors. "Normal" market trends for each community must be documented before anything can be said about the impact of events and disclosure.

Once these factors have been analyzed, any effects associated with disclosure can be evaluated in the context of local housing market dynamics. That is, not only must the entire market be considered, but so too must any sub-markets, defined by such characteristics as location, age and size.

RELATED STUDIES AND FINDINGS

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 described below support these contentions, over the short term. However, as time from the event increases, the impact of the event diminishes to become insignificant, if one exists at all. With regard to disclosure, there is a belief that designating a site as hazardous will mark a property as undesirable and therefore will decrease its value relative to similar properties elsewhere. However, the results of research on disclosure, also reported below, do not support this assertion. Instead, it appears that the decision to buy a house in a particular location is the result of a number of considerations, of which hazardousness is but one. This factor, combined with perceptions about individual vulnerability to the hazard, serves to diminish the adverse economic impact.

Studies that focus on the impacts of natural hazards and on hazard disclosure have been centered on flood and earthquake hazards and are based primarily in the United States. Recent work is also focussing on technological hazards, such as hazardous waste sites (Kohlhase, 1991). While the findings are not directly applicable to the New Zealand situation, they do provide some background for the analyses that follow.

Probably the first systematic disclosure of hazardousness in the United States came about as a result of the National Flood Insurance Program (NFIP) which imposed development requirements on areas designated as 100-year floodplains. It was suggested that designation of land as hazardous would, in fact, devalue that land, but findings of case studies do not support that expectation. Instead, the results are variable, ranging from a depressing effect in some communities to no effect at all in others (Montz, 1987; Muckleston, 1983). However, it has also been suggested that zoning of any kind will influence property values, and this too has been found to vary based on the dynamics of the local real estate market. The availability of land outside the regulated area, and amenities offered by the "marked" land, can offset any devaluations that might otherwise be evident (Dowall, 1979; Ohls et al., 1974).

Most studies dealing with floodplain designations look at already developed land. However, Burby et al. (1988) have undertaken an extensive analysis of the impacts of floodplain designations on the value of vacant land. Their findings show that the regulations associated with floodplain designation will increase the costs of development, thereby reducing the land values of designated properties.

Other studies address the impacts of flooding on property values and are based on the assumption that floods are eventually capitalized into property values such that analysis of a market at any given point in time will not show any differences (Tobin and Newton, 1986). But, depending on characteristics of the flood hazard, particularly severity and frequency, property value impacts may already be imbedded in market prices. It is necessary, therefore, to trace the market over time so that the preflood (or predesignation) situation can be incorporated into any analysis. The findings of Burby et al. (1988) illustrate the process of capitalization of the flood hazard, but in their study, it occurs prior to development. Combining the findings of the two groups of studies, one may not find any significant differences in subsequent analyses of selling prices because capitalization of the hazard has already occurred.

A distinction must be made here between actual and perceived impacts on property values. It has been noted that whether or not floodplain designation and subsequent disclosure lowers property values, the perception that it does may have a serious impact, in itself (Handmer, 1985). This has significance to the way in which disclosure is presented to the public and to various interest groups, and to its acceptance by different groups.

Studies on the impacts of disclosure were undertaken in California following implementation of legislation requiring disclosure of a property's location in a special studies zone. Some studies report lower house prices in designated special studies zones (Brookshire et al., 1985) while others indicate no impact on buyers' decisions as a result of disclosure (Palm, 1981). These conflicting results may represent differences in real estate markets that exist in different communities and different neighbourhoods. While the differences make it impossible to generalize about the impacts of disclosure, they offer only weak support for the belief about the devaluing effect of disclosure. It suggests that dynamics of the local market, characteristics of housing in and out of designated zones, and other locational factors play an important role, and hazardousness is apparently only one more factor to consider.

THE STUDY AREAS

The research questions presented above were evaluated in three case study communities in the Waikato Region of New Zealand (Figure 1). Two of these communities, Te Aroha and Thames, incorporated disclosure of hazard areas in their Borough and District Plans, respectively. In both cases, the impetus for disclosure came from the occurrence of events, described below. The third community, Paeroa, serves as a control because it does not have any more than basic building regulations, even though it

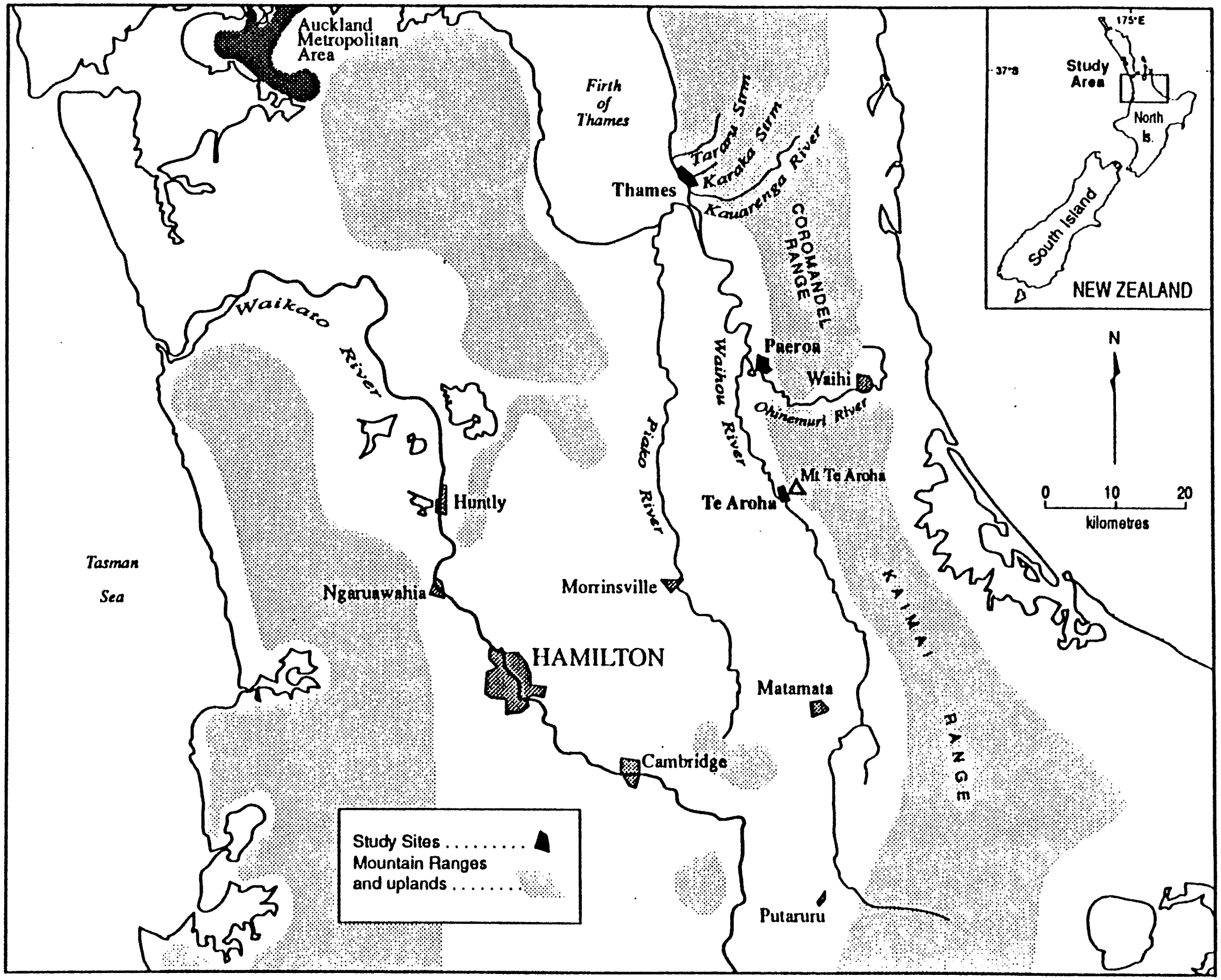

Figure 1. The Study Area

suffered from a flood in 1981. All three communities have some flood control structures in place.

Paeroa

Paeroa is small rural service community, located on the Ohinemuri River. Its main economic function involves servicing surrounding agricultural areas, though several government departments, particularly the Department of Social Welfare and the Hauraki District Council, have offices in Paeroa. The shutting down of production in the Te Aroha/Thames Valley Cooperative Dairy Company in 1988, previously the town's major employer, had a serious adverse impact on the town's economy, but this may be balanced to some extent by the Golden Cross Mine at Waitekauri, which is expected to begin operations in 1992.

Following an increase in population in the early 1970s, Paeroa has been losing population ever since (Table 1), though population numbers remain above what they were in 1971. There are approximately 1,250 occupied dwellings in Paeroa, of which 88% are single-family houses and 24% are rental stock (Department of Statistics, 1986).

Table 1
Population Trends in Paeroa

Year	Population	% Change
1971	3,431	-
1976	3,796	+10.6
1981	3,697	- 2.7
1986	3,549	- 4.2

Source: Department of Statistics, 1986.

Increasing Occupance of the Floodplain

Early development in Paeroa did not occur in the floodplain, partly because Paeroa was a service town for the Ohinemuri goldfields and development was therefore concentrated largely on the roads to the goldfields, which tended to be in hilly areas. In addition, much of the low-lying area was swampy and was thereby avoided (Ericksen, 1986). Some development occurred on flat lands near the Thames-Paeroa railway and along the Thames highway. Despite the construction of stopbanks in the 1920s, it was not until the 1930s that development of the floodplain effectively started. This did not continue for long, but resumed in the early 1970s, "stimulated by renewed economic growth, the dwindling availability of cheap hill-site sections, and the 1967 proposals for increased flood protection" (Ericksen, 1986, p. 69). Thus, we see a trend of increased occupance of hazardous sites, fueled in large part by government agencies using such land for low-cost housing. In turn, the existence of this development strengthened the case for improvement of the flood protection system.

Paeroa's Flood History

The graph in Figure 2 depicts the frequency and severity of flooding in Paeroa. Construction of stopbanks began in the 1920s, with completion in 1930, in response to flooding in the community prior to that time. These were breached in 1936 (which may well explain the temporary abandonment of housing construction in the floodplain about that time), and again in 1954 and 1960 (Ericksen, 1986). Several factors came together in the intervening period to diminish the ability of the flood protection scheme to be effective. Most prominent among these factors was the clearing of upland forests, which resulted in increased volumes and velocities of runoff and sediment, and the development of low-lying swamps, which diminished absorption capacity. By the time a new flood protection scheme was proposed in 1965, the existing stopbanks were not able to protect against much more than a 20-year flood.

The Waihou Valley Scheme (which affects Te Aroha and Thames as well as Paeroa) involves river control works to protect both urban and agricultural lands. In Paeroa, it includes channel widening and stopbank construction and increases the protection for Paeroa, along the main river, to the 100-year flood (Fowlds, 1991). Construction on the Waihou Valley Scheme began in 1970 and is projected to be completed in 1993. Work on the Scheme in Paeroa was progressing in 1981 when the flood occurred, and subsequent revisions to the Scheme have been designed to avoid problems experienced in 1981, particularly with regard to ponding behind the stopbanks.

The April 1981 Flood

The storm that caused the 1981 floods affected both the Ohinemuri Catchment, in which Paeroa is located, and the Kauaeranga Catchment to the north, which includes Thames, and it continued for two days (April 12 and 13). The resulting flood flow on the

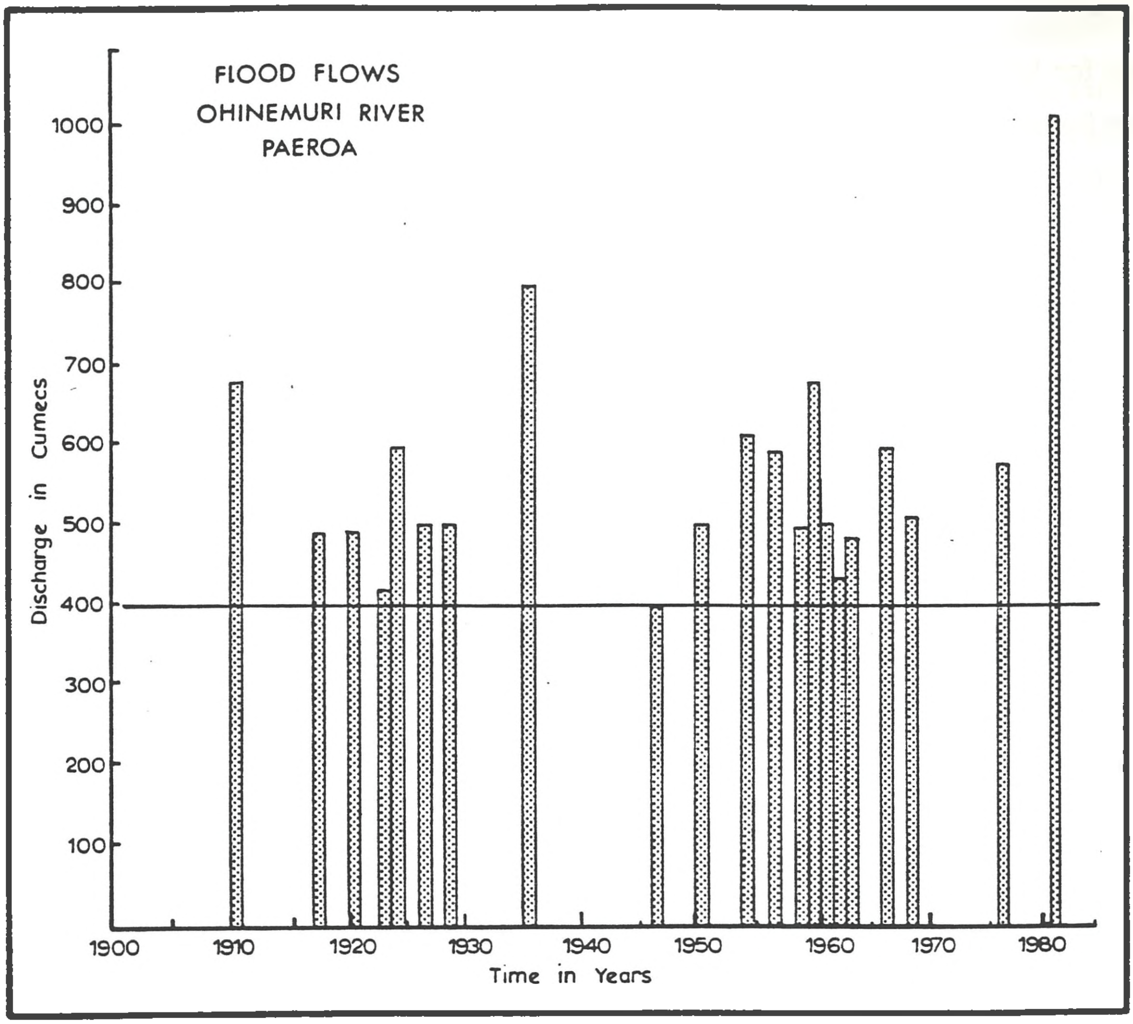

Figure 2. Paeroa's Flood History (Source: Ericksen, 1986)

Ohinemuri River at Paeroa (1,050 cumecs) is the greatest on record (Figure 2), owing in large part to the destruction of natural forest cover on steep slopes in the catchment. Indeed, landslides proved to be a widespread problem with an estimated 26.5 landslides per square kilometre (Ericksen, 1986). Flooding was affected by some of these slides, nearly half of which entered streams (Vine, 1982). The estimated return period for the flood is 70 years.

Flooding in Paeroa came from both the Ohinemuri River and from tributary streams (Figure 3). Specifically, on the first day, flood waters from the Ohinemuri flowed into town through an incomplete culvert. The next day, stopbanks along the Ohinemuri were breached and flood waters from tributary streams flowing through the town ponded behind the stopbanks. While some of the flood protection works seem to have aggravated the flood, it is acknowledged that the works that existed at the time of the flood (40% of those planned) were "sufficient to avert a much greater catastrophe than actually occurred" (Ericksen, 1986, p. 139).

The total losses incurred in Paeroa from the 1981 flood are difficult to assess because data were collected at the regional, rather than town, level. Nonetheless, estimates were gleaned from early reports and subsequent surveys (Ericksen, 1986). The range and magnitude of losses can be seen in Table 2. Of the 1,070 ground level dwellings in Paeroa, 219 or 20% were flooded inside. Of these, approximately one-third had more than a meter of water. The losses reported in Table 2 can be balanced to a certain, but unmeasurable, extent by the gains experienced by nonflooded businesses that provided services and materials for the restoration. Nonetheless, the total estimated price tag of $11 million dollars attributable to the flood translates into a loss of $3,673 per person (Ericksen, 1986).

Disclosure of the Flood Hazard in Paeroa

Not surprisingly, the Waihou Valley Scheme produced a false sense of security among residents and in the Paeroa Borough Council. Indeed, in the 1960s and into the 1970s, low-lying areas of the town were developed, and the 1974 District Scheme Plan did nothing to stem the tide. "The justification for this was (in part) the expectation of improved 'protection' and pumping capacity for the town under the Waihou Valley Scheme" (Ericksen, 1986, p. 222).

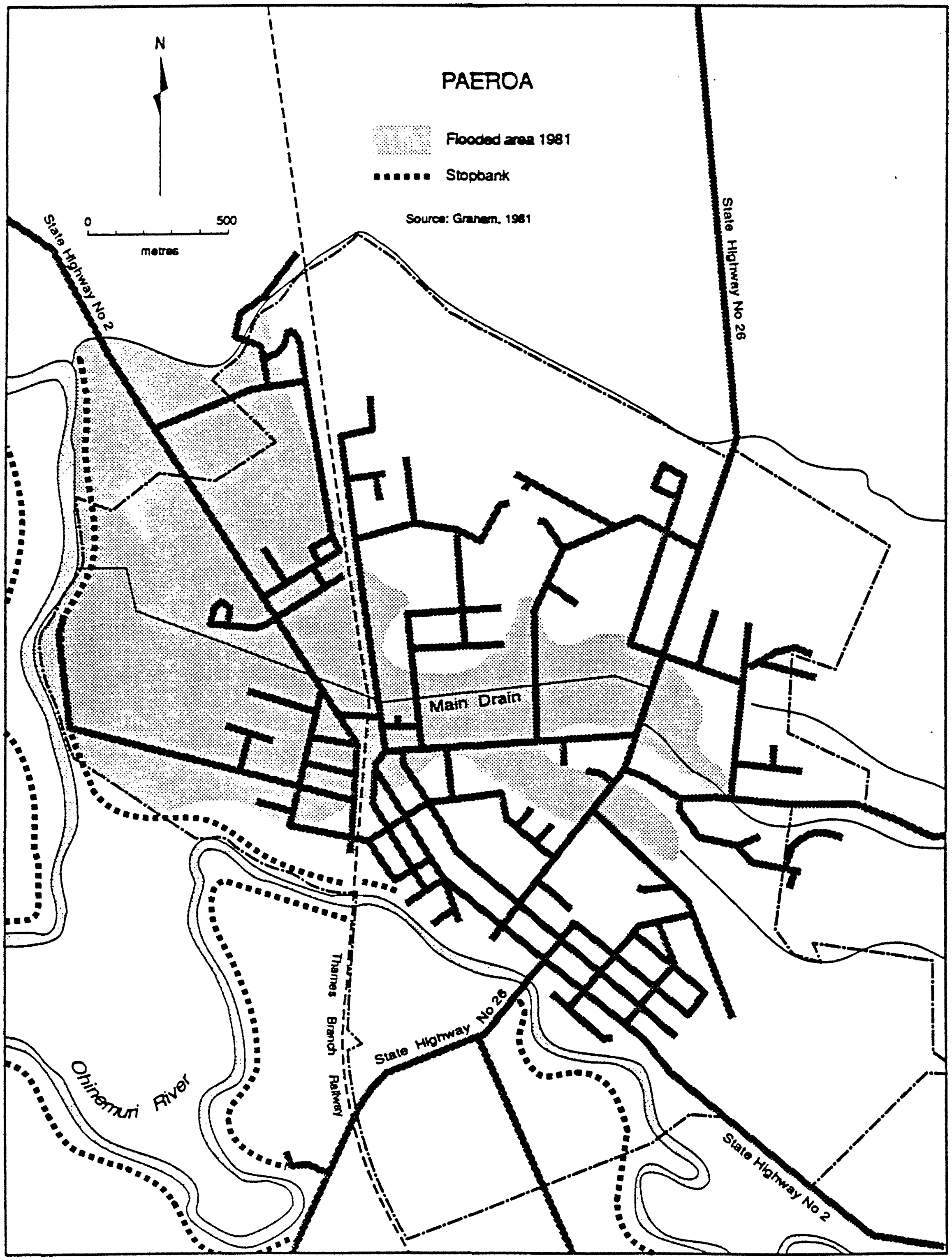

Figure 3. The Spatial Extent of the 1981 Flood in Paeroa

Table 2
Losses in Paeroa From Flood of April 12-13, 1981

Category	# Affected	$ Value (1984)	Comments
Property Losses			
Residences	219	$2.45 M*	
Contents		$1.55 M	
Commercial	40	$2.00 M	Approx. 20 required structural repairs.
Contents		$1.00 M	
Public		$0.63 M	
Social Disruption		$4.00 M	1100 evacuated, 40 businesses closed temporarily. Person-hours in relief & restoration.
Human Casualties	0		

*In millions of dollars; Figures are for 2/3 of 219 properties.

Source: Ericksen, 1986.

A new District Planning Scheme was developed and adopted in 1985. This scheme recognizes that low-lying areas exist. Specifically, "in areas which may possibly be affected by ponding or inundation a minimum floor level will be imposed as a condition on the granting of a building permit" (Borough of Paeroa, 1985, p. 11). The only mention of minimum floor levels in the Plan is: "In the area of the Borough west of the Railway line a level of 4.3 metres R.L. (reduced level, as defined by the Hauraki Catchment Board) will continue to be used as a guideline for the Council in requiring a minimum floor level" (Borough of Paeroa, 1985, p. 11). However, applicants are encouraged to consult the Borough Council (now the Hauraki District Council) and/or the Hauraki Catchment Board (now part of the Waikato Regional Council). Similarly, the areas in which such regulations apply are not explicitly mentioned or delineated. A map appended to the Plan delineates land taken or to be taken for river control works, land protected by the works, and land not protected. In addition, low-lying areas are shown on the Borough Planning Map, but a disclaimer in the Plan states that the designation is "indicative only."

Paeroa, then, has no disclosure other than several sentences in the District Plan. In addition, delineation of hazardous areas in Paeroa is sketchy. The Flood Protection Plan map focuses on protection. This, in itself, might be seen as a measure of hazardousness, but it does not depict the areas defined elsewhere as low-lying, ponding areas. Thus, emphasis is on areas that are protected rather than on areas in which development needs to be regulated if it is undertaken at all. Given this situation, Paeroa is considered to be a nondisclosure community and will therefore serve as a control for the purposes of this study.

Te Aroha

Te Aroha is located between the Waihou River and Mt. Te Aroha in the Kaimai Range (Figure 1). This site puts its population of approximately 3500 (Department of Statistics, 1986) at risk from floods, erosion, and landslips. Although not of direct concern to this project, Te Aroha is also subject to earthquakes and gale force winds. It is the flood and landslip hazards that are of greatest local concern and that are incorporated into the Borough's building regulations and other responses, both structural and nonstructural.

Like Paeroa, Te Aroha's origins can be traced to gold mining. A town was established in 1880 at the current site of Te Aroha, and it subsequently developed around an economic base of gold, and tourism owing to the local hot springs. While both of these uses have diminished in local importance, Te Aroha has grown to become an important service center for its agricultural hinterland.

Unlike Paeroa, Te Aroha has experienced an increase in population since 1976, though it is increasing at a decreasing rate (Table 3). Its base of employment is somewhat more diversified than that of Paeroa, though government and public service sector restructuring in the late 1980s led to some decreases in employment levels, and building and construction activity decreased as well (Te Aroha Borough Council, 1989). It is expected, however, that increases in mining activity around Te Aroha will lead to a resurgence of its role as a mining service centre.

There are 1,119 single family houses in Te Aroha, which account for 89% of the housing stock, almost 79% of which is in nonrental units (Department of Statistics,

Table 3
Population Trends in Te Aroha

Year	Population	% Change
1976	3,290	-
1981	3,418	+ 3.8
1986	3,510	+ 2.7

Source: Department of Statistics, 1986.

1986). There has been some growth in the number of dwellings since 1976, and the increase has been at a greater rate than the increase in population.

Occupance of Hazardous Areas

While some early development occurred in the floodplain of the Waihou River, most took place between the River and the mountain, on gentle slopes along tributary streams. These slopes are alluvial fans which join to form an alluvial apron (Ahrand, 1986). Because the streams periodically overtopped their banks, they were eventually channelized and culverted to allow for development to continue. This pattern of development and stream modification created an extremely hazardous situation that did not become widely recognized until 1985, despite earlier flood and landslide events that may have served as warnings.

More recent development in Te Aroha has occurred on the western side of the River (out of the shadow of Mt. Te Aroha), and to the north of the town, though there has been some infilling in the relatively narrow strip between the river and the mountain. Development of the Waihou River floodplain has generally been restricted through zoning and the redirecting or discontinuance of roads. In Te Aroha, then, the problem is centered more on tributary streams than it is on the floodplain of the Waihou River. As a result, avoiding development of the Waihou River plain only served to intensify a different problem.

Te Aroha's Flood History

The hazard posed by the Waihou River became evident as it flooded in 1907, 1936, 1954, 1956, 1958, and 1960. Despite this experience, while flooding from the Waihou River is a recognized problem, it is seen as a small one. First, the Waihou Valley Scheme, which consists of stopbanks, flood diversion channels, and channel training works along 120 kilometers of the River (Williman and Smart, 1987), has had an influence on this perception. The flood risk that remains, mostly in the floodway and in areas subject to ponding, is handled through land-use regulations and building restrictions (Fowlds, 1987). Thus, the area designated as being at risk from flooding from the Waihou River is small in areal extent and is occupied by very few houses; and what does exist is elevated above the design flood level.

The more significant hazard in Te Aroha results from a combination of small tributary catchments, steep mountain slopes, and urban development near the tributaries which led to modification of the streams. In addition, there is "the potential for serious soil erosion owing to the generally steep topography, the occurrence of weakened hydrothermally altered rocks, the complex pedology (with many soils now under a ground cover different from that under which they formed) and the high incidence of extremely heavy rainfall" (Ahrand, 1986, p. 34). This leads to landslides, flash flooding and debris flows, the most serious of which occurred in February, 1985.

The 1985 Event

The event that fueled the Borough's hazard response was a debris flow on 17 February 1985. Prior to this, Te Aroha had experienced six landslides in this century, all of which were preceded by heavy rains (Ahrand, 1986). The 1985 debris slide was preceded by 229mm of rain over a 48-hour period, 213mm of which occurred in 24 hours. The resulting mass movement left approximately 40,000 m^3 of debris to be removed from the Town Center. That figure does not include the debris left in stream-beds nor in the main reservoir above the town (Ahrand, 1986). Indeed, a debris avalanche into the reservoir caused a flood surge that worsened the impact of the event. There were three deaths and several million dollars in damages (Table 4). A newspaper report described the physical damage as follows: "Nearly every shop in the town centre was damaged, about 50 houses were destroyed, and there was still a threat from the town's weakened water supply dam" (Waikato Times, 1985).

While the mass movement is only one of many that have occurred in the area, it was worsened by engineering attempts to deal with tributary stream floods. Specifically, the piping and culverting of streams under the streets of Te Aroha limited their capacity to carry debris. Thus, this landslide is a classic example of human attempts to deal with

Table 4
Losses in Te Aroha From Debris Flow of February 17, 1985

Category	# Affected	$ Value (1984)	Comments
Property Losses Residences (damage)	50		
Insurance claims	350	$2.6 M	
Public		$3.2 M	$1 million for roads; $750,000 for water supply; $500,000 for street cleaning
Social Disruption			164 evacuated. Person-hours in relief & restoration.
Human Casualties	3		

Sources: Ahrand, 1986; Howarth, 1986; Waikato Times, 1985.

one hazard (stream flooding) aggravating the impacts of another (debris flows). Indeed, consultants retained by the Borough to assess the flood/landslip hazard in Te Aroha contend that the major cause of flooding in the Borough "can be attributed to the under capacity of man-made [sic] structures" (Beca, Carter, Hollings, and Ferner, 1988, p. 9).

The immediate response to the 1985 event was a call for additional structural works. If engineering mistakes contributed to the disaster, then additional engineering was needed to rectify the problems. However, additional regulatory controls were also seen to be in order. Both the Borough Engineer and the Borough Planner pointed out the relationship between engineering works and regulatory controls: "the lesser the amount of physical work carried out in the area, the greater the planning restrictions that will have to be imposed" (Piako Post, 1988). Nonetheless, given three structural options (no structural works, structural works costing $2.6 million, and structural works costing $1.2 million), within three years of the event, the third option was approved by the Borough Council (Waikato Times, 1988), based in large part on the recognized problems of obtaining money from the central government.

Disclosure of Hazards in Te Aroha

A nonstructural response was also considered because, as noted earlier, existing legislation, specifically the 1977 Town and Country Planning Act, requires regulation of building in hazard-prone areas. This approach may also have been encouraged by the difficulty the Borough had in gaining assurances from the central government that funding for upgrading structural works was forthcoming. Thus, the relationship between regulation and degree of engineering became quite apparent, as realistic options were considered.

Even before the 1985 event, mapping of the Borough was undertaken (though regulations or restrictions incorporating the designations did not follow). A Landslip Hazard Rating Survey which depicted areas subject to both flooding and to landslip was developed. This survey was made obsolete by the 1985 event, and subsequently additional mapping was undertaken, wherein the experiences and lessons of the 1985 event were incorporated into the hazard rating survey (Mitchell, 1985). The results of this survey, which are presented later in Table 10, are not, in fact, the basis for development regulations. However the least stable sites are identified on a planning map and are referred to in Section 5.4 of the Te Aroha Borough District Scheme, which deals with land instability of sites not subject to flood hazard regulations. That Section states:

> Council considers that there are some sites within the existing residential zone above Whitaker Street/ Centennial and East Avenues which may be subject to land instability . . . Prior to development taking place an individual assessment will be required to be carried out by a Geotechnical Engineer to ascertain that the site is suitable for development. (Te Aroha Borough Council, 1989, p. 5.6)

Areas subject to flooding and overland flows from tributaries are identified and regulated (Figure 4). Indeed, an engineering consulting firm was retained by the Borough to prepare a detailed report on the nature and location of stream and tributary land instability within the Borough. This report detailed the three response options noted previously and included a map of areas within the Borough subject to flood hazards. A somewhat modified version of the map eventually became part of the Borough's Pre-Review Document and is currently used in planning decisions and building permit applications. Six hazard categories are presented, and development

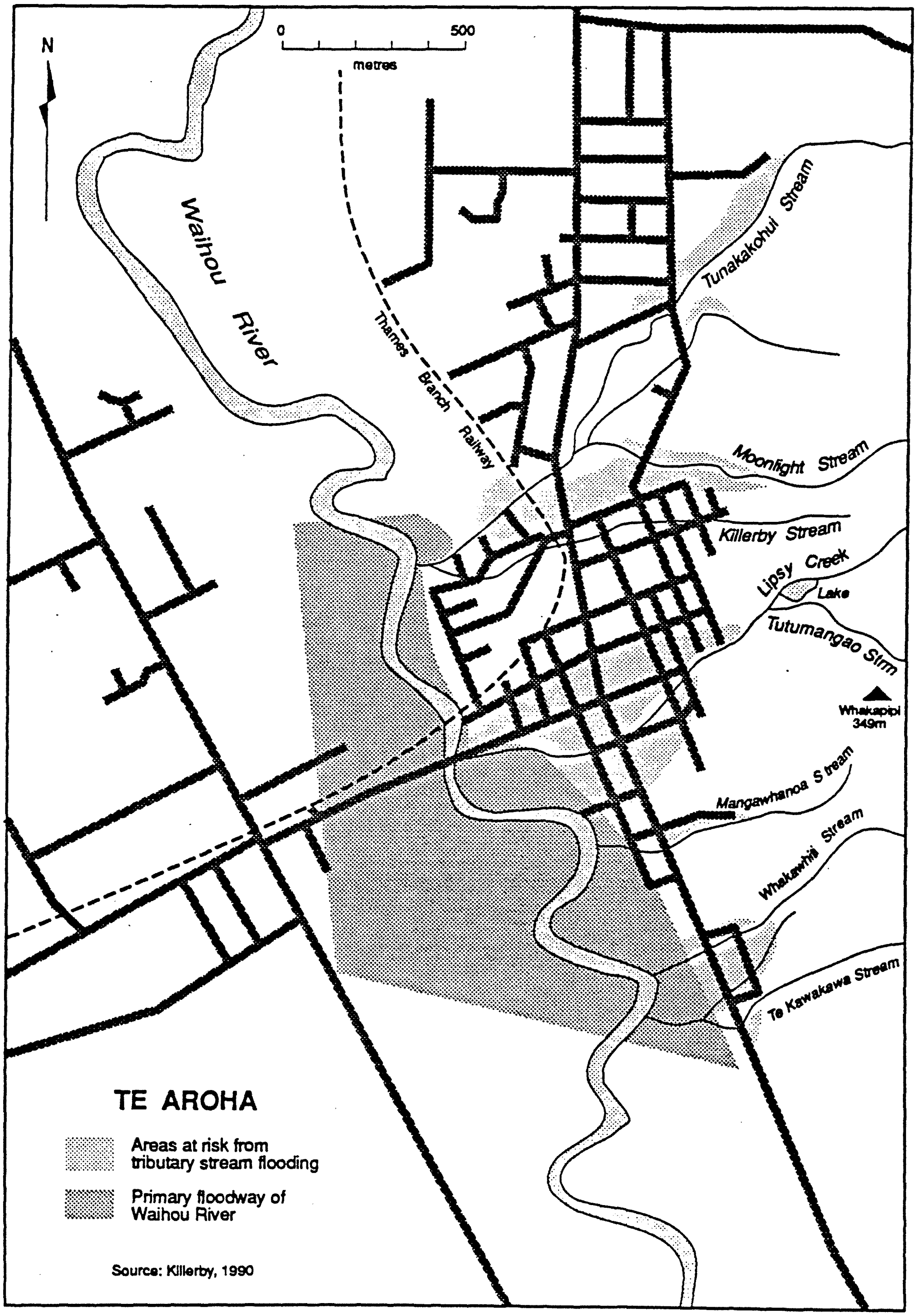

Figure 4. Hazard Areas in Te Aroha

restrictions relate to four of them (Table 5). The number of structures in each category that were used for analysis is discussed later.

Table 5
Categories of Hazardousness, Te Aroha Planning Map

Category	Description	Development Restrictions
A	Primary floodway of Waihou River	No development or redevelopment allowed
B	Secondary areas subject to flooding from Waihou River	Development allowed if 80% of section is 200mm above 100-year flood level; floor levels must be 500mm above 100-year flood level
C	Areas subject to inundation from tributary streams	No development or redevelopment
D	Areas possibly subject to overland flows from tributary streams	Development must meed certain criteria such as waterproofing external walls and locating large openings away from flow paths
E	Roadway areas along which overland flow paths should be created	
F	All other areas	No restrictions unless subject to localised ponding or flooding

Despite the combined approach undertaken in Te Aroha, it appears that structural measures dominate, particularly as they are being upgraded in 1991. An article in the Waikato Times describing the progress being made in upgrading culverts carried the title, "No More Worries in Te Aroha" (1991). In addition, the modifications made on the consultants' map to produce the District Scheme Planning Map involve the omission of two tributary streams. "The Council had decided that these streams were of low priority on the list of remedial works which could be funded adequately" (Killerby, 1990, p. 35). As a result, they are no longer considered to be problem areas. Thus, while a combined approach to the hazard is in practice, emphasis on structural works continues. The planning map, however, serves as disclosure because it "marks" some properties and restricts their development or redevelopment possibilities, based on the hazardousness of the location.

Thames

Thames, like Paeroa and Te Aroha, owes its origins in large part to gold mining. Two mining towns, Grahamstown and Shortland, were amalgamated in 1870 to become Thames. Exploitation of other resources, including timber and fisheries, has fueled the economy of Thames, and tourism appears to be continually increasing in importance. The population of Thames has decreased since 1976 (Table 6), a phenomenon that does not seem to be in line with the level of industrial and retailing investment in the town. However, "since 1956, Thames has been unable to generate its own population increase" (Thames-Coromandel District Council, 1983, p.8). Instead, it has experienced an influx of retired people, changing the demographic structure of the community and affecting the availability of housing.

Table 6
Population Trends in Thames

Year	Population	% Change
1971	5,780	-
1976	6,769	+ 17
	(Boundary Extension)	
1981	6,456	- 5
1986	6,117	- 5

Source: Department of Statistics, 1986.

There are 1,983 single family homes in Thames, which accounts for 84% of the housing stock (Department of Statistics, 1986). In addition, almost three-quarters of all dwellings are nonrental units, with a larger than average proportion of dwellings owned without a mortgage (owing to the demand from retired persons). Average housing prices in Thames are higher than those in Paeroa and Te Aroha, reflecting the strong demand by retired persons and a shortage of sites for development. In addition, there are many vacation homes that may or may not be available for rent during the off-season. Housing development is constrained physically in Thames, with the harbor on the west, hills on the east and north and flooding in the south and north.

Occupance of the Hazardous Area

With limited area on which to build, development in Thames occurred first on the flat lands between the hills and the harbor. Several streams flow out of the hills toward the Firth of Thames, thereby creating a hazard to development. As the floodplain filled in, development moved up the hills. While this development is generally out of flood hazard areas, it also serves to aggravate the flooding problem by increasing runoff. Historic logging of the hillsides has also contributed to the increased flood potential.

Some later development occurred west of the downtown area, on reclaimed land, along the Firth of Thames, and infilling in the already developed area continued. By the late 1980s, the absence of buildable sections and the expense associated with developing hill sections was recognized as a serious problem, resulting in a shortage of low cost residential sections (Paul and Paul, 1987).

The Flood Hazard in Thames

Because of its location between hills and the harbor, Thames is in a particularly vulnerable position with regard to flooding. Rapid runoff from the hills, aggravated by logging and urban development in the hills, creates a serious flood hazard, given the several streams and the Kauaeranga River that flow through and near Thames. Silt is carried down the streams and presents an added problem to the flood waters. When flood flows combine with high tides in the Firth of Thames, the flood hazard is increased. As an indication of frequency, Karaka Creek flooded six times in the 106 years preceding the 1981 flood (Fenton et al., 1981).

In response to the flood hazard, work on tributary streams has been undertaken as part of the Waihou Valley Scheme. This involves some channelization and stopbanks, built to a 50-year return level, used in conjunction with regulations on building in floodprone areas. The works, then, will decrease the frequency of flooding but do not provide protection from large floods.

It is the frequency of flooding that makes Thames an ideal study site. Serious floods occurred in 1981 and 1985, and high streamflows with localized flooding occurred in 1988 as a result of Cyclone Bola. Response to this problem has been both structural and nonstructural, with maps of flooded areas being prominent in the nonstructural component. Before discussing these maps and disclosure/regulation of floodprone areas (nonstructural responses), the extent of the 1981 and 1985 floods is presented.

The Thames Floods of 1981 and 1985

Thames experienced flooding in April of 1981, resulting from the same storm that caused the flooding in Paeroa. Several streams overtopped their banks in Thames, most notably Karaka Stream. Along this stream, water "escaped from the channel in four places: 1) at the debris trap, 2) at the culvert upstream of the hospital, 3) at the culvert downstream of the hospital, and 4) at the culvert under the main street" (Smith and Cameron, 1981, p. 28). Also in Thames, when Tararu Creek flooded, a residential street was washed away, taking with it sewerage and water pipes, and several sections along the creek were severely eroded. Similarly, Hape and Moanataieri Streams flooded the areas of town near them. Specific details of the extent of damage incurred from this flooding are difficult to extract from official reports on the event. Property damage, both public and private, was extensive, and the town's water supply was put out of action for almost a week. Costs for cleanup totalled $200,000 by June, 1981, and the weekly cost almost two months after the flood was about $11,000 (Fenton et al., 1981).

Silt and debris were particular problems with this flood. Debris clogged some stream channels, causing water to overtop the banks and flood adjacent properties. Silt caused problems both in-stream and out, and increased both the costs and time associated with post-flood cleanup. As a result, improvements to the streams including accessible debris barriers and widening and channelizing streams were recommended immediately following the flood (Fenton et al., 1981). Some of these ideas, especially in problem areas where debris and/or silt are seen to be substantial problems, were translated into action, as on Tararu Creek (Russell, 1982).

Serious flooding occurred again in Thames in February, 1985. The storm that caused flooding in Thames is the same one that caused the disastrous debris flow in Te Aroha. This flood was greater than the 1981 flood, as shown in Table 7 which indicates return intervals for the discharge on several of the streams that flooded. Damage was

Table 7
Recurrence Intervals of 1981 and 1985 Floods in Thames

Stream	1981	1985
Karaka Stream	20-30 years	50+ years
Kauaeranga River	20-30 years	50-100 years
Te Puru Stream	10-20 years	20+ years

Source: Howarth, 1986.

extensive, and silt was a particular problem. The rainfall followed a drought during which dry clay swept into streambeds. When streamflows increased, the clay displaced the water, and much of it was eventually carried away and into the town (Lawrence, 1991). This was quite a different flood than the 1981 flood in that, in some shops, "water levels were lower than the 1981 floods, while others reported higher levels of water" (Howarth, 1986, p. 10). An accounting of the losses is presented in Table 8. The losses and the spatial extent of the flooding make this flood worse than the one in 1981.

Disclosure of the Flood Hazard in Thames

Thames is subject to numerous hazards, but the flood hazard is the focus of this research project. However, some form of disclosure of floods and other hazards has been used in Thames for some time. For instance, prior to the development of specific restrictions on building in known hazard areas, some properties were tagged as hazardous on their titles (Lawrence, 1991). To accomplish this, the District Council took a mortgage interest of 10 cents in a property, thereby "registering interest" in that property. Subsequent buyers, then, were informed about the hazardousness of the location. This form of disclosure was used mostly in coastal areas, where the issues were setback requirements, coastal storms and coastal erosion. However, maps have been developed that identify properties as being subject to coastal erosion, and/or in areas known to flood. The focus here will be on the latter.

Policy maps depicting "areas known to flood" were developed in 1986 (Thames-Coromandel District Council, 1986) (Figure 5). The 1981 flood served as the base flood for the designations, but some areas that were not flooded in 1981 are in the designated hazard zone (DHZ). The flood area maps do not define variations in hazardousness, but rather separate floodprone areas from those not seen to be floodprone. However, the

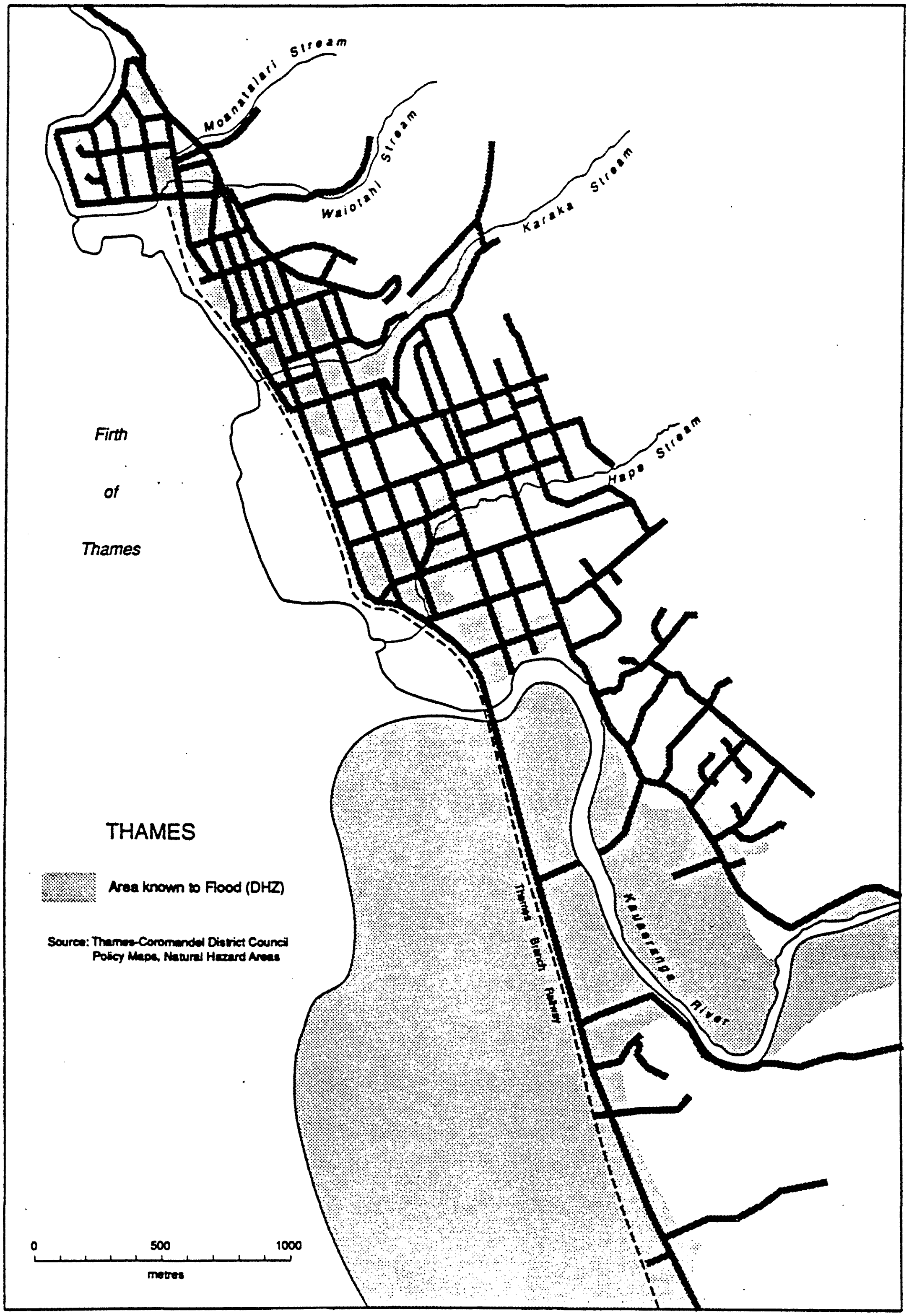

Figure 5. Designated Hazard Zones in Thames

Table 8
Losses in Thames from Flood of February 17, 1985

Category	# Affected	$ Value (1984)	Comments
Property Losses			
Houses flooded	361	$2.2 M	Insurance claims
Uninhabitable	19		
Destroyed	8		
Commercial			
Water inside	117		
Contents damage	96	$400-500,000	
Structural	4		
Public			
Repairs			
Streams		$100,760	
Roads		$192,000	
Footpaths		$ 60,000	
Stormwater system		$ 15,000	
Water supply		$125,000	
Social Disruption			Flooding in hospital basement. Person-hours in relief & restoration.
Human Casualties	1		

Sources: Howarth, 1986; Waikato Times, 1985.

District Scheme, which details policies and ordinances for dealing with flooding, incorporates these variations. Specifically, the District Scheme states:

> All houses, commercial, industrial, and administrative premises shall be constructed with floor levels a specified distance above flood levels. Flood levels shall be determined with reference to flooding history, a derived flood event, and flood protection measures in existence. (Thames-Coromandel District Council, 1991, p. 23-10)

Following this, reference is made to the flood maps. Thus, the maps play a central role in determining the areas that fall under this requirement, but they do not define the level of elevation universally.

These restrictions apply to new construction, but the District Council also has a

60% Rule (Lawrence, 1991). That is, if the value of a property is to be increased by 60% or more by some alteration, the elevation requirements must be met on the new construction. Similarly, any rebuilding following a flood, whether a completely new structure or alterations to an existing one, must be undertaken in compliance with the elevation requirements. Other restrictions have been imposed on sites seen to be particularly floodprone. For instance, in some cases, relocatable buildings have been required by the District Council, an option allowable under a 1981 amendment to the 1974 Local Government Act which permits Councils to impose conditions on building in hazard areas. In another instance, the Council has refused to let an owner rebuild on a section following a flood. In this situation, the Council purchased the section from the owner and turned it into a reserve.

Disclosure in Thames, then, is based on maps depicting locations in a designated hazard zone. Unlike Te Aroha, degrees of hazardousness are not included in the designations. However, the regulations that guide development decisions and therefore determine where and how development will be undertaken, do incorporate variations in hazardousness--perhaps moreso than the Te Aroha regulations. Thus, designation and disclosure are only part of the story. It is how they are applied to development and remodeling decisions that determines the flood hazard potential for Thames.

METHODS AND DATA SOURCES

In order to carry out this study, two sets of data were required. One set includes information on houses in each community, including characteristics of each house and selling prices and dates. The second set relates to the location of houses relative to designated hazard areas. These data sets are discussed below.

Housing Information

Data on all single family residences was obtained from Valuation New Zealand which maintains computer files on all buildings in New Zealand. Characteristics of each house that are available on this file include: latest assessed valuation, section size, condition of buildings on the section, zoning classification for the section, age of the house, building materials for external walls and roof, site size, and floor area. Site size refers to the area of the section that the house occupies, and floor area refers to the estimated floor space of the house. With a single-story house, site size and floor area are equal. These data make it possible to characterize the housing stock to take into account those factors that will influence the selling price of houses, irrespective of location.

A record of sales of houses for the period extending roughly from January 1979 until December, 1989 was also needed. For Paeroa and Te Aroha, these records were obtained from the Rates Departments in the respective district councils, the Hauraki District Council for Paeroa and the Matamata-Piako District Council for Te Aroha. Each sale is recorded with the District Council for taxation purposes, so the data collected represent a virtual 100 per cent sample of all sales during the period of study. These records were not available in Thames, because of an office move made by the District Council and the related purging of old files. However, all sales are also filed with Valuation New Zealand and are eventually recorded on microfiche. These were available in the offices of a local land valuer in Thames. All sales prices were converted to 1984 dollars using the Consumer Price Index.

Hazard Designations

Determination of a property's hazardousness involved different methods in each community and was based on different sources of information. The process used for each community is detailed because it is important to understand what different designations indicate, and such information may well be useful for similar exercises in other areas.

As noted earlier, Paeroa does not have any hazard disclosure beyond the minimum required. Paeroa was, however, flooded in 1981, and it is differences related to flood experience that are of interest here. In addition, Paeroa was studied in detail by hazard researchers in New Zealand (Ericksen, 1986; Ericksen, Handmer, and Smith, 1988), so a great deal of data exists that allows the division of the community into experience categories. Three categories were used: not flooded, water on section, and water in house. In addition, the depth of water in each house was estimated, based on data presented in Ericksen (1986) and derived from data files developed for ANUFLOOD in New Zealand (Ericksen, Handmer, and Smith, 1988). Depths ranged from 30 mm to 2 meters. The distribution of houses in each of the three flood categories is shown in Table 9.

Table 9
Flood Categories in Paeroa

Category	Number of Houses	Number of Sales
Not Flooded	770	477
Water on Section	139	107
Water in House	244	161
TOTAL	1,153	745

In Te Aroha, there are two ways in which hazardousness has been delineated, the Landslip Hazard Survey (LHS) as developed by Mitchell (1985) and the Pre-Review Hazard Area (PRHA) maps based on a consultant's report (Table 10). While the PRHA serves as the primary means of disclosure, the LHS also plays a role in development decisions. As a result, both are used in the analysis, though somewhat more emphasis is placed on the PRHA. There are eight hazard designations in the LHS, but they were combined for analysis, based on relative levels of hazardousness. Specifically, because categories 2 through 4 are based on "possibility," they will generally be handled similarly in development restrictions. The same goes for categories 5 through 8, which are considered high hazard areas and development, if allowed, would have to be designed to minimize the hazard.

The PRHA designations were modified as well for the purposes of analysis. Category A was dropped from analysis because no development or redevelopment is allowed, and there are no houses currently occupying the area. Similarly, Area B encompasses portions of the town with very little existing development, all of which is elevated above the design flood level. This zone, then, has much more meaning as a planning tool as it restricts future development in these areas, and thus is not readily usable in this analysis. Category C generally comprises a narrow swath along tributary streams and includes mostly undeveloped sections, or partial sections where the structure is not in the hazard zone. This, too, was deleted from the analysis. Finally, Category E was deleted because it deals exclusively with roadways. We are left, then, with Category D, those properties at risk from tributary stream flooding, and Category F, all other properties.

Table 10
Hazard Designations in Te Aroha

Landslip Hazard Survey

Code	Description	Number of Houses	Number of Sales
1	Unlikely to be affected by slope movement	400	170
2	Possible minor ground movement; slight problem of inundation	498	200
3	Susceptible to near-surface sliding	127	49
4	Possibility of structures being affected by slips	140	65
5	High probability of landslips and rock falls	16	6
6	High probability of flooding by river	8	3
7	High probability of flooding from streams or slip	9	1
8	Likely to experience heavy structural damage in flood or landslip	0*	
	TOTAL	1,198	494

Pre-Review Hazard Areas

Category	Number of Houses	Number of Sales
A	0	
B	0	
C	0*	
D	93	37
E	Not applicable	
F	1,105	457
TOTAL	1,198	494

*Comprises either partial sections with structures not in hazard zone or undeveloped sections.

Houses in Thames were evaluated on the basis of three factors: the flood of 1981, location with regard to the designated flood hazard zone (DHZ), and the flood of 1985 (Table 11). This allowed for analysis of the effects of both disclosure (i.e., location in or out of the DHZ) and flood experience (i.e., no experience, one flood, or two floods). In addition, because flood depths were measured at specific street locations for the 1985 flood, depths of water in houses could be inferred. Nonetheless, frequency rather than severity of flooding is the issue in Thames, and this is what is of concern here.

Table 11
Flood Categories in Thames

Category	Number of Houses	Number of Sales
In Flood, 1981	323	131
Not in Flood, 1981	1,621	598
In DHZ	427	163
Not in DHZ	1,517	566
In Flood, 1985	136	51
Not in Flood, 1985	1,808	678
No Flood Experience	1,606	594
Experienced 1 Flood	217	88
Experienced 2 Floods	121	47
Totals for each group	1,944	729

Data Analysis

The data were analyzed using various statistical tests, depending upon the questions being addressed. Chi-square analyses were used to establish any significant differences that exist between individual housing characteristics and locational categories. The results of these tests allow for the characterization of housing submarkets. A combination of housing characteristics was subjected to discriminant analysis, which provides a statistical means of "studying the multivariate differences between two or more groups" (Klecka, 1980, p. 63). This makes it possible to evaluate how distinct the locational groups are, based on the several variables that best define the groups. Thus, the existence and importance of housing submarkets based on the hazard can be established.

The impacts of the events and of disclosure as they are (or are not) manifested over time are analyzed in two different ways. The first utilizes T-tests on matched pairs of "before" and "after" sales. This method is similar to event analysis in finance, wherein the effects of a particular event are evaluated by pairing prices before and after the event. If the event had a significant depreciating (or appreciating) effect, the results will indicate this relationship. In essence, this method compares absolute differences in selling prices and tests whether or not the difference is statistically significant.

The second method is based on Palmquist's repeat sales analysis (Palmquist, 1982). In this case, the ratio of after-event selling prices to before-event selling prices serves as the dependent variable and environmental intrusions to the market (i.e., a flood or disclosure) are the independent variables. Repeat sales analysis makes it possible to evaluate the contribution that independent variables (depth of flooding, hazard location category, and time between sales) make to explaining the variance in the ratio.

These methods of analysis allow for evaluation of both the spatial and temporal differences in markets and in selling prices. In addition, they incorporate intrusions to the market, thus enabling analysis of the impact of an event or of disclosure. The findings from these tests, when combined for each community, serve to explain the spatial and temporal dynamics of the residential housing market and therefore the impacts, if any, of events and disclosure.

RESULTS: PAEROA

Characteristics of Housing

The housing stock in Paeroa, which consists of the 1,153 houses in the Valuation New Zealand data files, varies considerably from location to location (Table 12). Indeed, when houses are grouped based on their flood experience, and individual variables are analyzed, differences in value, age, and size are apparent. Nonflooded houses tend to be larger and on larger sections than houses occupying both of the flood categories and which tend to be much the same size. As a result of these size differences, nonflooded

Table 12
Characteristics of the Housing Stock in Paeroa

Variable	All Houses	Nonflooded Houses	Water on Section	Water in House
Valuation	62,906	66,773	54,946	55,236
Mean	61,000	65,000	54,000	52,000
Median	1,153	770	139	244
Area, in hec.				
Mean	.100	.104	.094	.090
N	1,152	770	139	243
Age[1]				
Mean	27.5	26.2	39	25
N	1,116	744	137	235
Site[2]				
Mean	11.1	11.4	10.7	10.3
N	1,152	770	138	244
Floor Area[2]				
Mean	12.2	12.9	10.9	10.8
N	1,152	770	138	244
Selling Price[3]				
Mean	35,905	38,508	30,050	32,084
Median	33,870	36,993	27,794	31,740
N	745	477	107	161

[1] At time of flood
[2] In tens of square meters
[3] 1984 dollars

houses are valued higher. Houses that had water in them are somewhat newer then nonflooded houses, a result of development trends in Paeroa discussed earlier, but both of these groups of houses are much newer than those that had water on the section. Selling prices reflect these characteristics.

Chi-square analyses were undertaken to determine if the differences in housing characteristics shown in Table 12 are, in fact, significant. The results suggest that a significantly larger proportion (at the .01 probability level) of nonflooded houses, compared to houses with water on the section or in them:

- are valued above median valuation
- are zoned residential
- are in the best (and worst) condition
- have more vehicle parking spaces
- are newer
- are on larger sections
- occupy larger sites on the section
- have larger floor area
- are 2 or more stories
- are brick
- sell above median selling price

Generally both flooded properties are similar, but there are some significant differences. Specifically, compared to houses which had water in them, a greater proportion of houses with water on the sections are valued below median, are zoned non-residential, have fewer parking spaces, are older, and are mostly one-story and built of wood.

The analysis above divides houses into three discrete categories. However, is it not known if the third category, that of houses that had water in them, is uniform throughout. To evaluate this, the housing stock was divided into four groups, based on the amount of water. One group includes houses that were not flooded and those that experienced water on the section. The remaining three groups were based on flood levels as follows: 1-500 mm, 501-1000 mm, and greater than 1000 mm. Significant differences, again at the .01 probability level, were found here as well. Specifically, as depth increases so does the proportion of smaller sites and so does the proportion of one-story houses. In addition, the greater the depth, the greater the proportion of houses (compared to the other depth categories):

- valued below median valuation
- in average condition
- that are newer
- on small sections

- that have smaller floor areas
- selling below median sales prices.

It should be noted that a comparatively large proportion of those in the 1-500mm depth category also tended to sell below median sales prices. Further, these houses were evenly divided between the best and the worst condition rating and between small and large sections.

These results show significant differences in the housing stock of Paeroa. While the spatial divisions used here are based on flood characteristics, the characteristics that were analyzed are independent of the flood event. Thus, subsequent evaluations of the impacts of the flood must incorporate these findings. Indeed, the differences noted here will likely have an influence on housing values, irrespective of the flood hazard.

The differences noted in this section also suggest that there are housing sub-markets in Paeroa that may further serve to explain and perhaps influence housing prices. Certainly, the spatial variations noted above suggest that the market cannot be considered as homogeneous. However, the analysis above looks at individual characteristics of houses as they vary between locations. It tells us that there are differences in housing characteristics from one location to another, but it does not tell us if the locations are truly different. In addition, it does not suggest which combination of variables best discriminates between locations. The next section analyzes these locational differences.

Differences Between Hazard Zones

In order to determine any differences, based on a combination of housing characteristics, that might exist between hazard areas, discriminant analysis was utilized. In this research the groups are defined by hazard experience. The procedure was undertaken twice, once using depth of water in houses as the grouping variable, and the other using extent of experience in the 1981 flood. The same categories that were used in chi-square analyses were also used here.

The results of the discriminant analyses are presented in Table 13. The variables that contribute significantly to the overall discrimination between groups are listed, along with their respective F-values. The canonical correlation and Wilks' lambda provide indicators (both between 0 and 1) of the utility and strength of the discriminant function

Table 13
Results of Discriminant Analysis for Paeroa

Groups = Flood Experience		Groups = Depth of Water in House	
Variable[1]	F-Value	Variable[1]	F-Value
Valuation	71.733	Valuation	41.951
Rated Condition[2]	35.276	Age	20.021
Age	24.393	Rated Condition	15.285
Zone	18.931	Zone	6.705
Canonical Correlation = .38		Canonical Correlation = .33	
Wilks' Lambda = .83		Wilks' Lambda = .87	
Nonsignificant Variables		Nonsignificant Variables	
Section size		Section size	
Site size		Site size	
Floor area		Floor area	
Number of vehicle spaces		Number of vehicle spaces	
Number of sales		Number of sales	

[1] Variables significant at .01 level
[2] Condition as rated by valuer at time of valuation: above average, average or below average.

with the former measuring the association between the groups and the function and the latter measuring discrimination (or differences between groups). The higher the canonical correlation, the greater the degree of association; the lower the Wilks' lambda the greater the group differences. These results suggest that while Paeroa's housing stock can, indeed, be grouped into submarkets based on flood experience, some caution must be taken, given the strength of the association. In neither case is there a large degree of separation between the groups. On the other hand, the same four variables serve to differentiate between both groups: 1989 valuation, rated condition, age, and zoning classification. These, then, are the most useful discriminating variables, with the relative contributions of individual variables indicated by the F-values. However, it is the set of variables, and not individual ones, that is of interest here.

Discriminant analysis also makes it possible to predict the group to which a case most likely belongs. In this instance, the goal is to classify houses into the most "suitable" groups, that is, minimizing within-group variation and maximizing between group variation. This provides a useful predictive tool, but that is not the purpose here. Rather, the classification procedure uses the significant discriminating variables to reanalyze the data and determine the group into which each case belongs. "The proportion of cases correctly classified . . . indirectly confirms the degree of group separation" (Klecka, 1980, p. 49). For both groupings, slightly more than half of the cases were classified correctly: 55% for the flood experience groups and 57% for the depth of water groups. This confirms the relatively low degree of separation between the groups.

These results show, again, that there are distinct differences between hazard groups, based on a set of four variables. However, neither the strength of association nor the classification procedure indicates much group separation. In other words, housing submarkets exist in Paeroa, but they tend to be somewhat similar such that distinctions between them are small. This finding, combined with the results of the chi-square analyses, suggest that the housing stock in different hazard locations can be characterized based on variables acting individually and acting as a set, but the separation between locational groups is not large.

Having characterized the housing stock based on spatial divisions, it is now necessary to look at trends in prices over time, using the same spatial divisions. Such analyses will provide further evidence of the impact of the flood hazard (or lack of impact) on housing prices in the several submarkets and in the market as a whole.

Temporal Changes in the Housing Market

Changes in the housing market were documented by tracking the selling prices of 478 houses that sold during the period extending from January 1978 until mid-1990. Some 208 of these houses sold more than once during this period. All prices were converted to 1984 dollars using the Consumer Price Index for each quarter. The graph in Figure 6 shows the changes for each of the three flood experience categories. (A similar graph using depths of water would prove meaningless because of the small number of house sales in some of the categories.) Given the existence of housing submarkets, it is necessary to look at fluctuations in prices as they occur within groups.

PAEROA - PERCENT CHANGE IN MEDIAN SELLING PRICE

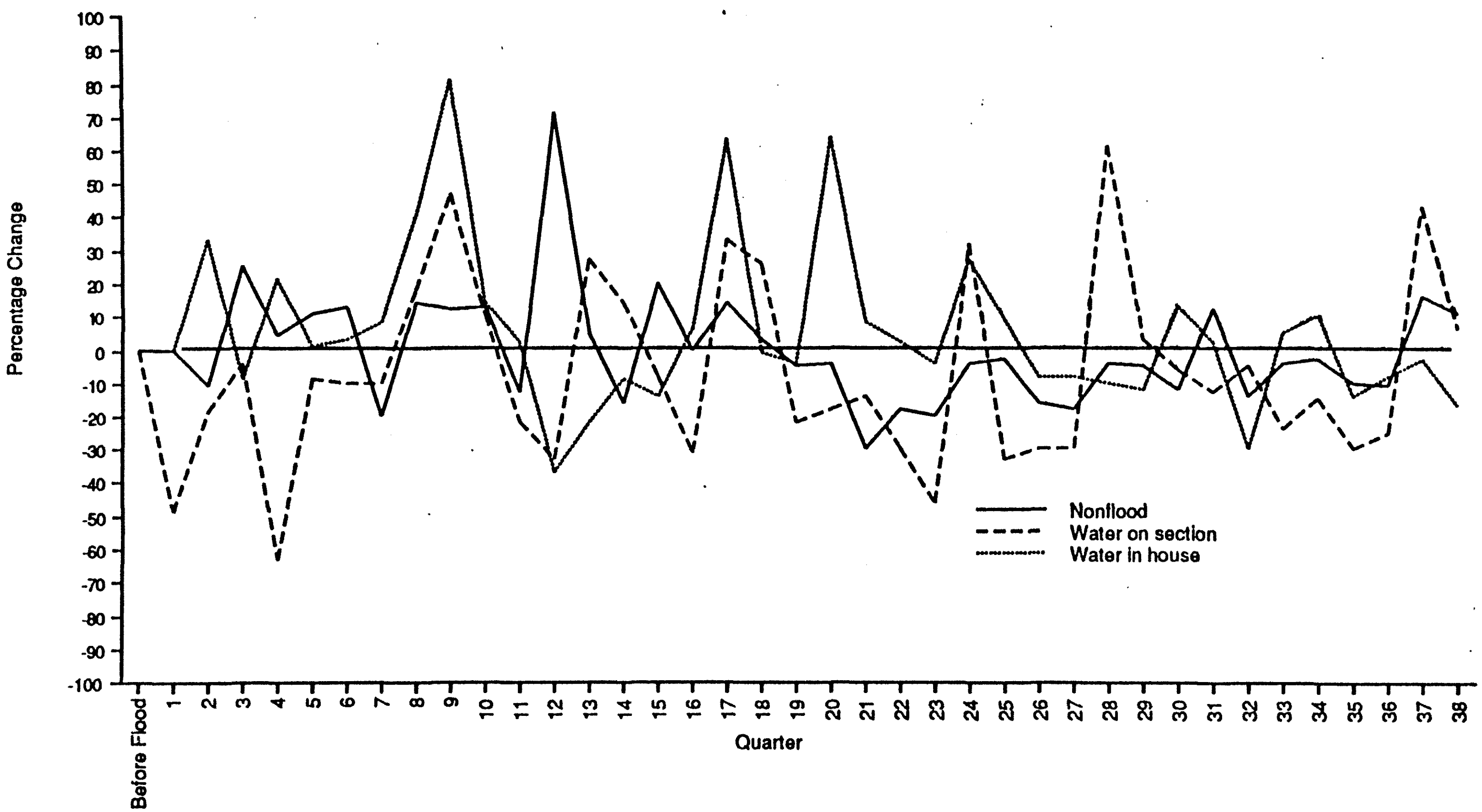

Figure 6. Changes in Median Selling Prices in Paeroa, by Flood Experience Categories

That is, selling prices for each group are compared to pre-flood selling prices for that group. Thus, it is the magnitude and direction of within-group changes that are important, and not actual or converted selling prices.

The graph indicates wide fluctuations in all three groups, with nonflood houses and houses that experienced water on the section showing prices above pre-flood levels by the end of the study period. The fact that houses that had water in them show selling prices below those prior to the flood is somewhat deceiving. Indeed, houses in this group sold above pre-flood levels during 20 of the 38 quarters shown on the graph, as compared to 16 quarters for nonflood properties and 12 quarters for those with water on the section. In addition, in the immediate post-flood period, houses that had water in them generally sold above pre-flood values while those with water on the section generally sold below pre-flood values. Nonflood properties also tended to sell above the pre-flood median. It is clear from this graph, then, that the housing market in Paeroa fluctuates considerably, no matter what housing submarket is studied. What needs to be addressed next is the impact of the flood event on selling prices.

Houses that were sold twice, once before and once after the flood, were used for the T-tests and the repeat sales analyses. 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, assuming that the effects of the flood will wane over time, particularly given the completion of flood protection works in Paeroa, two time periods were utilized. The first looks at the entire study period and the second extends only four years after the flood. Four years was chosen as the cutoff because flood protection works in Paeroa will have been mostly completed by this time, thereby permanently altering perceptions of hazardousness. The results are shown in Table 14. In the four year period following the flood, "after" house prices were significantly different than "before" prices in the community as a whole (which does not really tell us much) and in the nonflood 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

Table 14
Results of Matched Pairs (T-Tests) of Sales for Paeroa

Area	Before Flood Selling Price	After Flood Selling Price	Difference	T-Value	Probability
Within four years of flood					
Entire Community (N=34)	37,422	40,552	3,130	2.84	.008
Flooded Area[1] (N=10)	28,117	30,730	2,613	1.48	.174
Water in House (N=7)2	28,969	32,224	3,255	1.46	.194
Nonflood Area (N=24)	41,299	44,644	3,345	2.40	.025
Entire study period					
Entire Community (N=78)	35,973	37,179	1,206	1.38	.171
Flooded Area[1] (N=27)	30,317	31,916	1,599	0.88	.387
Water in House (N=16)	30,968	35,066	4,098	2.02	.061
Nonflood Area (N=51)	38,968	39,965	997	1.06	.294

[1] Includes houses with water on the section and those with water in house.
[2] N of cases is not sufficient to insure statistical reliability.

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 .06, the significance of the difference in prices must be interpreted with caution.

These findings suggest that the flood initially had a significant effect on housing prices, as seen in the significant increase in selling prices for nonflood properties, compared to flooded properties, but the impact did not last. In fact, the opposite effect occurred over the long term.

This is in keeping with the findings of Montz and Tobin (1990) who found that repairs and renovation following flooding increased the value of flooded properties relative to those that were not flooded or that experienced less damage.

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, 1991), it is 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. The model to be tested here is:

$$\mathrm{Ln}(SP2/SP1) = f(TIME, DEP) + error$$

where

Ln(SP2/SP1) = Natural log of the ratio of after-flood selling price to before-flood selling price

TIME = The number of quarters between the two sales

DEP = Depth of water in the house (the disamenity)

The model was tested using several time periods: 2 years after the flood, 4 years after the flood, and the entire study period. In the first two cases, with restricted time intervals, neither of the variables served to explain any of the variation in the ratio of selling prices. However, when the entire time period was used, both variables proved to be significant (Table 15). These results suggest that the greater the depth the greater the ratio between post-flood and pre-flood selling prices. In other words, houses that experienced greater depths are worth more after the flood relative to before the flood.

Table 15
Repeat Sales Analysis for Paeroa

Variable	T-Statistic	Significance Level	R^2
DEP	2.235	.0283	.06
TIME	-2.062	.0426	.05

In addition, the negative coefficient on time suggests that the greater the time difference the less the price differential. This is in keeping with the t-test results showing that differences in selling prices decreased over time. However, it is the flood factor, depth, that is of greatest interest here. This result is opposite of what might intuitively be expected, but supports the earlier finding that the greater the depth, the greater the value, over the long term, given repair and renovations.

Summary and Conclusions

This analysis of the effects of flooding on housing prices in Paeroa concentrated on two aspects: spatial differences and temporal differences. The former is important to document so that changes that may occur over time can be evaluated in proper context. Indeed, in Paeroa, there are significant differences in characteristics of housing in different hazard zones that certainly have an impact on selling prices, irrespective of hazardousness. Thus, all other things being equal, houses in floodprone areas generally sell for less than those in non-floodprone areas because of the size, age, and other characteristics of the housing stock. These differences are also apparent when houses are grouped based on their hazard zone location. The strength of the relationships is somewhat less when a set of characteristics is considered instead of individual characteristics. But, significant differences in housing exist. Thus, any comparisons of housing prices over time, particularly as they incorporate external factors like the flood hazard, must be made within groups, or submarkets. Comparisons between submarkets will yield erroneous results because of the differences that have been documented.

Analysis of the changes in housing submarkets over time indicates that the flood did, indeed, have an impact on housing prices, although the market as a whole and all submarkets experienced wide fluctuations. However, in the four-year period following the flood, nonflood properties experienced significantly greater increases in selling prices. This did not become a long-term trend as flooded properties became more valuable, relative to their earlier values. The results of the temporal analyses (t-tests and repeat sales analyses) lead to several conclusions. First, the impact of flooding on property values was temporary. Second, the repairs and renovations made to damaged houses increased their values, relative to earlier values. Finally, either the flood was seen as a once-in-a-lifetime event or the flood control works provided by the Waihou Valley Scheme have provided security from flooding, or both. Any or all of these factors have minimized any hazard-related differences between house values. Nonetheless, housing submarkets exist. Flooded properties exhibit different size and age characteristics that will influence their values relative to nonflood properties, and this will continue to be seen in different valuations and different selling prices.

RESULTS: TE AROHA

Characteristics of Housing

There are 1,198 single family houses in Te Aroha which, for the purposes of this study, have been divided into hazard categories based on two different designations. One is incorporated as part of the Borough's Pre-Review Statement and differentiates floodprone lands from those not prone to flooding (herein termed flood hazard zones). The other comes from a landslip hazard study and is utilized when applications for building or for renovations are received. The first grouping is the one which best represents disclosure because it is included in a public document. However, because both designations exist and may affect development decisions, both are analyzed.

These groupings suggest that there are housing submarkets in Te Aroha, and this becomes apparent when characteristics of the housing stock in each group are compared (Table 16). Houses in the non-hazard zones tend to be larger, valued higher, and sell for more than those in any of the hazard groups. Indeed, the floodprone houses are the oldest, the smallest, and on the smallest sections. Since only 33 houses fall into the high landslip hazard zone, it is somewhat difficult to generalize. Yet, although they are newer, on relatively large sections, and comprise large floor areas, they sell for less than non-hazard properties. The reasons for this are examined as the analysis continues.

As with Paeroa, it is necessary to evaluate the significance of the differences

Table 16
Characteristics of the Housing Stock in Te Aroha

Variable	All Houses	Nonflood Zone	Flood Zone	Nonslip Zone	Midslip Zone	Highslip Zone
Valuation	66,818	67,948	51,816	75,367	65,252	60,591
Mean	60,000	61,000	47,000	67,750	58,000	57,000
Median	1,198	1,105	93	400	765	33
Area, in hec.						
Mean	.106	.107	.094	.115	.101	.109
N	1,198	1,105	93	400	765	33
Age[1]						
Mean	37.3	36.8	42.6	33.7	39.3	30.4
N	1,198	939	82	323	670	28
Site[2]						
Mean	12.1	12.2	10.8	12.7	11.9	11.1
N	1,198	1,105	93	400	765	33
Floor Area[2]						
Mean	13	13	11.8	13.4	12.7	13.1
N	1,198	1,105	93	400	765	33
Selling Price[3]						
Mean	36,229	36,971	25,370	41,904	33,349	29,820
Median	32,963	33,565	24,983	38,485	30,430	27,060
N	700	652	48	244	439	17

[1] At time of flood
[2] In tens of square meters
[3] 1984 dollars

noted above, and chi-square analyses were used to this end. These results make it possible to state that, compared to floodprone properties, a significantly larger proportion (at a .01 probability level) of non-floodprone houses:

- are valued above median valuation
- are zoned single family residential
- are rated in average and above average condition
- have more vehicle spaces
- occupy larger sites on sections
- have larger floor area
- sell above median selling price

They do not differ significantly from floodprone houses in section size, age, or number of stories. Both the range of characteristics and the individual factors on which they differ suggest that the difference in selling price may well be attributable to the housing stock rather than the location. This is examined further, later.

Significant differences are also found when considering the housing stock based on landslip designations, but some of the variables are different than those listed above. Compared to the houses that have a "possibility of being affected" (i.e., the mid-range) and those that have a "high probability," houses designated as unlikely to be affected:

- are valued above median valuation
- are on larger sections
- are rated in average and above average condition
- have more vehicle spaces
- occupy larger sites on sections
- are less likely to have small floor areas
- sell above median selling price.

There is also a significant difference (at the .01 level) between landslip designations and age of houses. With this relationship, however, those in the least and most hazardous areas have similar characteristics, while houses in the mid-range (possibility of landslips) tend to be older. There are other differences between the two landslip-prone groups. For instance, a significantly greater proportion of houses categorized in the mid-range are on smaller sections than those at the greatest risk. On the other hand, while both of these groups have similar proportions in the smallest site size category, the mid-range has proportionately more in the largest site size category. Finally, as the level of hazardousness increases, so does the proportion of houses that are valued above median valuation and that are sold below median selling price. This last comparison presents an interesting contradiction, although it may be a function more of the numbers involved (17 sales in the most hazardous zone compared to 439 in the mid-range) than of actual submarket trends.

The results detailed above look at individual variables as they serve to define locational differences that may be considered housing submarkets. However, as with Paeroa, combination of the variables is necessary to evaluate if, in fact, there are large differences between hazard zones. This is presented in the next section.

Differences Between Hazard Zones

Discriminant analysis was used, again, to evaluate the extent to which hazard designations are different from one another, based on the variables that characterize housing stock. Here, the combination of variables that best differentiates between areas is sought, as is a measure of group differences. The results of the discriminant analyses for both designations are shown in Table 17.

Table 17
Results of Discriminant Analysis for Te Aroha

Groups = Flood Hazard Designations		Groups = Landslip Designations	
Variable[1]	F-Value	Variable[1]	F-Value
Number of Vehicle Spaces	38.263	Floor Area	31.399
Zone	10.902	Valuation	18.953
		Site Size	11.134
		Number of Vehicle Spaces	7.656
		Age	4.430
Canonical Correlation = .21		Canonical Correlation = .34	
Wilks' Lambda = .96		Wilks' Lambda = .88	
Nonsignificant Variables		Nonsignificant Variables	
Valuation		Section size	
Section size		Rated Condition	
Rated Condition		Zone	
Age		Number of Sales	
Site Size			
Floor Area			
Number of Sales			

[1] Variables significant at .01 level
[2] Condition as rated by valuer at time of valuation: above average, average or below average.

Only two variables surface as significant in discriminating between the two flood hazard designations: number of vehicle spaces and zone. This, combined with a low canonical correlation and a high Wilks' Lambda value, suggests that there is not much difference between the designations. The logical conclusion to be drawn from these findings is that distinct submarkets based on hazard designation do not exist. However, the classification procedure yielded 84% of the cases correctly classified, suggesting that, in 8 out of 10 cases, one would be able to predict accurately the proper designation of houses, based on the two significant variables. This does not fit well with the low degree of separation indicated in the table, and examination of the classification table (Table 18) shows that more than half of the floodprone properties were classified into the non-floodprone group. Thus, the small number of houses designated as floodprone (93) compared to those not "marked" as being at risk (1,105) may influence the results. While attempts were made to overcome this by adjusting prior probabilities of classification into the discriminant analysis model, the results were never very different than those reported here. Thus, the two flood hazard groups can be defined based on two variables, but they do not exhibit much separation. As a result, the argument for housing sub-markets using flood hazard designations is somewhat more tenuous in this case than was seen with Paeroa. Differences exist but the strength of within-group correlations and the degree of separation are both low.

Landslip hazard designations were also subjected to discriminant analysis. The results are shown in Table 17. Five variables emerged as significant, suggesting that the groups can be differentiated based on a combination of these characteristics. There is a stronger within-group correlation than was seen with the flood hazard designations, given the canonical correlation of .34. There is also a higher degree of separation between groups, but the Wilks' Lambda value of .88 still does not signify a great deal of separation.

Overall, the classification procedure (Table 18) shows less accuracy in prediction than that for flood hazard designation (49% compared to 84%). However, in two out of three groups there is a better than 50% chance of an accurate prediction; with the flood hazard designations, this is only true with one out of two groups. The landslip designations, then, produce more distinct housing submarkets than is the case with flood hazard designations, but separation is still not large.

The findings from the discriminant analyses, combined with the chi-square results,

Table 18
Results of Classification Procedure for Te Aroha

(A) Flood Hazard Designation

Actual Group	N	Predicted Group: Non-floodprone	Predicted Group: Floodprone
Non-floodprone	1,105	970 (87.8%)	135 (12.2%)
Floodprone	93	54 (58.1%)	39 (41.9%)

Percent correctly classified: 84.22%

(B) Landslip Designation

Actual Group	N	Predicted Group: Nonhazard	Predicted Group: Possibility of Landslip	Predicted Group: High Probability of Landslip
Nonhazard	388	207 (53.4%)	119 (30.7%)	62 (16%)
Possibility of Landslip	731	194 (26.5%)	338 (46.2%)	199 (27.2%)
High Probability of Landslip	31	6 (19.4%)	7 (22.6%)	18 (58.1%)

Percent correctly classified: 48.96%

provide weak evidence of the existence of housing submarkets in Te Aroha, particularly with the designated flood hazard areas, which are very different in size and spatial extent. Individual characteristics serve to separate these areas, but the combination of characteristics seems to lessen the differences. Thus, further investigation into the impacts of an event and of disclosure on property values must be made in this context. That is, selling prices are influenced by a variety of factors, some specific to the housing stock, some specific to locational attributes, one of which may be hazard potential. As the findings here indicate, focusing on one or more variables, individually, may lead to erroneous conclusions regarding the nature of spatial and temporal differences. Temporal differences are addressed in the next section.

Temporal Changes in the Housing Market

During the study period, 1979-1990, 493 houses were sold in Te Aroha, and 167 of them were sold more than once. The graphs in Figure 7 and 8 trace change in median selling prices for houses in Te Aroha. As was the case with Paeroa, the percent change is based on the pre-event median for that group of houses, as defined by hazard category. Overall, the patterns indicate fluctuation, but prices end up essentially at their pre-event levels for all categories. There are notable differences between groups throughout the study period, with the hazard groups experiencing greater variations from quarter to quarter. Of particular interest are quarters 4, 8, and 20. The debris flow occurred in the middle of the 4th quarter, the landslip designation maps were available a year later (the 8th quarter) and the Borough's Pre-Review Statement was released in 1989 (the 20th quarter). Selling prices did not decrease significantly following the event, and, in fact, the hazard area shows a marked increase. Following the first disclosure, selling prices for non-hazard houses decreased, but the same is not true for those designated in one of the hazard zones. Finally, some decrease is seen following flood hazard delineation for those properties so marked. These findings can only be seen as indicative of trends, particularly because of the small number of houses in the hazard categories, relative to non-hazard houses. This translates into a small number of sales in some quarters, which may exaggerate differences shown on the graph. Further, the housing market's tendency toward fluctuation (seen also in Paeroa), irrespective of hazardousness, will likely exaggerate differences. Thus, statistical analyses are required to sort out relationships.

T-tests using matched pairs of sales (i.e., houses sold both "before" and "after") were undertaken for each hazard grouping and for three different time frames. The first looks at sales before and after the event (1985), thereby evaluating its impact. The second addresses the effect of landslip designation (1986) and the third the effect of floodplain designation (1989). The results are listed in Table 19.

From Table 19(A), it is apparent that the housing market underwent a downturn following the landslip. In all of the categories except for one, there is a statistically significant difference (at the .05 level) between pre- and post-event selling prices. Two of

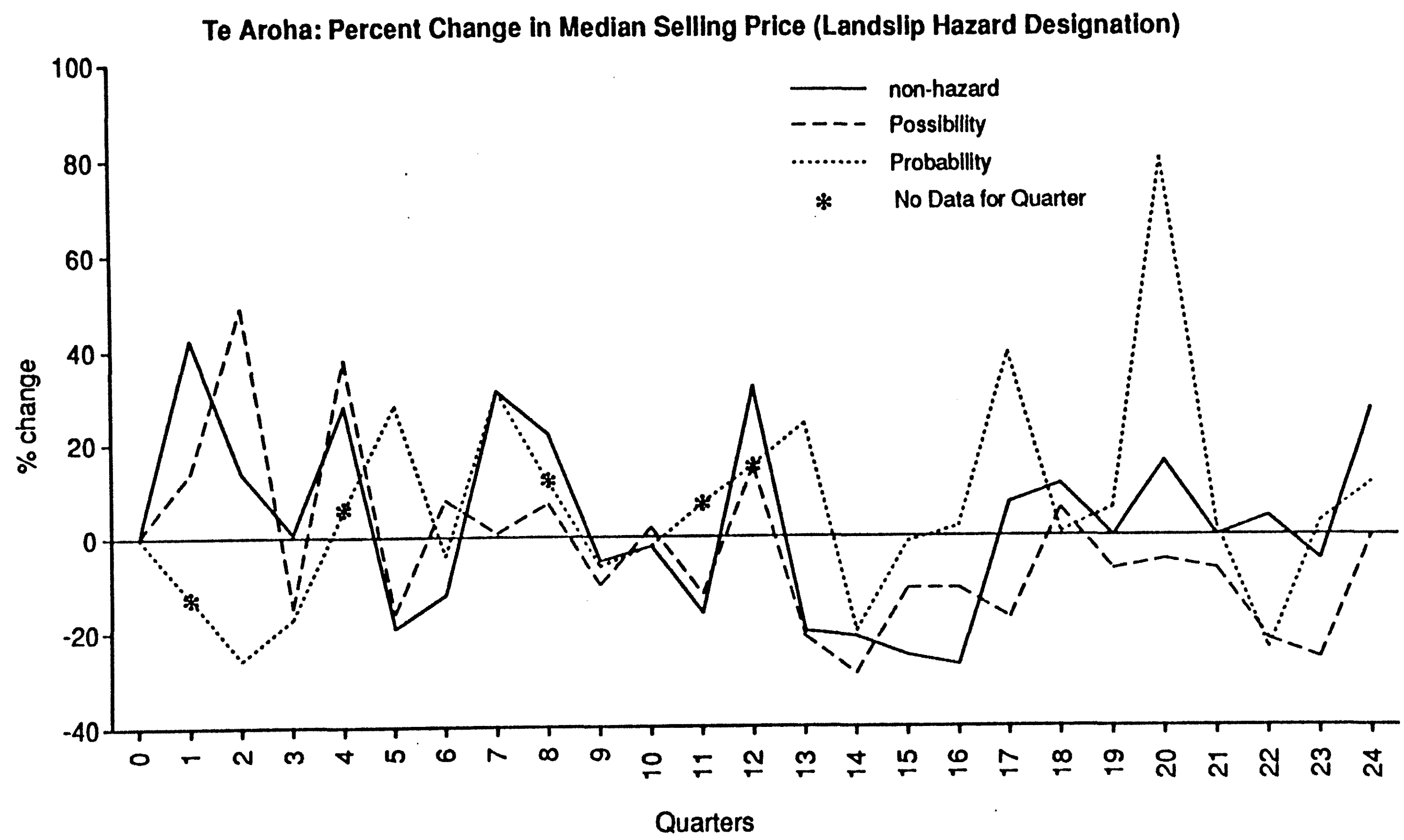

Figure 7. Changes in Median Selling Prices in Te Aroha, by Landslip Hazard Designation

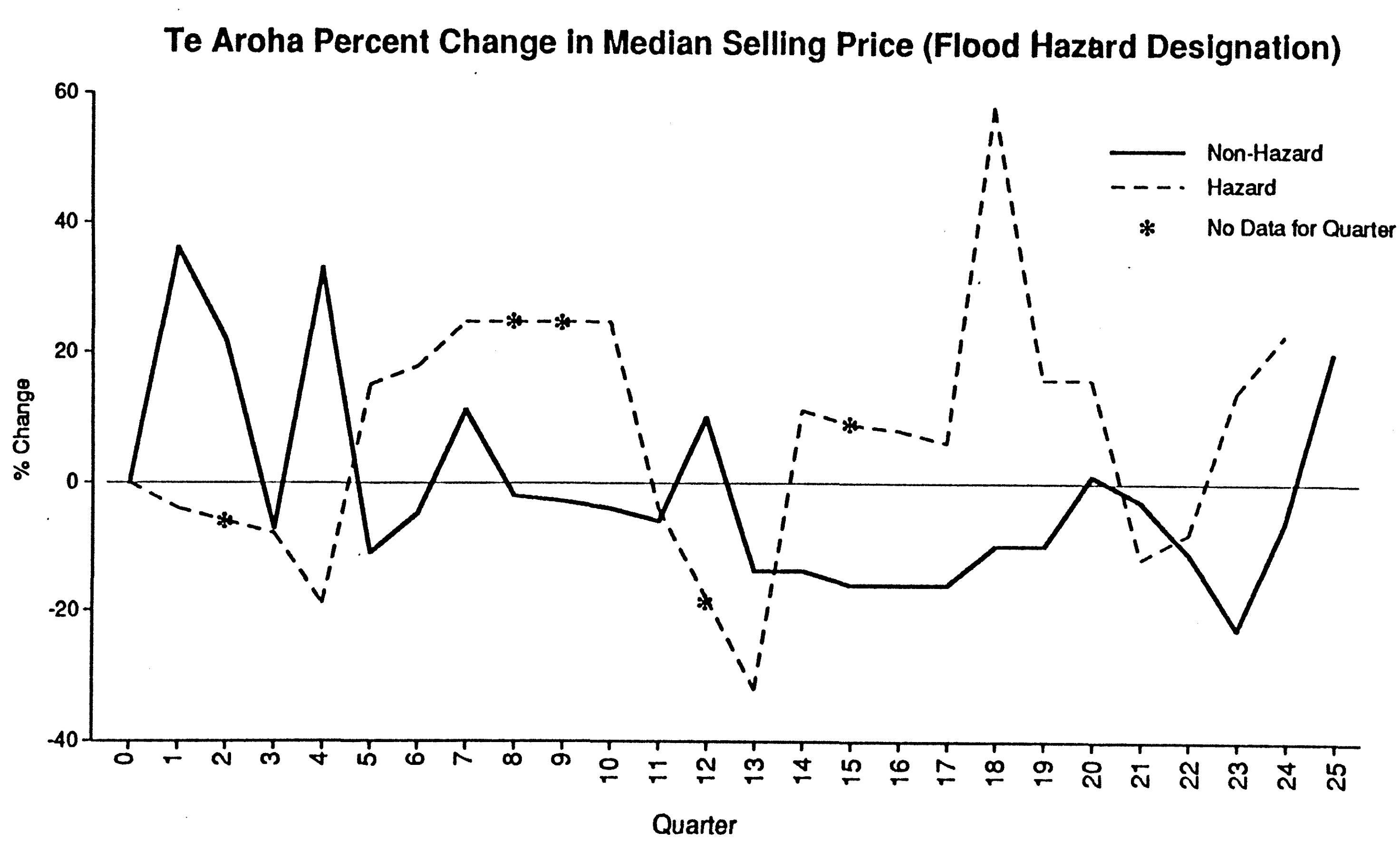

Figure 8. Changes in Median Selling Prices in Te Aroha by Flood Hazard Designation

Table 19
Results of Matched Pairs (T-Tests) of Sales for Te Aroha

Area	Before Flood Selling Price	After Flood Selling Price	Difference	T-Value	Probability
(A) Landslip Event:					
Entire Community (N=98)	37,690	34,280	-3,410	-3.18	.002
Non-floodprone (N=92)	38,693	34,787	-3,906	-3.58	.001
Floodprone (N=6)[1]	22,314	26,506	4,192	3.30	.022
Nonhazard (N=35)	43,658	39,128	-4,530	-2.65	.012
Possibility of Landslip (N=58)	35,257	32,250	-3,007	-2.03	.047
High Prob. of Landslip (N=5)[1]	24,133	23,893	-240	-0.11	.920
(B) Landslip Designation					
Entire Community (N=104)	37,865	33,099	-4,766	-4.74	.000
Non-floodprone (N=97)	38,982	33,702	-5,280	-5.01	.000
Floodprone (N=7)[1]	22,391	24,743	2,352	1.36	.224
Nonhazard (N=35)	44,426	38,362	-6,064	-3.42	.002
Possibility of Landslip (N=64)	35,350	30,940	-4,410	-3.39	.001
High Prob. of Landslip (N=7)[1]	24,133	23,893	-240	-0.11	.920
(C) Flood Hazard Designations					
Entire Community (N=46)	35,480	36,255	775	.66	.516
Non-floodprone (N=44)	36,197	36,994	797	.64	.523
Floodprone (N=2)[1]	19,710	19995	285	0.9	.533
Nonhazard (N=15)	41,256	43,558	2,302	1.24	.236
Possibility of Landslip (N=28)	33,221	33,231	10	.01	.995
High Prob. of Landslip (N=3)[1]	27,683	27,953	270	.28	.805

[1] N of cases is not sufficient to insure reliability.

the analyses, those of floodprone houses and houses with a high probability of landslip, yield questionable results because of the small number of sales that could be used[1]. Nonetheless, no matter what the location of the house, post-event selling prices were significantly lower than pre-event prices, suggesting that the event affected the market as a whole and not one or another of its submarkets. Similar results are seen with post-landslip designation prices. However, it may be that the differences seen here are simply carryovers from the effect of the event. Indeed, in this analysis, there is no way to separate the impacts of the event from those of designation, one year later. The whole community continues to experience lower "after" selling prices. Although the number of cases is small, and the findings questionable as a result, it is interesting that both high hazard areas (floodprone and high probability) do not share the same trends as the rest of the community, and even suggest recovery rather than continued decreases.

When floodplain designations are considered, substantially different results are seen. There are no significant impacts anywhere in the community between before and after designation prices. Certainly selling prices are different than they were in the earlier instances, with post-designation prices being higher (though not significantly so) than predesignation prices. In addition, these results suggest that disclosure in the Pre-Review Statement did not have an adverse impact on selling prices because no down-turn, particularly in the hazard areas, is indicated.

These findings suggest that the landslip event did, in fact, have an adverse impact on selling prices for houses, but this effect was not restricted to the areas directly affected. In addition, the impact was relatively long-term, as evidence of it existed more than a year after the event. However, by the end of 1989, the differences are gone and even disclosure of hazard-prone areas is not sufficient to generate a repeat of trends seen in earlier periods. These tests, however, do not directly address the impact of location on selling prices, and they deal only with absolute differences. Repeat sales

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[1] An attempt was made to increase the number of houses in the High Probability of Landslip category by moving group 4 (possibility of structures being affected by slips from higher up-slope) into this category. However, the results continued to be not significant, so any gains were not seen to be sufficient to justify such a change. The same kind of data manipulation is not available for the non-floodprone/floodprone categories.

analysis is used, therefore, to distinguish spatial impacts, based on hazardousness, as location influences the relative difference in selling prices.

The model to be tested in the repeat sales analysis differs somewhat from that used for Paeroa because location is defined by designated hazardousness, and there are two ways in which this has been done. Thus, the model is:

$$Ln(SP2/SP1) = f(TIME, HAZZON1, HAZZON2) + error$$

where

Ln(SP2/SP1) = Natural log of the ratio of "after" selling price to "before" selling price

TIME = The number of quarters between the two sales

HAZZON1 = Landslip hazard designation, by Mitchell (1985)

HAZZON2 = Flood hazard designation presented in the Borough's Pre-Review Statement.

As before, the model was tested using three time periods based on the event, landslip designation, and release of the Pre-Review Statement by the Borough. For the first two, HAZZON2 was not included in the model because it had not yet been developed and is therefore irrelevant to the analysis. The results are shown in Table 20.

Table 20
Repeat Sales Analysis for Te Aroha

Variable	T-Statistic	Significance Level	R^2
<u>(A) Landslip Event</u>			
HAZZON1 (Landslip Desig.)	2.057	.0424	.04
<u>(B) Landslip Designation</u>			
TIME	2.238	.0274	.05
HAZZON1 (Landslip Desig.)	1.735	.0858	.02
<u>(C) Flood Hazard Designation</u>			
No significant variables			

The three time periods show very different results. For the first, landslip designation (HAZZON1) is the only significant variable. In this case, hazard designation serves as a surrogate for location relative to the area affected by the event (e.g., the higher the designation the more likely to have been affected). Certainly, in this case, the event serves as disclosure anyway. Contrary to what might be expected, the higher the designation (and therefore the more hazardous the location), the greater the ratio between post and pre-event selling prices. That does not necessarily mean that these houses are selling for more than they did before the event, but rather that post-event selling prices represent a larger proportion of pre-event selling prices. This is evident in Table 19 where the difference decreases with increasing hazardousness, as does the significance of the difference.

Once the town has been mapped based on landslip hazard, the relationship changes (Table 20(B)). In this case, TIME is the largest contributing variable, explaining 5% of the variance in the ratio between post- and pre-flood prices. Because the T-value is positive, the greater the time between sales, the greater the differential between pre-event prices and post-event prices. Landslip designation also contributes to the relationship, but its influence is less than that of time and less than it had been a year earlier. By the time of the Pre-Review Statement, repeat sales analysis yields no significant variables. Thus, the ratio of post-designation to pre-designation selling prices is not explained by either of the variables associated with disclosure nor by the time factor. Again, the figures in Table 19 may provide an explanation. Specifically, post- and pre-designation selling prices are not significantly different, so locational differences in the ratio will not be different. This serves to strengthen the argument that disclosure has not had a significant impact on property values. Indeed, had there been an impact, one or the other of the hazard designation variables would surface as significant.

Summary and Conclusions

In Te Aroha, comparisons of housing characteristics between hazard categories yield some important differences. For instance, houses in the high landslip hazard category generally sell for less than houses in other categories, despite the fact that they are relatively new and are relatively large in size. In addition, houses in the designated flood hazard zone sell for less and are smaller, older, and on smaller sections. However, the differences do not translate into distinct submarkets that can be differentiated based on a combination of variables. Indeed, the distinguishing power of individual housing characteristics is lost when the characteristics are combined. Thus, submarkets exist but they are not very different from one another.

Analysis of the impact of location on the housing market suggests the locational variable, hazardousness, is not as important as might be expected. The landslip in 1985 had a definite impact on the housing market with all houses selling for less after the event than before it. This impact continued for more than a year, in some areas, but not in the high hazard zones. It may be that differences in selling price following the event cannot be attributed to variations in hazardousness. Similarly repairs to houses may have increased their value relative to pre-event levels. Whatever the case, houses marked as being at the greatest risk, in fact, felt less of an adverse impact after the event. While they sold for less after the event compared to houses in less hazardous locations, within category comparisons show that the differences between post- and pre-event selling prices are smaller. Thus, their owners suffered less, relative to pre-event expectations.

Any impact from hazard disclosure is not apparent from the findings of this study. Following release of the Borough's Pre-Review Statement with its hazard designation map, no significant differences in selling prices are documented. In addition, analysis of selling prices of houses sold before and after disclosure indicates no significant influence from locational characteristics. If there is any impact from disclosure, it did not occur within two years of disclosure. Instead, it appears that normal market fluctuations dominate, as was the case before the event.

RESULTS: THAMES

Characteristics of Housing

The 1,944 houses in Thames can be categorized in a variety of ways, given the two floods that occurred in the 1980s and subsequent disclosure of flood hazard areas (on a series of planning maps) by the District Council. For this study, two categorizations are utilized: one addresses designation, and therefore disclosure, of floodprone areas and the other incorporates experience with the hazard. The former has two designations, in or out of the designated hazard zone (DHZ), and the latter three designations (no experience, experience with one flood, and experience with two floods). Use of both groupings gives a more complete picture of the extent of the flood problem in Thames and avoids analytical problems that have been associated with dichotomous hazard designations (Montz and Tobin, 1988). These particular groupings are not replications of each other as there are more houses in the DHZ than have experienced one or two floods. Thus, flood experience is not the sole determinant of hazardousness.

Comparison of housing characteristics between these categories shows some distinct differences (Table 21). For instance, houses in the DHZ tend to be older, smaller, and on smaller sections than those not in the DHZ. Similarly, as experience with flooding increases, the value and size of homes generally decreases while age increases. Chi-square analyses of housing characteristics and hazardousness provide statistical evidence of these differences. Based on the relationships between location and individual characteristics, it can be stated that, compared to houses in the designated flood hazard zone, a significantly larger proportion (at the .01 level) of nonhazard houses:

- are valued above median valuation
- are zoned single family residential
- are in better condition
- tend to be newer
- have larger floor areas
- are more than one story
- sell above median selling price.

Houses not in the DHZ are relatively evenly divided between the section size categories, and there is a greater proportion in the largest section category, compared to hazard zone houses. No significant difference was found between areas regarding the number of vehicle spaces and the area of the section occupied by the dwelling (i.e., site size). Clearly the housing variables that differ between locations are those that would influence selling price and may, therefore, explain the significant difference in selling price. However, location may also be an important factor.

Experience categories also yield significant differences (at the .01 level) in housing characteristics. Specifically, as experience increases, so does the proportion of

Table 21
Characteristics of the Housing Stock in Thames

Variable	All Houses	Not in DHZ[1]	In DHZ	No Flood Exper.	One Flood Exper.	Two Flood Exper.
Valuation	85,101	87,255	77,477	87,288	79,569	65,992
Mean	80,000	82,000	76,000	82,000	80,000	65,000
Median	1,944	1,517	427	1,606	217	121
Area, in hec.						
Mean	.093	.099	.072	.099	.074	.048
N	1,912	1,496	416	1,585	212	115
Age[2]						
Mean	32.7	30.6	40.8	30.7	36.2	57.3
N	1,728	1,364	364	1,444	193	91
Site[3]						
Mean	11.2	11.3	11.2	11.3	11.0	11.1
N	1,944	1,517	427	1,606	217	121
Floor Area[3]						
Mean	13	13	11.8	13.4	12.7	13.1
N	1,944	1,517	427	1,606	217	121
Selling Price[4]						
Mean	50,300	51,392	46,276	51,782	48,083	34,584
Median	48,720	49,960	45,238	5,000	48,781	33,780
N	1,059	833	266	872	122	65

[1] DHZ=Designated Hazard Zone
[2] At time of flood
[3] In tens of square meters
[4] 1984 dollars

houses that:

- are valued below median valuation
- are not zoned single-family residential
- are in average condition
- are one story
- are on smaller sections
- are older
- sell below median selling price.

In addition, the greater the experience, the greater the proportion of small and mid-sized houses. There continues to be a nonsignificant relationship with site size.

Again, these characteristics are likely to influence selling prices and valuation, independent of location. This is analyzed in a later section. Nonetheless, the results for both categories of hazardousness suggest that housing submarkets do, indeed, exist in Thames, at least when considering individual variables. How these characteristics combine to distinguish between locations must now be evaluated.

Differences Between Hazard Zones

The results of the discriminant analyses are shown in Table 22. In both cases, essentially the same variables combine to discriminate between groups, and in both cases, zoning classification is, by far, the most important variable. Further, section size is an important contributor, but neither of the other size variables (site size or floor area) comes into play at all. There are differences, however. The number of vehicle spaces is significant in the DHZ grouping but not when dealing with experience groups. In addition, the relative contributions of the variables to overall discrimination differ.

Table 22
Results of Discriminant Analysis for Thames

Groups = Designated Hazard Zones		Groups = Flood Experience	
Variable[1]	F-Value	Variable[1]	F-Value
Zone	66.472	Zone	96.173
Section Size	38.578	Section Size	30.211
Rated Condition[2]	22.131	Age	25.725
Number of Vehicle spaces	11.925	Rated Condition	5.195
Canonical Correlation = .31		Canonical Correlation = .41	
Wilks' Lambda = .91		Wilks' Lambda = .82	
Nonsignificant Variables		Nonsignificant Variables	
Valuation		Valuation	
Site size		Site size	
Floor area		Floor area	
Number of sales		Number of vehicle spaces	
		Number of sales	

[1] Variables significant at .01 level
[2] Condition as rated by valuer at time of valuation: above average, average or below average.

Another important difference between the two analyses is seen in the canonical correlation and Wilks' Lambda values. Grouping based on experience represents a stronger association within the groups (indicated by the higher canonical correlation) and has a higher degree of separation between groups (shown by the lower Wilks' Lambda). It is fair to state, then, that housing submarkets exist in Thames, differentiated by designated hazardousness and experience with flooding, but the differences between groups (particularly DHZ groups) are not great. This is confirmed by the results of the classification procedure where 69% of the cases were correctly classified into DHZ groups and 59% correctly classified into experience groups. In fact, since there are three experience groups, expected accuracy of classification is 33%, so 59% is an improvement. For the two DHZ groups, expected accuracy is 50%, so 69% is a relatively small improvement.

These findings provide some evidence of significant differences in housing characteristics between hazard groups, suggesting that these groups can be used to define housing submarkets. The experience groups tend to exhibit greater differentiation, being more coherent within each group and more different between groups than is the case with DHZ groups. In both cases, however, the differences make it necessary to consider trends in selling prices within each group because of the distinctions noted. They are different markets, even though they may not exhibit much separation, so they must be analyzed as such, and any comparisons must be made within groups and between groups, but not across groups.

Temporal Changes in the Housing Market

There were 729 house sales from 1979 to 1990 for which data were available (representing almost a 100% sample). Of these, 240 sold more than once. The graphs in Figures 9 and 10 show changes in median selling prices, by designated hazard zone and experience group. The housing markets in Thames exhibit a great deal of fluctuation, but there is generally an upward trend. With regard to Figure 9, the wide variations seen in the "two floods" submarket are somewhat misleading because there are fewer sales in this category than in the others, with some quarters having no sales at all and others having only one or two. Nonetheless, the trends over time, rather than changes between two quarters, are important. In addition, changes following flooding and disclosure can

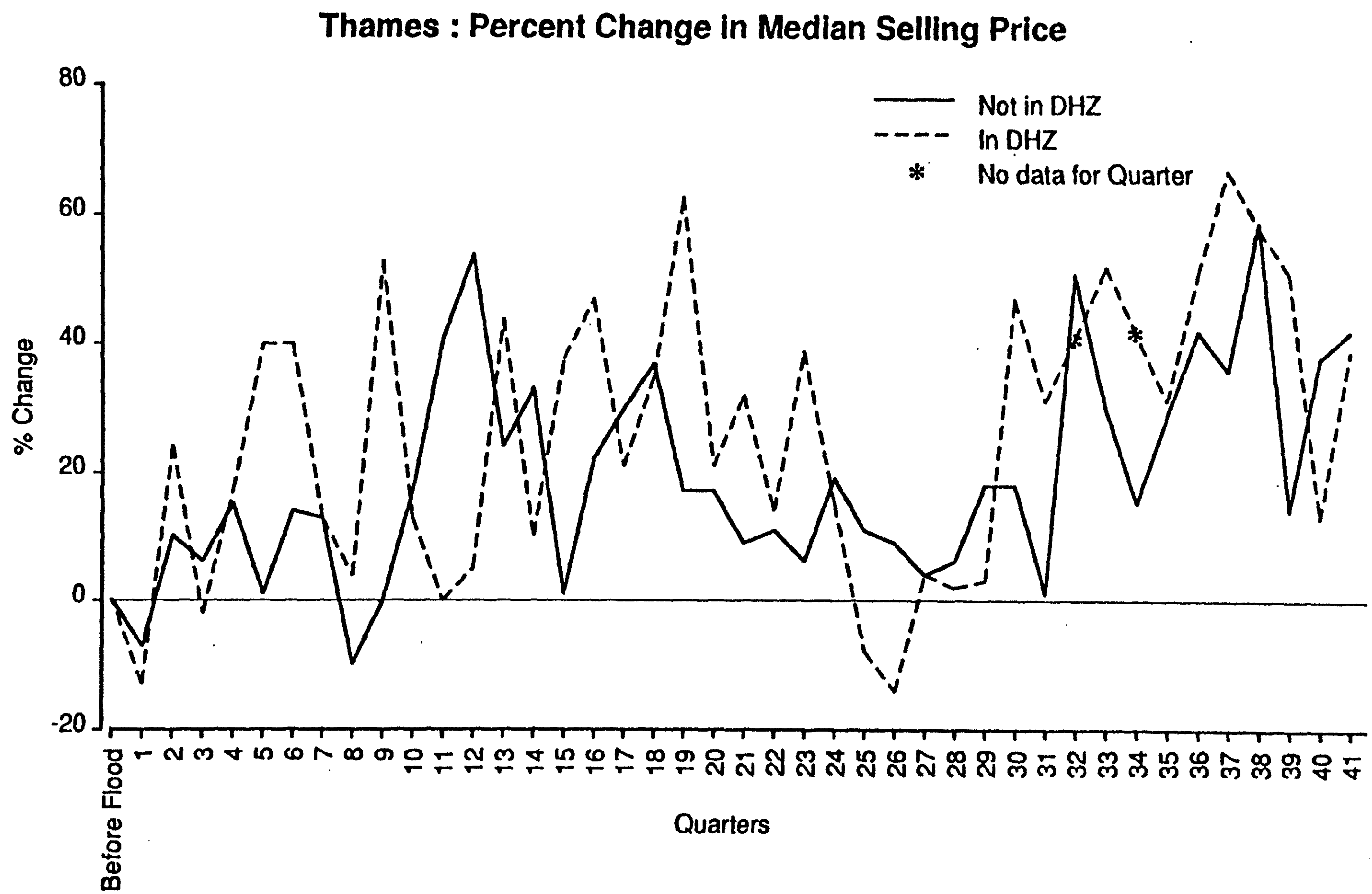

Figure 9. Changes in Median Selling Prices in Thames, by Designated Hazard Zone

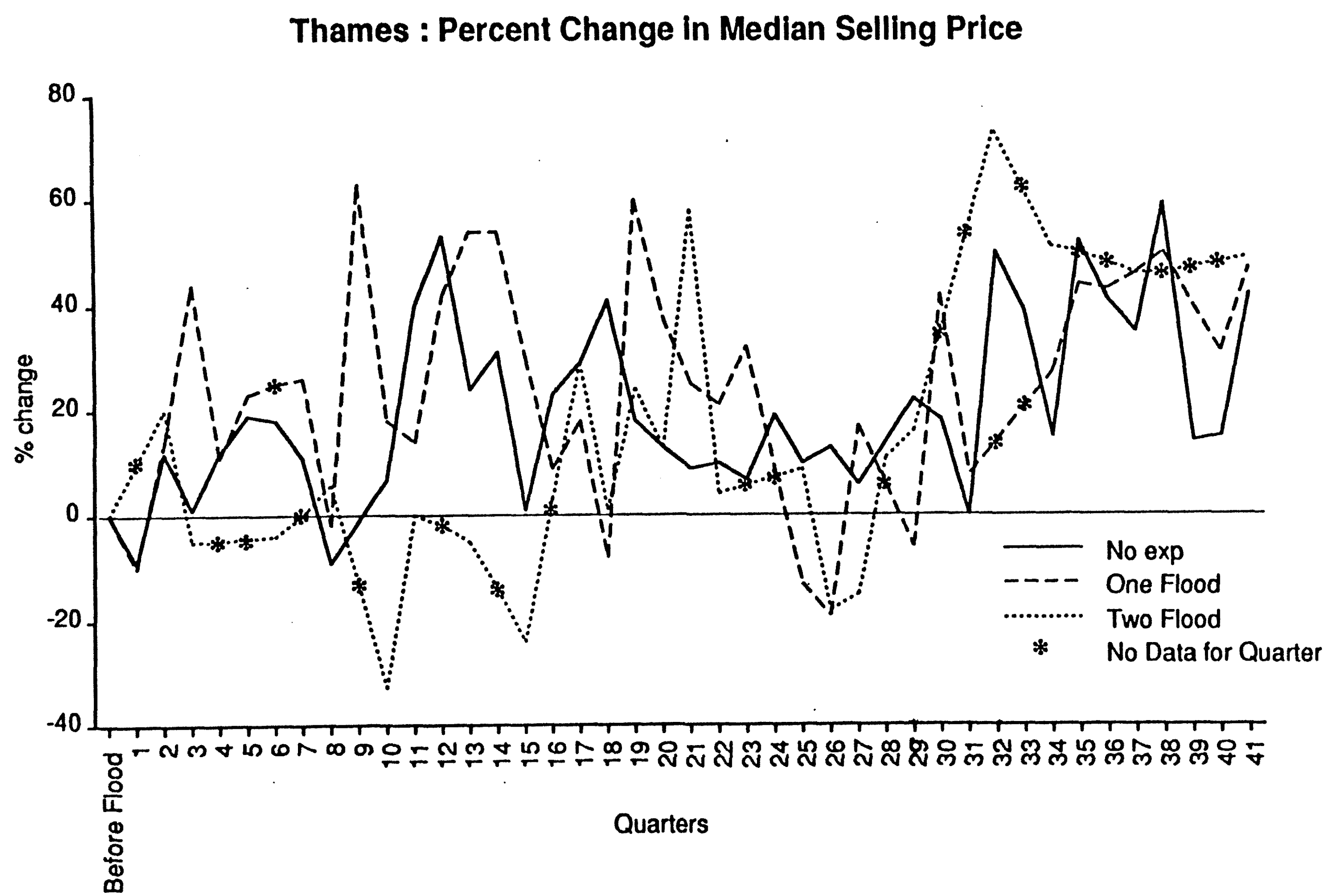

Figure 10. Changes in Median Selling prices in Thames, by Flood Experience

also be seen. The first flood occurred in the middle of the first quarter and the second in the middle of the 15th. The hazard maps were released in the 22nd quarter. Following the second flood, the decrease in the one flood category is a continuation of pre-flood trends and is therefore not necessarily attributable to the flood. Both of the other categories experienced increases, including houses that were directly affected by this flood. There is also an apparent decrease following disclosure, but the fluctuations suggest that other factors may be at work. Examination of Figure 10 supports this. Specifically, those properties that should be adversely affected by disclosure (i.e., those designated as floodprone) show a decrease several months after disclosure, but properties in this category return to selling prices well above pre-flood levels within about a year, and they remain there. Also of note is the fact that properties not in the DHZ generally experienced a trend of decline or stagnation for a longer period, suggesting that disclosure was not the primary factor at work.

Despite the fluctuations, all submarkets are well above pre-1981 levels by the end of the study period. This is largely due to the increased demand for housing that has occurred in recent years, a result of increasing numbers of people choosing to locate in Thames upon retirement. This has caused an increase in house prices as supply is relatively inelastic, given physical constraints on future development, and many new residents have the resources to buy without a mortgage. Whether or not flood events or designation of hazardous areas had any impact is not readily apparent, but this can be evaluated by looking at differences in selling prices before and after certain points in time.

T-tests using matched pairs of sales were undertaken four times in order to analyze the impacts of each "event." The impacts of each of the two floods were analyzed, as was the accumulation of experience from both floods. In addition, the impacts of flood hazard designation were evaluated. The results are presented in Table 23.

Following the first flood, prices were significantly higher (at the .01 level) than before it for areas not flooded and for the community as a whole (included to indicate extent of overall impact). Flooded properties also increased in value following the flood, but the difference is not significant. This suggests that the 1981 flood caused flooded properties to increase in value at a rate proportionately less than other properties.

Table 23
Results of Matched Pairs (T-Tests) of Sales for Thames

Area	Before Flood Selling Price	After Flood Selling Price	Difference	T-Value	Probability
(A) 1981 Flood					
Entire Community (N=41)	42,183	50,662	8,749	5.07	.000
Not Flooded (N=34)	44,585	52,854	8,269	4.49	.000
Flooded (N=7)[1]	30,513	40,010	9,497	2.22	.068
(B) 1985 Flood					
Entire Community (N=149)	49,177	47,603	-1,574	-1.65	.101
Not Flooded (N=138)	50,606	48,723	-1,883	-1.92	.057
Flooded (N=10)[1]	28,750	34,054	4,304	1.17	.273
(C) Flood Experience					
No Experience (N=122)	51,331	49,305	-2,026	-1.94	.054
One Flood (N=17)	43,890	44,113	223	.07	.942
Two Floods (N=9)[1]	30,298	33,242	2,944	.77	.464
(D) Designation of Hazard Zones					
Entire Community (N=150)	48,552	47,219	-1,333	-1.27	.207
Not in DHZ (N=121)	50,301	48,323	-1,978	-1.73	.083
In DHZ (N=29)	41,255	42,613	1,358	.52	.608

[1] N of cases is too low to insure reliability.

Nonetheless, an increase is evident. These differences do not continue after the second flood. In this case, there were no significant differences in before and after prices, though it is interesting to note that flooded properties increased in value while non-flooded ones did not. Given that non-flooded properties represent most of the sales in the community, a decrease in value is seen throughout the community, a trend that might otherwise be attributed to flooding.

While no significant differences exist in any of the experience categories, houses with no experience have tended to lose value over time. Those that experienced either one or two floods generally increased in value, though not significantly. Designation of flood hazard areas reveals similar trends, with no significant differences in selling prices before and after designation. However, those not designated as floodprone show a decrease in value while those designated as such do not.

These findings are supported by the repeat sales analyses which were undertaken for each of three time periods (before and after the first flood, before and after the second flood, and before and after designation). The overall model is:

Ln(SP2/SP1) = f(TIME, FL81, FL85, EXP, DHZ) + error

where

Ln(SP2/SP1) = Natural log of the ratio of "after" selling price to "before" selling price

TIME = The number of quarters between the two sales

FL81 = In or out of the 1981 flood

FL85 = Depth of flooding in the 1985 flood

EXP = Extent of flood experience (i.e., none, one or two floods)

DHZ = Flood hazard designation (in or out of designated hazard area)

The independent variables were incorporated as appropriate. For instance, only FL81 was used when repeat sales following the 1981 flood were analyzed, while FL81, FL85 and EXP were used for analysis of the 1985 flood. The results are presented in Table 24.

In no case were any of the hazard related variables significant contributors to the ratio of "after" selling prices to "before" prices. However, TIME contributes significantly to the differential in the analysis of the second flood and of hazard area designation. Specifically, the results indicate that the greater the time difference between sales, the greater the price differential. This occurs independent of the existence of the flood hazard.

Summary and Conclusions

Thames is a town with limited area for development, given physical constraints, and a flood hazard that emanates from several sources. It is, therefore, subject to

Table 24
Repeat Sales Analysis for Thames

Variable	T-Statistic	Significance Level	R^2
(A) 1981 Flood			
No significant variables			
(B) 1985 Flood			
TIME	3.098	.0023	.06
(C) Flood Hazard Designation			
TIME	2.427	.0164	.04

frequent floods, a fact the Thames-Coromandel District Council has recognized and acted on. The action is in the form of maps that delineate flood hazard areas and development restrictions that relate to the designations. Given these characteristics, Thames is an excellent case study of the impact of disclosure on property values, because flood events as well as disclosure can be studied.

Housing can be divided into submarkets based on experience with flooding and flood hazard designation. The differences between groups is not large, but there is sufficient separation to suggest that the submarkets be analyzed separately. Indeed, houses that have been in one or two floods are older and on smaller sections than houses that have not been flooded. The same is true with houses in the designated hazard zone--they tend to be older and smaller than those out of this zone. Thus, differences in before and after prices must be evaluated within zones.

Comparison of selling prices over time, within zones, reveals no significant differences in those affected by flooding, except following the 1981 flood. In this case, all houses increased in value compared to pre-flood prices, including flooded houses. However, only 7 flooded houses were sold before and after the first flood, so the results of the t-tests are not statistically valid. No similar differences exist after the 1985 flood when prices decreased, though not significantly, for all but flooded houses. Thus, it is difficult to conclude that the difference is due to the flood.

Houses that are older and smaller (i.e., those that were flooded or in the designated hazard zone) tended to appreciate after the "event" (one or both of the floods or hazard designation) compared to those that are not floodprone. Indeed, houses that were not flooded and are not in the designated hazard zone generally sold for less after each "event," compared to their respective group's pre-event prices. And, these are newer and larger houses. On the other hand, time between sales rather than hazardousness turned out to be the significant variable in explaining some of the variance in the ratio of after selling prices to before selling prices.

Several factors may serve to explain these findings. First, as has been noted in other studies, flooded houses tend to sell for more than non-flooded houses after a flood because they have been refurbished and therefore have newer interiors, appliances, electrical systems, and the like (Montz and Tobin, 1990). Thus, while the house itself may be old, the interior or parts of it are likely to be much more modern. Thus, there is an increase in selling prices after this necessary cleanup and repair work has been completed. In addition, "strong demand by retired persons who are often able to buy without mortgage commitments have forced prices up" (Paul and Paul, 1987, p. 6). Many are looking for relatively small houses. Further, much of this demand is concentrated near the business district of Thames (Lawrence, 1991), which is also the oldest part of town and the area that has the greatest flood risk. Therefore, it is the demand for centrally located housing that has influenced this submarket upward, and not the flood hazard.

In sum, it appears that neither flood experience not hazard disclosure has had any depreciating impact on affected housing in Thames. The market as a whole and individual submarkets are generally experiencing increases in values. The 1981 flood may have decreased the increase for flooded properties over the short term, but neither the 1985 flood nor subsequent disclosure of flood hazard zones had the same effect.

IMPLICATIONS OF THE RESEARCH FINDINGS

This research is centered on the impact of hazard disclosure on property value, and the findings suggest that disclosure has little effect. However, several other questions had to be addressed in order to investigate this fully. Each contributes to our understanding of the dynamics of the residential real estate market as it is influenced by natural events, and each suggests implications regarding hazard management and hazard disclosure policy.

Impacts of Disclosure

The perception that disclosure of the hazardousness of locations will lower property values for designated properties is not supported by the results of this research. Indeed, it is not apparent anywhere. In Thames, for instance, no long term effect could be documented and, in fact, the properties that decreased in value following disclosure are those out of the designated hazard area--quite the opposite of what might be expected. Here, however, other local economic factors may be more important than those related to disclosure or they may mask disclosure-related impacts. However, in Te Aroha, where the market is somewhat less complex, no effect from disclosure is apparent. Indeed, publication of flood hazard areas in the Borough's Pre-Review Statement led to no significant differences in property values. The market shows some decreases following landslip designation, but it is doubtful if they are related to the designations, themselves. That is, the map was never widely publicized nor were any specific building restrictions associated with individual hazard designations. In addition, the market was already in a downturn following the landslip a year earlier. Finally, those properties in the most hazardous areas experienced the least effect, again the opposite of what would be anticipated.

If one were to rely solely on the results regarding hazard disclosure, a logical conclusion would be that if there is any impact from disclosure it is a positive one. In the two "disclosure" communities studied, each with different housing markets and each with different hazard situations, property values in the areas designated as most hazardous generally increased more than those in less hazardous areas, though the differences were not always statistically significant. In neither of the communities is hazardousness a variable that adversely impacts on repeat sales of houses. Thus, disclosure does not depreciate property values.

Impacts of Events

Separate from the impacts of disclosure on property values is the impact of events. 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 affected areas, would be affected because attention is focused on the impacts of the event. This was found to some extent in all three communities, but the impact was temporary. In Paeroa, for instance, non-flooded properties 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 community experienced a decline in selling prices in Te Aroha 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.

These results appear to be contradictory. However, findings elsewhere suggest that flooded properties sell for more than pre-flood values following a flood, and indeed experience a greater proportional increase that non-flooded properties (Montz and Tobin, 1990; Tobin and Montz, 1990). The same appears to be occurring in Paeroa and Te Aroha. 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 Thames, the market is so influenced by supply-demand considerations, with many people moving in from outside the community, that this influence on property values likely overshadows any caused by the flood event. Indeed, the decrease following the 1985 flood may as easily have been caused by non-flood factors as those noted above.

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, and there are none associated with disclosure, it appears that hazardousness is not an important consideration in house buying decisions, a fact that may be related to several characteristics, including the nature of disclosure. This point will be discussed in greater detail later.

The Importance of Local Submarkets

The spatial analyses undertaken for this research project illustrate that housing submarkets within communities must be considered in any evaluation of trends. While the distinctions between some submarkets may be small, their existence requires that comparisons be made within and between submarkets but not across them. Specifically, if submarkets were not considered in this research, it would be possible to show that "marked" properties sell for less than unmarked properties. However, they are different submarkets, comprised of houses with different age, size, and amenity characteristics, which may well explain price differences. Thus, it turns out that housing characteristics and not hazardous locations serve to explain differences in housing prices--a fact that would be lost without consideration of submarkets.

Similarly, local market trends may suggest a depreciating effect from an event or following hazard area disclosure when that may not be the case at all. As the graphs of changes in prices show clearly, local housing markets fluctuate widely, as do submarkets. If a downturn in housing prices for the market coincides with a flood or with disclosure, it may be attributed to the event or to disclosure. Again, that may not be the case at all, as was seen in Thames where non-flood properties decreased in value following flooding and non-designated properties decreased following disclosure. Thus, submarkets must be evaluated because spatial differences in housing stock as well as in hazard experience may account for trends that would otherwise be seen as community-wide.

POLICY CONSIDERATIONS

The research results reported here suggest that disclosure of the hazardousness of locations, as it is undertaken in the two case study communities, does not have a depreciating effect on property values. Trends in the two communities which have disclosure are not different than those in the control community without disclosure. This is not unlike findings in a California study in which the study showed that "mandated disclosure has had little effect on buyer behavior or market performance" (Palm, 1981, p. 94). Thus, there are no market reasons to avoid disclosure.

In considering disclosure of hazardousness, two questions have to be answered. First, what is the purpose of disclosure? And second, how will disclosure be undertaken? In Thames and Te Aroha, disclosure was undertaken to avoid or control development or redevelopment in areas seen to be particularly prone to natural events, thereby minimizing monetary losses to the events and possibly saving lives. Thus, disclosure does not necessarily occur with all property transactions. Another purpose of disclosure might be to insure that prospective buyers are informed of the risks that they would be taking. This is one of the purposes of special studies zone disclosure in California. Presumably then, buyers may choose not to accept the risk (and therefore not buy the house), to accept the risk, but with mitigation measures they choose to adopt, or to accept the risk and adopt no mitigation measures. In either case, the buyer is informed. Neither of the disclosure methods used in the case study communities deals with anything but new building or with remodelling. It does not necessarily require disclosure as part of the sale. Nonetheless, the purpose of minimizing losses through wise land-use development practices is an appropriate one.

In part, the way in which disclosure is undertaken is related to the purpose of disclosure. If the purpose is to inform buyers, then it will have to be verbal or written disclosure made by the land agent or some other person involved in the process. If the purpose is to bring about wise development for new building or remodelling, then disclosure would be tied to the building permit process and would involve specific requirements for building elevation or other hazard proofing. In either case, maps of a scale appropriate to depicting the locations of individual properties are required.

Any consideration of disclosure will be made with concern for how it will affect development decisions. The results from this study show that it does not depreciate property values. Thus, it may have no effect on development decisions or on market processes or it may provide prospective buyers or builders with a full range of information about a site. Informed buyers are more likely to do something about the hazard than those who are not informed. And, if individuals take appropriate actions, then public actions, in the form of protection works in an attempt to keep an event from occurring or in the form of relief and rehabilitation funds for cleanup, can be reduced, thereby saving money.

There are two caveats that must be considered in light of the results and conclusions presented here. First, all of the communities studied have some form of structural control to protect against natural events. In all cases, the controls have not functioned entirely effectively in that flooding has occurred anyway and has even been aggravated by the structures, as in Te Aroha. This is not unexpected, as flood control works do not protect against all events. However, it is also known that the existence of structural controls may provide a false sense of security for the residents. Indeed, it may well be that the existence of structures causes residents to minimize the probability of hazard occurrence, even in the face of disclosure. Thus, the role of structural controls must be considered in conjunction with disclosure.

Finally, hazardousness is another site characteristic for prospective buyers. If they have this information, it will become part of their knowledge base about a property, along with its size, its shape, its relative location, its proximity to shops, schools, work, and the like. Having information about hazardousness does not mean that it will become the deciding factor. In fact, it will probably not, unless there are other overwhelming reasons to make it so, such as prior experience of the buyer. This is not to minimize the importance of disclosure. Instead, disclosure of hazardousness must be seen in the context of the package of information that buyers receive about a property. As a result, it was found to have no impact on the market, and it can only serve to minimize losses to hazards over the long term, losses that were found to extend beyond the affected area to the housing market as a whole.

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