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Storm Surge Flooding: Risk perception and coping strategies of residents
in Tsawwassen, British Columbia

by

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in partial fulfillment of the requirements for the degree of

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Dedication

~ To the land facing the sea ~

Abstract

This thesis examines how residents perceived and coped with storm surge flooding in Tsawwassen, British Columbia. On February 4, 2006 the community experienced a storm surge flood that affected residents within the neighbourhoods of Beach Grove and Boundary Bay Village. This study identifies how residents perceived and coped with the flood, and what factors influenced how individuals perceived and coped. Qualitative methods were used for this study, and a total of 23 in-person interviews were completed. The findings of this research showed that how participants perceived the threat of storm surge flooding and how they coped with the flooding varied greatly. Government intervention; the influence of family, friends and neighbours; the perceived benefits of living in the area; experience; financial support; and perception of other hazards all influenced how the participants perceived and coped with the storm surge flood.

Keywords: Risk perception, coping, storm surge flooding, Tsawwassen
British Columbia

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Chapter One: Introduction

Flooding is a significant and common global threat. In Canada some of the costliest disasters involve either the lack of water (drought) or an excess of water (floods) (Environment Canada, 2003). Flooding in Canada can be caused by precipitation, snowmelt, ice jams, and storm events (Natural Resources Canada, 2007) and can occur quickly or slowly depending on the cause. Two of the most expensive flood events in Canada were the Red River Flood (Manitoba) in 1997 which cost approximately 817 million dollars, and the 1996 Saguenay Flood (Quebec) which cost upwards of 1.7 billion dollars (Natural Resources Canada, 2007). These two notable events are examples of riverine flooding which occurs when a river overflows its channels as a result of high water volume (Christopherson, 2000). However coastal areas in Canada are also at risk of flooding.

People living in areas vulnerable to flood risks highlight the dichotomous relationship between humans and the water-land interface. Throughout history, humans have settled in areas near water bodies to satisfy both needs and convenience. For example, water bodies have played a significant role in human settlement by assisting movement and transportation of goods and people (Few, 2003). Floods themselves also play an important ecological role as they provide nutrients to fertilize soil and water to both irrigate soil and recharge reservoirs (Few, 2003). Although water bodies and flooding can be beneficial, there is also

significant concern for people living in close proximity to water, since flooding can also threaten lives and property.

Flooding is also an important hazard to study because populations in floodplains and along coastlines are increasing all around the world (Nicholls, 1995). There is also growing concern that coastal communities will be even more vulnerable to flooding in the near future as climate change is expected to increase the frequency and magnitude of storms (Environment Canada, 2003) and increase global sea levels (Nicholls, 1995).

In the lower mainland of British Columbia, flooding is a major threat to people and infrastructure. The primary source of flooding in the region is the Fraser River; however it is not the only source. The coastline of British Columbia is also vulnerable to flood risk from the Pacific Ocean (Environment Canada, 2008). Tsawwassen British Columbia was chosen as the study area for this project because it has been identified as a region that is vulnerable to coastal processes: floods, beach erosion and migration, and dune destabilization (Natural Resources Canada, 2007a; Shaw et al. 1998).

The main goal of my master's research was to examine how residents perceived and coped with the storm surge flooding in Tsawwassen, British Columbia that occurred in February 2006. Storm surges are "an abnormal, sudden rise of sea level associated with a storm event" (Danard et al. 2003 p 408). Risk perceptions are the judgements that individuals make concerning the degree of threat or risk that they are exposed to and the underlying factors that

lead to that judgement (Slovic, 1987). Coping is the way that people respond to stressful situations (Bachrach and Zautra, 1985). Coping was explored by examining the ways that residents coped with flooding in the past, how they dealt with the storm surge flood that occurred on February 4, 2006, and what their plans are for future mitigation. Factors that persuade or dissuade residents from taking self-protective action to prepare and mitigate the risk are also examined. Ultimately, the results of this study may assist managers and policy makers gain insight on how individuals make decisions related to flooding and how they might encourage self-protective behaviour amongst local residents, thereby reducing costs to the community as a whole.

Research Objectives

The objectives of this study were to explore how individuals perceive the risk of flooding in their community and how individuals coped with a flood event that occurred in February, 2006. The specific research questions that guided this study were:

1. How did residents perceive the flood risk prior to the flood, and how residents perceive the risk a year later?
2. How did residents cope during and after the flood?
3. What factors influenced the risk perception and coping strategies of residents?
4. How can the results of this study assist the government to support local residents?

Thesis Organization

This thesis is divided into six chapters. The second chapter presents background information about the study area, storm surge flooding, and the history of emergency planning and management with regards to flooding in Canada, British Columbia and Tsawwassen. The third chapter presents a review of literature related to this project, including early work on flooding, as well as research on hazard risk perception and coping strategies and flood research in Canada. Chapter four describes the qualitative methods used in this study. Chapters five and six present and discuss the results of the interviews. Chapter five focuses on how residents perceived and coped with the flood. Chapter six focuses on the factors that influenced risk perception and coping strategies. Chapter seven presents the conclusions and recommendations.

Chapter Two: Background

This chapter describes Tsawwassen, British Columbia, the community that was affected by a storm surge in February 2006 and summarizes the hazard that is central to this thesis, storm surges and the risk of flooding.

Flooding in Tsawwassen, BC

The Corporation of Delta is located in south-western British Columbia just south of Vancouver in the lower mainland of British Columbia (See Figures 1 and 2). There are three communities within the Corporation of Delta's jurisdiction: North Delta, Ladner, and Tsawwassen. This project focuses on flooding that occurred within the community of Tsawwassen in the neighbourhoods of Beach Grove and Boundary Bay Village, which lie on the western coastline of Boundary Bay (See Figure 3). In February 2006, areas within these two neighbourhoods were flooded during a winter storm (The Corporation of Delta, 2007).

Tsawwassen, British Columbia is the smallest community within the Corporation of Delta with a population of 20,933 (The Corporation of Delta, 2009). Tsawwassens' population is slightly older than the regional average. According to census data from 2006 the median age of the population is 46 years old and approximately 60 percent of the population is over the age of 40 (The Corporation of Delta, 2009). The median age for the province of British Columbia is 40.8 years of age. Within Tsawwassen approximately 61 percent of

residents have a postsecondary certificate, degree or diploma (The Corporation of Delta, 2009). The median income for households in Tsawwassen is approximately \$75,000 (The Corporation of Delta, 2009). This is significantly higher than the median income for other households in British Columbia, which is approximately \$53,000 (The Corporation of Delta, 2009). The average price of a home in Tsawwassen is also substantially higher than in many other regions of British Columbia. Single-detached homes account for approximately 65.3 percent of private dwellings and 81.6 percent of all dwellings are owned (The Corporation of Delta, 2009). The average value of owned dwellings is approximately \$565,000 (The Corporation of Delta, 2009). In British Columbia the average value of owned dwellings is \$418,000 (The Corporation of Delta, 2009). Within the Corporation of Delta the home values are approximately \$100,000 more in Tsawwassen than in North Delta and Ladner (The Corporation of Delta, 2009).



Figure 1 Study Area



Figure 2 Tsawwassen, British Columbia with highlighted study area

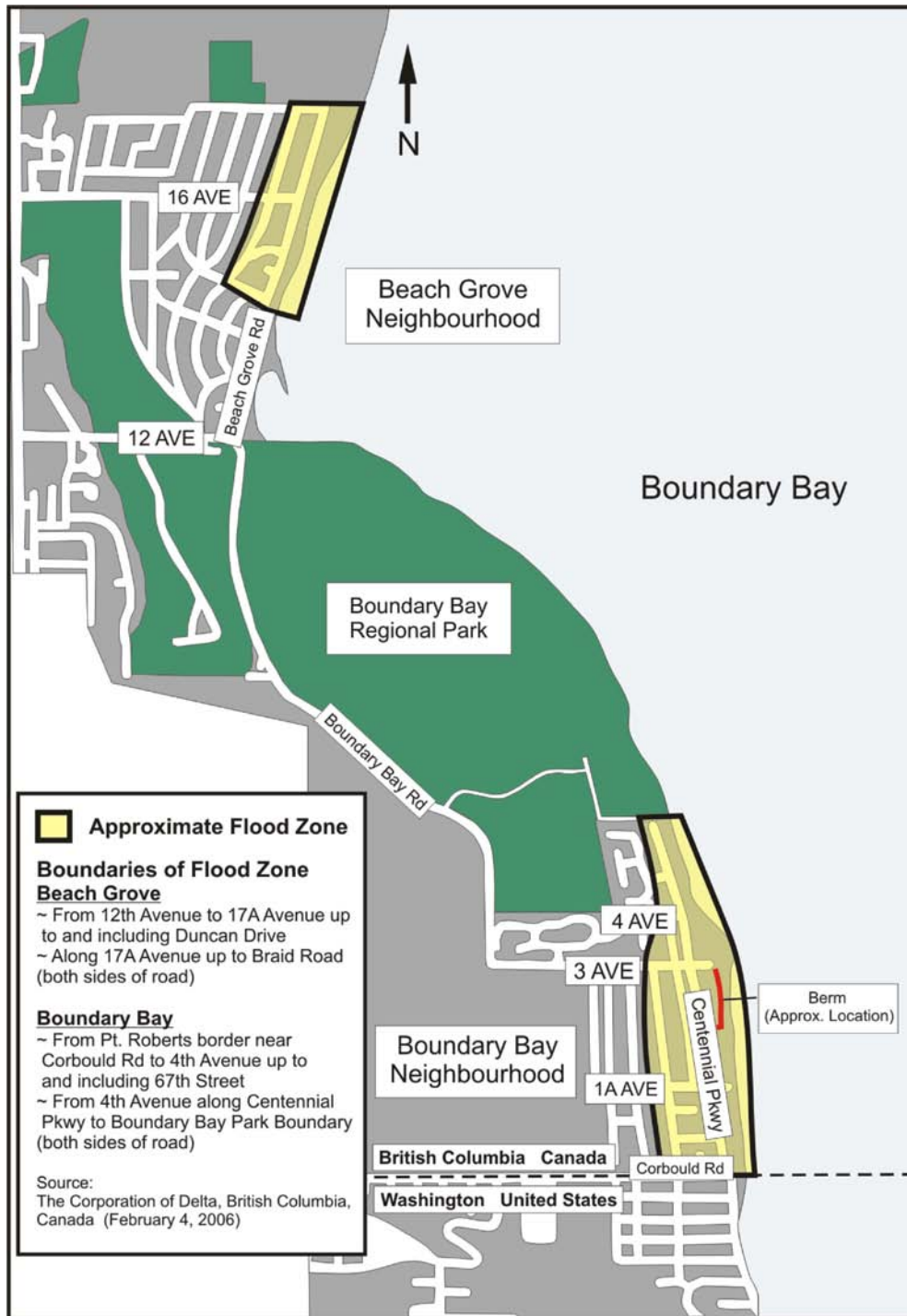


Figure 3 Areas flooded in the Beach Grove and Boundary Bay neighbourhoods (Source: The Corporation of Delta, 2007)

The winter storm that occurred on Saturday February 4, 2006 caused a storm surge that resulted in a water level higher than what had occurred in the past 20 years (The Corporation of Delta, 2007; Hansen, 2006). Strong 75 km/h winds combined with the record morning high tide produced the storm surge (Hansen, 2006). The peak water level was 5.55 metres which was nearly a metre higher than what had been predicted (The Corporation of Delta, 2007). The water was approximately 1.2 metres deep and the water surrounded residential properties, covering lawns and spilt into homes and garages (Hansen, 2006). The water also spread inland from the waterfront past homes and over the roads (in Beach Grove, Beach Grove Road and in Boundary Bay Village, Centennial Parkway) (see Figure 3) (Hansen, 2006). Approximately 150 to 200 homes were affected by the flooding (see Figure 3) (Willis, 2006). Forty-nine of those affected had substantial damages that warranted applying for Disaster Financial Assistance (Willis, 2006). It was also noted that money is only available to replace and restore essential items, not included is money to fix non-essential items such as recreational equipment or landscaping (Willis, 2006). A total of \$218,515 was paid out to residents in the area as of June 2006 (Willis, 2006).

The flood in February 2006 was not the first time that this area had experienced flooding due to winter storms. Previous flooding had occurred in 1932 (Ouston, 1983), 1983 (Ouston, 1983) and 1999 (Gulyas, 1999). The earliest flood on record affected residents in Point Roberts, Washington (Refer to

Figure 2) in 1932 (Ouston, 1983). Point Roberts is located on the southern portion of the peninsula just south of the Boundary Bay neighbourhood in Canada. Fifty years later, damage during the 1983 flood reportedly ranged from a home being knocked off its foundation to mud on the floors of other residents' homes (Ouston, 1983). The neighbourhood of Boundary Bay experienced a flood in March 1999 (Gulyas, 1999). This flood warranted the Corporation of Delta declaring a local state-of-emergency because the seawall was breached and many homes and streets were flooded (Gulyas, 1999). In all three of these events the flooding was caused by strong winds, heavy rain and high tide (Ouston, 1983; Gulyas, 1999).

In fact, in November 2006, nine months after the flood in Boundary Bay Village and Beach Grove that is the focus of this research, the Corporation of Delta issued a warning that there was a risk of another storm surge (The Corporation of Delta, 2007). According to the participants of this study government officials were in the area monitoring the situation however the storm conditions did not result in any flooding.

Floods in Coastal British Columbia

In the lower mainland of British Columbia, flooding is a major threat to the people and infrastructure. The primary source of flooding in the region is the Fraser River. The coastline of British Columbia is also at risk of flooding from a tsunami should an earthquake or underwater landslide occur (Environment

Canada, 2008). A third potential cause of flooding is storm surges, which are “an abnormal rise in water levels and can often accompany very intense winter storms, hurricanes, or high winds” (Public Safety and Emergency Preparedness Canada, 2003, p 1). Storm surge flooding is the hazard that is the focus of this thesis.

The primary characteristics that cause a storm surge to be destructive are the combination of high winds and waves (Handmer, 2007). A characteristic that may increase the damage potential of storm surge is the shape of the coastline. The physical dimensions of a bay focus tidal energy on a smaller area and the wind and water are essentially “funnelled” to the shoreline (Christopherson, 2000). Low atmospheric pressure (Handmer, 2007) caused by storms may play a significant role as lower air pressure applies less pressure on the ocean and as a result the water rises up (Keller, 2000). Storm surges are also dangerous because they can occur very quickly and without much warning (Public Safety and Emergency Preparedness Canada, 2003; Bush et al., 1999). Low-lying coastal areas are particularly vulnerable to the effects of storm surges (Public Safety and Emergency Preparedness Canada, 2003). In Canada all coastlines (Pacific, Arctic, Atlantic and the Great Lakes) are vulnerable to the storm surge hazard (Danard et al., 2003). It is difficult to assess exactly how many storm surge events occur because storm surges may also be included within data associated with Hurricane events so separate storm surge events are more difficult to track (Danard et al., 2003).

An added but less common characteristic that can worsen storm surges are tidal fluctuations (See Figure 4). At the time of the flooding in February 2006, high tide occurred at the same time as the storm surge and both factors combined to cause the flooding. Tides are daily fluctuations in sea level and they are experienced along every coastline in the world (Christopherson, 2000). Tides are caused by the gravitational pull of the Sun and the Moon (Christopherson, 2000). Tides in Boundary Bay are semidiurnal (Engels and Roberts, 2005) which means there are two high tides, known as flood tides, and two low tides, known as ebb tides (Christopherson, 2000).

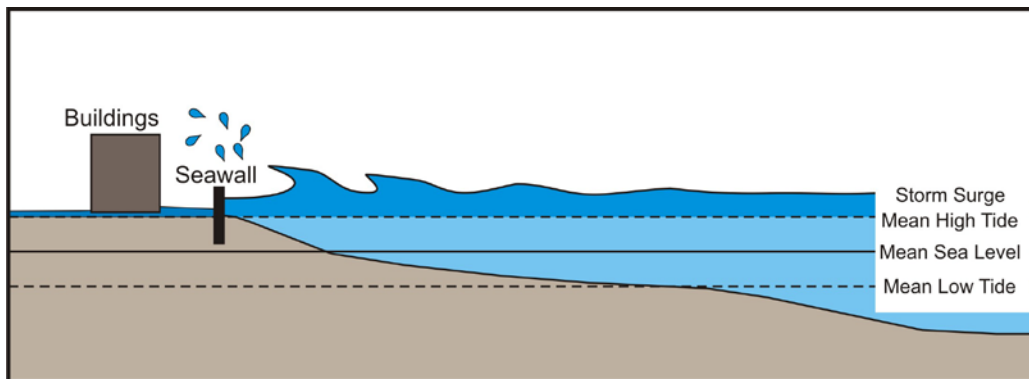


Figure 4 Diagram of a storm surge

Flood Mitigation

Flooding is a hazard that poses a significant threat to communities across the country. According to the Canadian constitution, water related issues are the jurisdiction of provincial governments (Environment Canada, 2008). However

as the effects of flooding can exceed local and provincial resources, federal government support is provided in some instances. Therefore all levels of government are stakeholders in the programs designed to mitigate the risks posed by flooding. Broadly defined, disaster mitigation refers to “all actions directed towards reducing the negative impact of a natural hazard event on human society” (Gibbs, 2007 p 80).

Mitigation measures fall into two main categories: structural and non-structural (Gibbs, 2007). Structural flood mitigation measures include seawalls, dykes, berms and sandbags (de Loe and Wojtanowski, 2001). Non-structural flood mitigation measures include tools such as floodplain mapping and zoning, to ensure that developments are not permitted in floodplain areas (de Loe and Wojtanowski, 2001), or land use restrictions, to reduce activities and development on the floodplain (Scanlon, 2007). Other non-structural mitigation measures that might be implemented are flood-proofing (de Loe and Wojtanowski, 2001), insurance, warnings (Scanlon, 2007) and education.

At all three levels of government, the primary strategies for flood mitigation have focused on physical structures. It is these physical structures that provide a barrier between land and water. Between the 1950s and the 1980s, federal and provincial governments spent millions of dollars building dams and dykes across the country to deal with flood threats (Environment Canada, 2008a). However these strategies were still not able to protect populations to an adequate standard and the costs of flood disaster assistance still rose

(Environment Canada, 2008a). This situation led to a federal initiative in the 1970s to change the government's approach to flood protection from reliance on building physical barriers to adding techniques such as floodplain mapping and zoning to reduce floodplain development (de Loe and Wojtanowski, 2001).

The Canadian Flood Damage Reduction Program (FDRP) was initiated in 1975 in response to flood events that occurred across Canada in the early 70's (Environment Canada, 2008a). The objectives of the Canadian FDRP were threefold. The first objective was to reduce the loss of life due to floods (de Loe and Wojtanowski, 2001). The second objective was to reduce the rising costs associated with disaster assistance payments to flood victims (de Loe and Wojtanowski, 2001). The third objective was to reduce the need for expensive structural flood works (de Loe and Wojtanowski, 2001). The goal of the program was to guide flood management efforts away from costly structural expenditures (i.e. dams, dykes, etc.) and focus the efforts on flood proofing existing structures and to create floodplain maps to assist in zoning regulations (de Loe and Wojtanowski, 2001). In order to achieve the goals of the FDRP, provincial/territorial governments (except Prince Edward Island and Yukon Territory) entered into agreements with the federal government and floodplain mapping was conducted to establish zones of flood risk (de Loe and Wojtanowski, 2001). A total of 265 areas were mapped and designated flood risk zones in 780 communities across Canada (de Loe and Wojtanowski, 2001). The FDRP allowed for the development of a consistent national strategy until the

program ended in 1999 (de Loe and Wojtanowski, 2001). Since then, the federal government has transitioned from specific hazard programs to an all-hazards mitigation and preparedness approach (de Loe and Wojtanowski, 2001).

The Canadian Flood Damage Reduction Program implemented initiatives within British Columbia, including the BC Floodplain Mapping Program. This program ran from 1987-1998 and was established to identify and map areas that were highly susceptible to flooding (Environment Canada, 2008a). As part of this mapping effort, a 1 in 200 year flood height was identified, and subsequently dams or dykes in BC have been built to this height (Environment Canada, 2008a). The neighbourhoods of Beach Grove and Boundary Bay Village are entirely within the 1 in 200 year floodplain (Fraser Basin Council, 2004).

Prior to the Canadian Flood Damage Reduction Program, the Canadian government and the province of British Columbia were working together to resolve some of the flood concerns within the province. In British Columbia the main areas of concern were and still are communities along the Fraser Valley and in the lower mainland (Fraser Basin Council, 2004).

On May 24, 1968 the Government of Canada and the Province of British Columbia signed an agreement to provide flood control works in the Lower Fraser Valley (British Columbia Ministry of the Environment, 2007). The agreement, known as the Fraser River Flood Control Program, was a comprehensive flood control program which included the construction and maintenance of dykes as well as river bank protection and the improvement of

internal drainage infrastructure (British Columbia Ministry of the Environment, 2007). One of the primary objectives of the Fraser River Flood Control Program was to provide flood protection for land and infrastructure behind the dyke system to the 1 in 200 year flood level that would reduce the threat and impacts of floods (Associated Engineers (BC) and Hay and Co. Consultants, 1987). Between 1968 and 1995, when the program operated, over 250 km of dykes were constructed and rehabilitated (British Columbia Ministry of the Environment, 2007). As a result of this program, the lower mainland and Fraser River Valley have been protected by a large network of dykes that cover over 300 kilometres (Fraser Basin Council, 2004).

In 1973, the Fraser River Flood Control Program initiated flood protection measures within the Corporation of Delta (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987). By 1977, construction was completed in the Beach Grove neighbourhood (see Figure 3) (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987). These construction efforts included building and upgrading existing seawalls and dykes in the area (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987). By December 1986, waterfront properties along the western shore of Boundary Bay (the water body) in the Beach Grove neighbourhood had been improved to the Fraser River Flood Control Program's 200 year flood protection level (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987). The exception, however, were properties located within the neighbourhood of

Boundary Bay Village (from 12th Avenue to the United States border – see Figure 3). In this area, the proposed seawalls or other barrier were not accepted by local residents because of concerns about how the construction of the proposed seawalls would affect the aesthetics of the beach and reduce the use and enjoyment of the beach and as a result the work in this area was postponed (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987).

However in late 1982, a winter storm caused a storm surge when the high tide and south-easterly winds combined to cause flooding in the Boundary Bay Village neighbourhood (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987). As a result, there was renewed interest in developing flood protection works along the waterfront in the area. In 1986 the Corporation of Delta commissioned a study to examine potential flood protection strategies within the Boundary Bay Village area with the objective of offering flood protection while maintaining the beach areas for public and private enjoyment and minimizing any negative environmental impacts (Associated Engineers (B.C.) and Hay and Co. Consultants Inc., 1987). According to the study conducted by Associate Engineers (B.C.) and Hay and Co. Consultants Inc. (1987) Boundary Bay Village is the last area within the Corporation of Delta that is without consistent flood protection.

Existing Flood Mitigation Measures in Tsawwassen

The Beach Grove and Boundary Bay Village neighbourhoods both experienced flooding in February 2006 as a result of a storm surge. The reason that these two neighbourhoods were selected for the focus of my study was that these two neighbourhoods are relatively close together along the shores of Boundary Bay but these areas have different mitigation measures in place. In the Beach Grove neighbourhood there is a consistent seawall that extends the length of the waterfront (refer to Figures 5-7), whereas in the neighbourhood of Boundary Bay Village there is varied mitigation, including seawalls, rock walls, unstructured mounds of sand or nothing at all.



Figure 5 Photo oriented northward along seawall in the Beach Grove neighbourhood



Figure 6 Photo oriented southward along seawall in the Beach Grove neighbourhood

Seawall - permanent

Seawalls are structures that are built parallel to the coastline (Keller, 2000). They may be made of concrete (which is the primary structural material in Boundary Bay Village and Beach Grove) as well as riprap (large stones) (Keller, 2000). As discussed previously, in Beach Grove, some of the seawalls were built by residents and in the late 1970's residents were offered funding from the federal government to build seawalls for all property owners or modify seawalls that were there already (Raphael and Bryan, 2006). In Beach Grove this was the option that was chosen by resident consensus (Raphael and Bryan, 2006). Whereas in Boundary Bay Village, the residents opted out of the programs that would help supplement the construction of seawalls for all of the

properties. The reasons for that decision appear to include that they did not want their views obstructed by flood protection and that they would rather deal with clean-up every ten years (Raphael and Bryan, 2006). These reasons were outlined in media reports and by interview participants.

Figures 7, 8 and 9 illustrate the usage of seawalls and areas where seawalls do not exist. An inventory of residential properties within Boundary Bay Village indicates that of the 66 homes on the waterfront, 17 have seawalls, seven have no seawall, and the remaining homes have a limited barrier including a fence or a natural sand berm (Raphael, 2006). The majority of the seawalls are located in the southern portion of the neighbourhood. As you move further north, the mitigation is more varied and there is inconsistency in the height of the seawalls if there is any seawall at all. Interestingly, seawalls along this stretch of waterfront have slightly different designs (Raphael, 2006). For instance some residents' seawalls had a "lip" (a feature at the top of the wall angled back towards the water), which is used to reflect the wave action back onto the water rather than onto the property (Raphael, 2006). Figure 10 illustrates some of the differences in the designs of the seawalls.

Some of the negative aspects of utilizing seawalls are that they strongly reflect waves, which increases erosion and results in a narrower beach with less sand (Keller, 2000). Interestingly, geologists typically do not support the use of seawalls because they cause environmental degradation and reduce the aesthetic value of the beach area (Keller, 2000).



Figure 7 Photo of seawalls built along the southern coastline of Boundary Bay Village



Figure 8 Photo of a rock wall in the Boundary Bay Village neighbourhood



Figure 9 Photo of homes with no seawalls in Boundary Bay Village



Figure 10 Photo highlighting variations or “lips” at the tops of the seawalls

Dykes - permanent

Dykes are the most common structural barrier used to protect low-lying coastal communities in Canada (Environment Canada, 2008). Dykes are essentially embankments. The success of dykes as mitigation is reliant on regular maintenance to ensure their stability (Environment Canada, 2008). The dyke along the coastline of Boundary Bay is located in Boundary Bay Regional Park. The photo shown in Figure 11 below was taken from the top of the dyke. The top of this dyke is a walk/bike path that extends the entire distance of the park and leads from the residential area to Centennial beach. As shown in this

photo, the dyke structure is reinforced with large concrete blocks and rocks at the base.



Figure 11 Photo taken from atop the dyke along the park.

Berm – temporary

A berm is a large earthen embankment (Environment Canada, 2008). This structural mitigation method has been used in Boundary Bay Village to protect approximately a dozen homes. The berm is constructed out of beach sand that is piled and compacted by heavy machinery. It is built every winter (and subsequently taken down every spring) to combat storm surge flooding at a cost of approximately ten thousand dollars (Raphael and Bryan, 2006). The area

that is blocked off by fencing is the trench that collects the water if it surpasses the berm.



Figure 12 Photo of the Berm (and trench) that protect homes in Boundary Bay Village



Figure 13 Photo from the top of the berm facing homes in Boundary Bay Village

Sandbags - temporary

Sandbags have often been an option for reducing the risk of floodwaters in situations where the risk is imminent. In media reports we often see people filling sandbags and shoring up existing structures or building large “walls” of sandbags to protect homes and property. In Boundary Bay Village and Beach Grove sandbags are provided by the local government.

Prior to the storm in the winter of 2006, large sandbags were placed to the south of the berm structure in Boundary Bay Village by the Municipal government to extend the protection from the berm to the shoreline and divert water in the event of a flood (Figures 3 and Figure 14).



Figure 14 Photo of large-scale sandbags that protect homes south of the berm in Boundary Bay Village

Summary

This chapter described the study area and highlighted the areas within the Beach Grove and Boundary Bay neighbourhoods that were flooded during the storm surge in February 2006. Characteristics of storm surges were discussed generally as well as historical flooding in the area. Specific characteristics of the storm surge flood on February 4, 2006 were also detailed. Also discussed were other flood risks to the coastal areas of British Columbia. This chapter also examined flood mitigation and specific flood mitigation measures along the coastline in the study region. These mitigation measures included permanent measures such as seawalls and dykes and temporary measures such as the berm and sandbags.

Chapter Three: Literature Review

This chapter describes the risk perception, coping and Canadian flood hazards literature that is relevant to this research project. Previous studies influenced the development of the research questions and the data analysis phases of this project. The final section of this chapter will highlight how this research project will add to the existing literature.

Hazards Research

Early hazards research examined the physical dimensions of hazards (Tobin and Montz, 1997). One of the first geographers to research hazards was Harlan Barrows (Cutter, 1994). Barrows was interested in the interaction between humans and the environment and approached the issues within this relationship from a human ecological perspective (Cutter, 1994). Transitioning from Barrows' perspective, one of his students, Gilbert F. White, continued on this trend of research (Cutter, 1994). White subsequently became one of the earliest and most influential hazard researchers. His works are relevant to this research project because he analysed water and water related issues including flooding and floodplain management. He specifically studied human adjustments, risk perception and the process of decision making (Kates and Burton, 1986). As a result White was one of the first researchers to delve into the human dimensions of hazards. He and subsequent researchers recognized that disasters themselves are not solely the result of a physical event, such as a

flood, but rather by the interaction of the physical event with the characteristics within the economic, social, and political systems (Sarewitz et al. 2003). This perspective began to grow in the 1960's when more researchers began to assess the human dimensions of hazards (White, 1994; Tobin and Montz, 1997).

Risk Perception

'Risk' is a broad concept that defines the exposure of humans and infrastructure to a hazard (Smith, 2001). Risk is often expressed as the probability and potential loss of a particular situation or event (Smith, 2001). Others aspects of risk also include the negative characteristics and the conditions that exist which add to the danger (Hewitt, 1997).

Risk perception is the judgement that individuals make concerning the degree of threat or risk that they are exposed to and the underlying factors that lead to that judgement (Slovic, 1987). Risk perception is a process where individuals organize stimuli in a way that allows them to define a situation (White, 1963). Cultural theorists also hold the belief that individuals are active organizers with respect to their perceptions (Wildavsky and Dake, 1990). Individuals choose what they fear and the degree that they fear it in order to cope with those risks within the context of their everyday lives (Wildavsky and Dake, 1990). Risk perception is an important concept to study in hazards research because there is a need to understand what people think about risks and how they respond to those risks (Slovic, 1987). The general premise of risk perception is

that individuals respond to hazards that they perceive (Slovic et al., 1979). The manner in which individuals respond to hazards is related to both the perception of the hazard itself and to the awareness of potential opportunities to adjust to those hazards (Burton et al., 1993). For the most part individuals are aware of the hazards that they face but the way in which they perceive and define the threat may vary between individuals (Burton et al., 1993).

Slovic et al. (1982) suggests three different reasons for studying risk perception. The first reason is to gain information and opinions regarding perceived risk (Slovic et al., 1982). The second is to determine how the public understand risk and give practitioners a sense of how to anticipate public response to risks (Slovic et al., 1982). And finally by studying risk perception it may provide insight as to how to improve communication between the public, experts and policy makers (Slovic et al., 1982). By highlighting determinants of risk perception there is potential to influence policy to reduce the negative consequences of those risks. In this study, gaining an understanding of how individuals perceive a flood threat may begin to provide insight into the willingness of the residents to take actions that will reduce their vulnerability. For example, if they perceive a high risk they may be willing to take action or if they perceive a low risk they may be unwilling to take action to protect themselves and their property.

Risk perception has been studied in a variety of ways. Fischhoff et al. (1978) examined how individuals perceive risk, and factors influencing risk

perceptions. Factors that influence risk perceptions include: *voluntariness of risk*; *the immediacy of effect*; *knowledge about risk* (of both the people who would be exposed as well as scientific experts); *ability to control risk*; the *newness* of the risk (new and novel or old and familiar); whether the consequences are *chronic* vs. *catastrophic*; a risk that is *common* and people have learned to function normally in spite of it, versus one where the risk elicits feelings of emotional *dread*; and the *severity of the consequences* (Fischhoff et al., 1978). They found that risk was more acceptable if that risk was perceived to be voluntary, immediate, known precisely, controllable and familiar (Fischhoff et al., 1978).

Slovic et al. (1979) found that when individuals are asked to make an assessment of how they perceive risk it is often the case that their thoughts and opinions are not derived from statistical references (Slovic et al., 1979). Rather individuals form and articulate their opinions via what they have previously experienced, or remembering observations and comments about the risk (Slovic, et al., 1979). The rules by which people make judgements in this manner are formally called heuristics (Slovic et al., 1979). Heuristics allow people to understand complex circumstances, but they limit what information people take in, which may provide a false sense of security (Slovic et al., 1979). Overconfidence may also be another limiting factor of heuristics as people may feel very confident in the base of their knowledge but the reality is that people do not often know how little they actually know (Slovic et al., 1979).

One research model that has been used in the study of risk perception is Lazarus and Folkman's (1984) cognitive appraisal model (Figure 15). For this project, and based on how the term appraisal is used in the literature, the term appraisal and risk perception will be used synonymously.

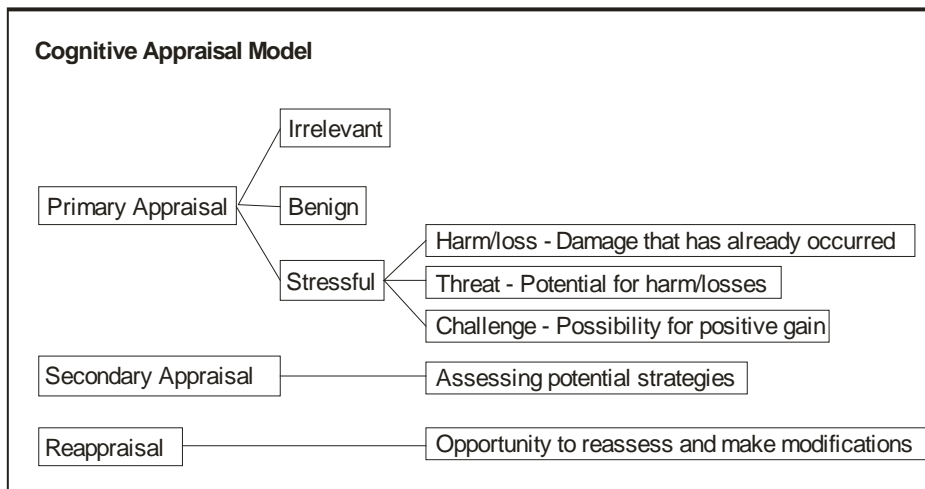


Figure 15 Cognitive Appraisal Model (Adapted from Lazarus and Folkman, 1984).

The cognitive appraisal model (Figure 15) incorporates three stages that an individual goes through: primary appraisal, secondary appraisal, and reappraisal (Lazarus and Folkman, 1984). The first stage is primary appraisal, which consists of the assessment that an event is either irrelevant, benign or stressful (Lazarus and Folkman, 1984). A stressful appraisal is further divided into a harm or loss that has already occurred, the potential threat of harm or loss occurring, or a challenge that may lead to some type of positive gain from the experience (Lazarus and Folkman, 1984).

The second stage is secondary appraisal where an individual assesses the different strategies that could be used to minimize the negative effects of an event (Lazarus and Folkman, 1984). In the context of this research the strategies an individual might use to reduce or eliminate the risks posed by a flood could be deciding between building a concrete fence to stop water, collaborating with neighbours to build a large rock wall, or potentially doing nothing and applying for disaster assistance from the government after the flood.

The third stage of this model is reappraisal. Reappraisal refers to the re-evaluation of the risk as the context and available coping strategies change (Lazarus and Folkman, 1984). Again in the context of this research it could mean that residents initially appraise the flood risk as being uncontrollable, but reappraise it as controllable once they discover that they can afford to put up a rock wall if they work together with their neighbours. The cognitive appraisal model points out that risk perception is an evolving process where an individual's perception of risk can change through time.

Coping

Coping can be defined as “*the efforts we take to manage situations which we have appraised as being potentially harmful or stressful.*” (Kleinke, 2007 p. 290). For the purposes of this research, coping refers to how an individual deals with an actual or potential hazard, in this case a flood. The concept of coping has played an important role in many facets of research. Several studies in

health research have examined coping. For instance, Moos (2006) examined the general health and well-being of individuals and how adversity and social resources influence how individuals cope (Moos, 2006). Specifically how financial resources, positive supportive relationships with spouse(s) and friends as well as supportive relationships between the individual and their co-workers, children and other family members plays an important role in the self-confidence of an individual. In the context in the occurrence of an environmental hazard such as a flood, these relationships may also play a vital role in how an individual responds. If these relationships are positive and strong it may facilitate a positive coping response where the individual is able to respond in a manner that successfully protects their lives, the lives of family and friends, and their homes and property.

The ways in which people respond to floods include a variety of coping mechanisms (Few, 2003). Coping, like risk perception, is not limited to only occurring at a specific time in the context of a hazardous event. In the best case scenario, coping can occur when a risk is first perceived and an individual takes some sort of protective action.

According to Burton, Kates and White (1993), coping with natural hazards involves either adaptation or adjustment. Adjustments include actions that are purposefully adopted to reduce losses (purposeful) or actions that are executed with the indirect benefit of also reducing the losses (incidental) (Burton, et al., 1993). Within the context of this research, adjustments refer to

the structural mitigation efforts along the coastline. Purposeful adjustments include the seawalls and rock walls and incidental adjustments include landscaping and fencing that has been done for aesthetic reasons but also prevents flood damage. In flood research purposeful adjustments are often the most examined in terms of mitigation activities (Laska, 1990). Adaptation is categorized as biological or cultural however only cultural adaptation is relevant to this research (Burton, et al., 1993). Cultural adaptations are changes made through time by the social groups experiencing the environmental stressors (Burton, et al., 1993; Laska, 1990). An example of cultural adaptation in relation to flooding would be changing land use plans where areas considered part of the flood zone would be re-zoned as recreational areas. This however is not a feasible option within the study region because there is already significant development.

Lazarus and Folkman's (1984) coping model is also relevant to my study. Lazarus and Folkman (1984) divide coping into emotion-focused and problem-focused coping. Emotion-focused coping occurs when an individual feels that nothing can be done to change their situation (Lazarus and Folkman, 1984). Emotion-focused coping techniques include deception, minimization and avoidance (Lazarus and Folkman, 1984). For residents in the study area they may minimize the risk and as a result do nothing to prepare or mitigate for the consequence of a flood. Problem-focused coping techniques include defining the problem, developing solutions, weighting the pros and cons of the solution,

and acting on a potential solution (Lazarus and Folkman, 1984). For the residents of Boundary Bay Village and Beach Grove, this could involve identifying potential methods of minimizing or eliminating the risks posed by flooding, and implementing activities such as building a sea wall.

In a later paper, Lazarus (1993) asserts that neither emotion-focused coping nor problem-focused coping are more effective or useful than the other. However in western cultures problem-focused coping methods are thought to be the more effective approach (Lazarus, 1993). When individuals employ problem-focused methods of coping they are creating a situation that encourages resilience (Paton and Johnston, 2001). People who employ emotion-focused strategies may create a situation where they increase their vulnerability (Paton and Johnston, 2001). The reason is that emotion-focused coping has the potential to illicit actions that may be counter-productive or ill conceived and result in more harm (Lazarus, 1993).

The way in which people respond to flooding is related to the coping strategy they chose to employ (Few, 2003). This relates to the different phases of the flood threat, which ranges from the time an individual is first made aware of the risk, to the recovery after a flood (Few, 2003). In the context of coping as a process during a flood, an individual may cope with a flood in a variety of different ways. An individual may evacuate from the area to protect their life or someone might choose to build structure of sandbags to prevent damage to property. If flooding begins to occur, an individual may change their mind if

they believe their actions are not having the desired affect and subsequently choose to evacuate, so the strategy changes as the individual receives feedback on the effectiveness of their applied strategies (Lazarus, 1993).

Risk Perception and Coping with Flooding

Grothmann and Reusswig (2006) developed a socio-psychological model of precautionary adaptation to flooding, based on a study in Germany. This model identifies two different perceptual processes which are highlighted in Figure 16. 'Threat appraisal', the first process, is divided into three parts: Perceived probability, perceived severity, and fear (Grothmann and Reusswig, 2006). The second process is 'coping appraisal', which consists of the individual evaluating their ability to cope or avoid the threat (Grothmann and Reusswig, 2006). Coping appraisal is divided into three subcomponents: protective response efficacy, perceived self-efficacy, and protective response costs, which reflect an individual's capacity to achieve the results they want (Grothmann and Reusswig, 2006). Protective response efficacy is defined as the belief that proposed risk-mitigation behaviour is perceived to be effective at reducing risk (Grothmann and Reusswig, 2006 and Martin et al., 2007). Perceived self-efficacy is defined as the belief in one's capability to perform a mitigation activity (Grothmann and Reusswig, 2006; Martin et al., 2007; Bandura, 1995).

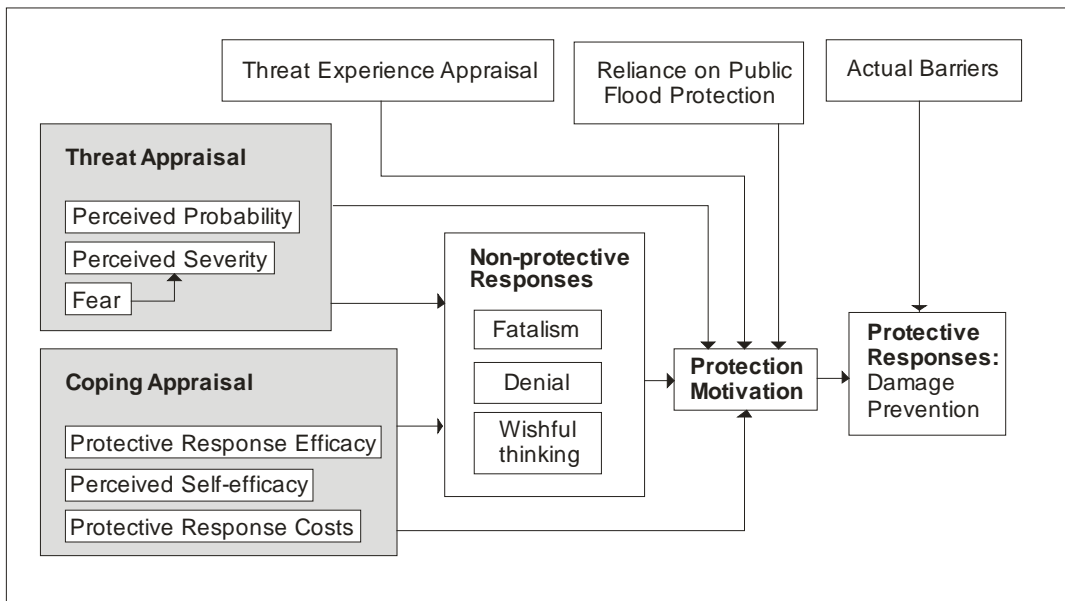


Figure 16 Socio-psychological Model of Precautionary Adaptation (From Grothmann and Reusswig, 2006).

This model by Grothmann and Reusswig (2006) is useful in addition to Lazarus and Folkman's (1984) models because, although some components of these models are the same, the Grothmann and Reusswig model also included components specific to floods. For example in Grothmann and Reusswig's model, the non-protective responses of fatalism, denial, and wishful thinking parallel Lazarus and Folkman's description of emotion-focused coping. However in the Grothmann and Reusswigs' model, they have included components specific to individual's reliance on public flood protection as well as the barriers that may impede an individual from acting on their own behalf.

Flood Research in Canada

Flooding is one of the most studied hazards as many areas of the world are threatened by floods. In Canada much of the research relating to coastal floods, such as storm surges, focuses on the physical characteristics of the hazard (Dolan and Walker, 2004; Danard et al., 2003; Khandekar and Swail, 1995; Shaw et al., 1998; Chiotti, 1998; Murty et al. 1995) as opposed to the social aspects of how people interact with the hazard. Haque (2000) identified that further research should be conducted that examines variations in the perception of and response to flood hazards. The study described in this thesis aimed to identify how residents in a coastal community perceived and coped with storm surge flood risk, which as far as I am aware is something that has not been examined in Canada.

Flood hazard research in Canada has focused primarily on major disaster events such as the Red River Flood (Manitoba) in 1997 and the Saguenay River flood (Quebec) in 1996 in part because they have been two of the costliest flood disasters in Canada (Shrubsole, 2000). Shrubsole (2000) examined the trend of flood management in Canada. The research highlighted that Canadian flood management has had a dynamic history (Shrubsole, 2000). In 1975 Canada was viewed as a very progressive nation with the development of the Flood Damage Reduction Program and at that time Environment Canada (the lead agency) helped other nations develop their flood management programs (Shrubsole, 2000). Since then the federal government has since abandoned the initiative and

there has been no policy or program to replace it since. The concern however is that in Canada the trend of flood damage and other weather-related hazards are increasing (Shrubsole, 2000).

Haque (2000) studied the Red River Flood and examined how residents perceived, responded to, and managed the consequences of the riverine flooding. Perception of flooding in this instance was influenced by experience and common sense (Haque, 2000). It was also identified that government policy and emergency management benefits from public participation (Haque, 2000). Mitigation and preparedness activities regarding floods have also been found to be influenced by experience (Haque, 2000). Experience has been shown to help people to anticipate and therefore prepare for disasters (Haque, 2000).

Summary

This chapter presents a review of the literature that frames this research, including early research on environmental hazards and floodplain management, more recent risk perception and coping research, and Canadian flood research. Although there has been considerable research conducted on these topics, White emphasized the benefit of conducting research focusing on specific geographic localities (White, 1945). By focusing on specific areas, local problems can be more fully defined and incidentally more specific, comprehensive solutions can be identified (White, 1945). This study aims to identify the specific factors that influenced how residents perceived and coped with storm surge flooding in

Tsawwassen, BC. The results of this study will also help to identify ways to enhance positive coping strategies for residents and the community as a whole.

Chapter Four: Methodology

This Chapter will discuss the qualitative approach that was utilized in this project. The research design, methods, and limitations will be described. Due to the nature of this research project, the role of the researcher will also be discussed.

Research Design

Qualitative research methods were used for this study because the aim of the project was to gain an understanding of how residents perceived the flood risk and how they coped with the flood in 2006. Qualitative methods are used to gain an in-depth understanding of people's subjective experiences (Limb and Dwyer, 2001; Richards and Morse, 2007). The primary method of data collection was interviews. By conducting interviews, I was able to obtain an in-depth examination of the experiences, feelings and opinions of residents living in the flooded area (Kitchin and Tate, 2000; Miles and Huberman, 1994; Winchester, 2005).

A case study approach was used for this project. Yin (1994) outlines two critical features of case study research. The first feature is meant to define the scope of the research where the researcher "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident." Yin (1994, p 13). For the purposes of this research project it was important to gain an understanding of the

real life context that affected how residents perceived and responded to the flooding. The second feature that defines this project as a case study is the methods by which the information was obtained and managed (Yin, 1994). For this research project, data collection was mainly through in-person interviews. However, I also reviewed local media reports, government documents and historical information. By examining these documents I was able to gain an understanding of development along the waterfront area of Boundary Bay as well as information on the number and extent of previous floods that affected the study area. The design of this project is also reflective of case study research as the aim was to examine how two theoretical concepts (risk perception and coping) related to individuals in a real situation.

Naturalistic paradigm

This research project is based in the naturalistic paradigm. In naturalistic inquiry, context is a very important quality (Erlandson *et al.* 1993). In my project the aim was to gain an understanding of what happened during the flood in 2006, how the events unfolded, how people felt and behaved before, during and after the event, and how the context influenced their feelings and actions. Highlighting the context may explain what happened and it may provide insight into what factors will influence future actions (Erlandson *et al.* 1993). Another characteristic of naturalistic inquiry is the concept of multi-realities which takes into account how different individuals may deal with the same situation, in this

case a flood, but their experience with the situation may be articulated differently from person to person (Erlandson *et al.* 1993). Naturalistic inquiry also recognizes that the researcher and participants influence each other (Erlandson *et al.* 1993). Later in this chapter I discuss this influence.

Background Research

The first stage of the research involved a background review of secondary data relating to the Municipality of Delta and coastal flooding caused by storm surges. The secondary data collected included media reports (local and national sources), town records and government documents. These documents were found at the local library, the local museum and online. This provided a context for the project and helped with the development of questions and probes to be asked during the interviews. The data used from these sources described the history of flooding in the area, detailed the events and characteristics of the storm and highlighted the history of mitigation in the area. This stage of the project also consisted of completing a preliminary literature review on risk perception and coping strategies employed by individuals facing hazards.

An initial community visit was conducted in March 2007 in order to familiarize myself with the area and see the mitigation measures that were in place, and to decide whether this community and event would be the focus of my research. The measures that the Municipality had in place for the winter storm season included a large berm that had been constructed in front of homes that

lacked seawalls, and a large deposit of sandbags that added protection to homes along the waterfront.

Ethics Approval

Following the initial visit, ethics approval was obtained from the University of Alberta's Faculties of Arts, Science & Law Research Ethics Board. Participants that were recruited for the project were given an information letter and a letter of consent prior to the interview (see Appendix A and B). Within the information letter I introduced myself and provided my contact information as well as my supervisors' contact information and outlined the objectives of the project. I also explained the time commitment for participation (approximately 1 hour), that the interviews would be conducted in person and that they would be tape recorded. The letter also confirmed that participation was voluntary and that the information that was gathered would remain confidential throughout the research process and beyond.

In order to keep participants identities confidential each participant and transcript were given corresponding numbers and the key that identified this information was kept in a secure location separate from the data. The only other individual to examine any of the transcripts was my supervisor in order to assist in data analysis. These transcripts did not contain identifying information so I remain the only individual who knows the identity of the participants. In the results section of this thesis, quotes have been used to present findings but the

term 'participant' has been used to protect the identity of participants.

Participants were also informed that they could provide as much or as little information as they wanted and if they felt uncomfortable with their responses or participation in the study they were free to make modifications to their statements or withdraw from the project before the data was analyzed. This information was highlighted again on the consent form that participants were asked to read and sign to indicate that they understood their role and rights within the research study.

Sampling and Recruitment

The overall sampling technique utilized in this project was purposeful sampling. In order to recruit participants within the timeframe that I was in the community a combination of strategies were used: Criterion, opportunistic, convenience and snowball sampling (Bradshaw and Stratford, 2005). Criterion sampling was utilized by selecting participants based on the fact that they lived in or close to the flooded area. Opportunistic sampling was also used. The initial focus of the project was on the experiences of residents within Boundary Bay Village however after interviewing a few residents it was evident that the flood had also affected the Beach Grove neighbourhood. In order to increase the chance of recruiting more participants the project was expanded to include individuals in both neighbourhoods. In total seven participants were recruited

from the Boundary Bay neighbourhood and 16 participants from the Beach Grove neighbourhood.

Convenience sampling was also used. In order to maximize the opportunity to collect data, a few participants were recruited as I walked up and down the streets canvassing the neighbourhood and initiating conversations with residents who happened to be outside. Others were recruited by hand delivering letters of introduction to residents living within the area affected by flooding and asking them to contact me if they would like to participate in an interview. The final technique was snowball sampling, also known as chain sampling (Bradshaw and Stratford, 2005; Robson, 1996). In instances where I had recruited a participant (using one of the previously mentioned techniques) I would ask the participant at the end of the interview if they knew of other individuals who might be interested in participating. In some instances I was given names and telephone numbers and in other instances the participant would place a call on my behalf.

Data Collection - Interviews

Data was collected by conducting semi-structured in-person interviews with residents. The interviews were tape recorded. Semi-structured interviews were selected because this allowed for one-on-one interaction, where the interviewer is guided by a set of questions but this allows for variation in the format and order of questions (Kirby *et al.*, 2006; Dunn, 2005). This style of

interview allows interview participants to identify what issues are important to them and potentially uncover issues that were not previously identified in the literature, rather than the researcher assuming what issues are of importance (Kirby *et al.*, 2006; Dunn, 2005). Overall, the semi-structured interview method was chosen to gather an in-depth description of residents' experiences (Dunn, 2005), flood risk perceptions and coping actions. By combining recruitment techniques a total of twenty-three participants were recruited for this study over a three week period in June of 2007.

The interviews ranged in length from 20 minutes to 3 hours. The interviews were conducted one-on-one or with the participants' spouse and/or children also in attendance. This was a result of the interviews taking place in the residents' homes as that was consistently the most convenient venue for participants. As a result of the interviews taking place at the homes of the participants there were two distinct benefits. The first benefit was that the participants were in a comfortable and secure environment which helped facilitate the level of rapport with me. The second benefit is that in some instances the participants gave me a tour of their homes and property (Aitken, 2001) to show me where the damage had been and the types of mitigation that they had in place or had modified.

Prior to the start of the interview, I introduced myself and discussed the project as well as answered any questions the participant(s) had. Then I either formally read the information sheet (Appendix A) and consent form (Appendix

B) or gave the participants a few minutes to read the forms over and once their signature had been obtained the interview began.

In order to give the interviews some degree of structure an interview guide was used (Appendix C). The interview guide consisted of questions and topics that I wanted to cover during the interviews; these were identified during a preliminary literature review. Modifications were made to the interview guide during the research process.

The interview began with participants explaining what happened on the morning of the flood. The subsequent questions focused on elaborating their experiences, the extent of the impacts, how they perceive the flood risk, and how they responded. Specific questions included whether they were directly or indirectly affected, if their property or homes suffered any damage, and the strategies that they used in order to reduce the impacts as the flood was occurring. Participants also discussed the community and their personal lives. At the end of the interview I asked participants if they knew of anyone else who may be interested in participating in this project in order to recruit more participants.

Upon completion of the interviews, they were transcribed verbatim. The residents were informed that if they would like a copy of their transcript one would be sent to them and one participant took advantage of the offer. This was done to ensure that the participants had the opportunity to review and edit any statements they made during their interview.

As a supplement to the interview data collected I also kept a field journal which included notations that I made during the interviews and observations about my experiences during my time in the field.

Data Analysis

Initial data analysis occurred during data collection. After conducting interviews, I reviewed the data collected and started to analyze the results. Modifications were regularly made to the interview questions and probes throughout the data collection process as a result of this initial data analysis. The majority of the data analysis was completed after the field work and once the interviews had been transcribed. The first step in data analysis at this phase was to read through the transcripts and code the data by highlighting important concepts and ideas that were located in the data (Cope, 2005; Jackson, 2001). Coding enabled me to reduce, organize and analyze the data (Cope, 2005). Descriptive and analytic codes were used. Descriptive codes highlight themes or patterns that are explicitly stated by the participant (Cope, 2005). Analytic codes highlight concepts that the researcher is aware of but also reflects the context of the statements and/or behaviours that explain those underlying concepts (Cope, 2005). The coding process is also a reflexive process because new concepts emerge from that data as analysis progresses (Cope, 2005).

In the case of my project I chose to code my transcripts manually. In order to assist in the management of my codes I created a codebook which was

essentially a listing of all of the codes that were identified from the transcripts (Cope, 2005; Miles and Huberman, 1994). At this stage my supervisor also had the opportunity to independently code selected transcripts and the results paralleled the codes that I had identified so it was an exercise which subsequently enhanced the reliability of the data (Cope, 2005 p 231). After examining the interviews several times I began to group the codes together to organize themes which formed the basis of the results presented later in this thesis.

Reflexivity

Reflexivity is defined as “the term often used for writing self into the text” (Mansvelt and Berg, 2005 p 248). In order to enhance the credibility of my research project I believe it is important to critically discuss my role in the research and how my perspectives influenced the project from start to finish (Mansvelt and Berg, 2005, p 257; Koybayashi, 2001). The principle behind elaborating on this concept is that it will acknowledge my motivations and the circumstances that lead to the generation of the data and how the data was analysed (Mansvelt and Berg, 2005 p 260; Jackson, 2001; Butler, 2001; Koybayashi, 2001).

Some of the choices that I made in this research project were a reflection of my previous academic and personal experiences. These experiences ultimately influenced the type of knowledge that was produced (Kirby et al.

2006). One example of my influence in the project is reflected in one of the general aims of the project. Based on my previous experiences in dealing with the effects of a flood in south-western Manitoba, I was interested in completing research that examined how individuals cope with disasters. The specific event in my past was a flash flood that occurred when a severe storm resulted in heavy rains that inundated small communities and farmland in south western Manitoba. After this flood, I assisted a local non-governmental organization to assess the damage and help determine where recovery resources needed to be allocated. Once that determination was made then I was responsible for distributing those resources and support. This included distributing financial vouchers to be used at local businesses to purchase necessities such as food, clothing and hygiene supplies. It also involved distributing cleaning supplies and instructing individuals on how to safely clean their homes. This experience furthered my desire to work with people on a one-on-one basis and help them express their feelings associated with a hazard event.

A second example of how I affected my research but on a different level is reflected in the fact that I am a young university student. I felt that during the interviews the participants took on the role of teacher where I was the student and they were trying to teach me about what had happened. I also felt that during the research process it was easier for me to recruit individuals as many of my participants were professionals who had university degrees or had children who had completed a university education and I felt that they empathized with

the fact that I was working on a graduate degree and needed people to participate in my project.

Limitations

I believe that as much as one can try to minimize the limitations of any research project they undertake, some limitations will inevitably still exist. One of the limitations of this study may be the trustworthiness of the data. Part of the research project aimed to identify what mitigation measures local residents had completed at the time of the flooding. However, participants may have felt uncomfortable with the mitigation actions that they had completed, therefore may have been reluctant to discuss this with me. The participants may also have been cautious because they may have been concerned that the results of my study would encourage government officials to take action that would result in extra costs or stress to the residents or affect their views. For example, local government officials may decide to make some flood mitigation measures mandatory for residents. This concern may have resulted in participants minimizing their concerns about flooding and emphasizing their ability to cope well with the flood.

A second limitation of this study may be issues with the sample. Snowball sampling may lead to participants being recruited that are typically more similar (Robson, 1996). My strategy to compensate for that was to try to use different methods of recruitment during the time that I was out in the field.

Another limitation of my project may be the fact that in some instances I interviewed couples. The difficulty in those situations was that on occasion throughout the interview when one individual would make a comment their partner would “correct” or modify the statement or thought. This made it harder to distinguish how each individual perceived and dealt with the flood because the ideas would become those of a “couple” rather than two individuals so their opinions were reinforced by participating together (Aitken, 2001).

Summary

This chapter presented an overview of the methodological approach used to analyze the risk perception and coping strategies of participants who reside within Beach Grove and Boundary Bay Village of Tsawwassen, British Columbia that experienced a flood event in 2006. This study utilized qualitative research techniques. Details of the research design, sampling methods, recruitment techniques were outlined as well as reflections and limitations of this study. The following chapters will analyze and discuss the results of this study.

Chapter Five: How Participants Perceived and Coped with the Flood Threat

How Participants Perceived and Coped with the Threat Prior to the Flood

As outlined earlier, the Boundary Bay Village and Beach Grove neighbourhoods have different types of structural flood mitigation in place before the flood in 2006. The mitigation approaches that have been implemented seem to reflect how the neighbourhoods have changed over time. In both Beach Grove and Boundary Bay Village, many homes are now permanent residences, whereas in the past there were mainly cottages. As people have made permanent homes in the area many of the houses have undergone extensive remodelling and are now expensive modern homes. In response to the upgrades done on homes in the area participants seemed interested in mitigation activities that might prevent damage to their homes. Most residents have focused on structural mitigation measures. As mentioned earlier, during the 1970's, the government constructed a seawall in Beach Grove, but public outcry meant that a seawall was not constructed in Boundary Bay Village.

These choices may reflect differences in risk perception at the neighbourhood level. In the Beach Grove neighbourhood interview participants described that residents of Beach Grove perceived that storm surges and the potential for flooding were enough of a concern to motivate them to take advantage of the government's offer to build structures (seawalls) or modify

existing structures to protect their properties. However, within the Boundary Bay Village neighbourhood the majority of residents did not perceive the threat of storm surges as enough of a problem to warrant mitigation activities (Raphael and Bryan, 2006) and the participants reiterated that point. The exception however were that some interview participants, as well as other residents, have since built seawalls or rock walls on their own. Some participants had made modifications to their seawalls in efforts to make their seawalls more effective at stopping the water and debris.

How Participants Perceived the Flood Risk and Their Coping Strategies during the February 2006 Flood

On Saturday February 4, 2006 the neighbourhoods of Boundary Bay Village and Beach Grove in Tsawwassen, British Columbia experienced storm surge flooding. This section describes how interview participants perceived and coped with the situation that morning.

The ways in which participants perceived the storm and subsequent flooding varied on the morning they occurred. When interview participants were asked if they were aware that there was the potential for flooding on that particular Saturday morning, a few of the participants mentioned that they had heard news reports the previous evening (via evening newscasts) warning of storm conditions throughout the night and into the early morning. However many did not think that this storm would result in any significant flooding. As a result, none of the interview participants took any action to protect their property

the evening prior to the flood even if they had heard the storm warning. In the morning as the storm was occurring, many participants listened to their local radio newscasts to get more information about the severity of the storm.

It is also important to mention that the level of awareness also varied between participants who live along the waterfront and those who live further inland. Some of the participants, especially those who live right along the waterfront, did mention that through the night they heard the strong winds but again they simply went to bed as strong winds and rain are expected with storms that occur in the region. Those who live along the waterfront were all aware of the wind and some reported that they could feel their homes vibrate with the impact of the waves on the seawalls. However those who live along the waterfront were generally unaware of the intensity of the storm and subsequently the flood threat.

One participant who lived a few streets inland mentioned that a family member not been coming home early in the morning had seen the spray of the waves from a distance and warned them. Once people became aware of the storm some identified it as a problem whereas others dismissed it, even after the flooding. The majority of the participants spoke of this storm as if it were a “*one in a million*” event. The storm surge was caused by the high winds speeds travelling from a south easterly direction. High wind contributes to the height of the waves on the ocean’s surface and the homes that were affected the most by this storm were the ones that are directly exposed to south-easterly winds. The

other homes along this stretch of the beach are somewhat protected by the physical shape of the Bay. The flooding occurred because the high tide occurred at the same time as the storm. Residents described the combination of wind and tidal factors as a “*fluke*” and a “*perfect scenario*” that had never happened before, despite previous flood events.

The primary characteristics of this storm that caused the surge and flooding were: Low atmospheric pressure, high wind speeds, wind direction, and high tide. It is important that during the actual flooding there was no rain but there had been rain during the night just prior to the flood (Hansen, 2006). The storm and high tide reached a water level of 5.55 metres in height (Spencer, 2007; The Corporation of Delta, 2007). The maximum water height was slightly lower than the historic high from twenty years ago (The Corporation of Delta, 2007). For one participant, initially the storm was, “*Oh it was neat. No it was. I say neat but for the damage that’s not a very good word but I think most people were probably excited*”.

In fact many people in the area who took photos. However the novelty of the storm quickly wore off once the flooding started. At this stage some residents became concerned. In retrospect participants viewed the flood as a result of a combination of rare events. One participant said,

“It’s all really wind directed, you know really wind related and the direction of the wind and it happened to be a fluky high tide so the stars were all aligned and nailed us a little bit.”

Some participants viewed the risk as low. As one participant stated, *“I didn’t think it looked like anything too serious you know, so I went back to bed and I didn’t think anymore of it [the storm].”* Similarly, another participant said, *“I tend not to call it flooding. It’s just a storm.”* The participants who minimized the problem did not take any actions to prepare themselves or their property before the flooding occurred. Once some participants identified the storm surge in the morning, they became concerned. In the words of one participant,

“...It was like, it was like stressful and so I started going ‘Oh no’ because I didn’t know how high it was coming, (going) to come, so I started building that barricade.”

Another participant was unaware of the risk and stated that, *“it [the storm surge] was totally unexpected and the speed of it too.”*

Some participants did not perceive there to be a flood risk until the flooding had started. On the morning of the flood, many of the participants who lived right along the waterfront reported waking up to the sound of strong winds and surf. As the water level continued to rise, the wave spray became more severe. One of the participants stated that not only was the rising water level a problem but the seawall created an issue as well, as one participant stated,

“there’s a wall all the way along here and the problem [that] develops is when one wave hits the wall and then goes back and hits the second wave and then they sort of produce a little turret or puff of water [that] comes flying up and then the wind takes it along over the wall and it’s just like a fire hose in a way.”

The water going over the seawalls created pools of water in participants' yards. The wave spray was reportedly higher than the two story homes on the waterfront. Another participant who lived a few streets off the waterfront became aware of the storm surge when they looked out their window and saw the wave spray over the waterfront homes. The flood water also splashed plant matter from the ocean onto homes. For some participants, it was only at this point when people realized that the risk of flooding was high. At high tide, water had begun to flood the waterfront homes and low-lying areas close to the waterfront. Figure 3 highlights the flood zone. This shows that at different stages during the storm event some of the participants appraised the situation as problematic.

Those participants who viewed the storm and flooding as a problem coped in many ways. Some participants felt that there was nothing that could be done to change the fact that the water would flood their properties no matter what action they took. This coping strategy is known as emotion-focused coping. Participants who used emotion-focused coping viewed the risk as benign or irrelevant. There were also those who ignored the flood threat. One participant said:

“I looked out in the morning and it looked pretty vicious out there and I thought hey if this doesn't change it is going to be kind of interesting and then went back to bed you see and then I got up and the water was right up there.”

This individual did not initially perceive a problem and did not deal with the problem any further. Another resident minimized the potential threat by referring to the flood event simply as a storm. They also did not do anything to reduce the risk. While another participant could see that the water level was rising and that there was a lot of debris coming towards the shore, but took no action. They stated:

“We saw it coming. We were standing upstairs where we have a fabulous view...and the waves got higher and closer and closer and probably the scariest thing was [the deadwood]...so when these huge logs came running, coming towards us that is when the fear of god came into us and there was absolutely nothing that we could do.”

This participant coped with the problem in an emotion-focused way as a result they did not take action because they felt as if there was nothing that could be done to reduce the floods impacts so they were simply waiting for the impacts of the storm to occur. Another one of the participants described the flooding as an “*Act of God*”. The action that they took was to leave their home while the flooding occurred.

It is also important to note that during the flood the power was off and as a result the pumps and drainage system under the streets were unable to handle the excess water and the water was not able to drain as the system was designed. When participants were describing the flooding and the characteristics that caused the flooding a few participants commented that they suspected the municipality was responsible for the power shut down. As a result, some of the flood damage was caused by drains backing up. Flooding that was caused by

drain back up was eligible for coverage via insurance and some residents were able to make successful insurance claims. Because the Corporation of Delta may have played a role in making the flood situation worse a few residents initiated legal action against the Corporation of Delta in an effort to receive compensation for their losses. These actions were still pending at the time of this study.

Those participants who identified the storm surge and flooding as a problem tended to use problem-focused coping. Once they identified the problem they took actions that might help protect their property in the event that flooding accompanied the storm. Most participants had an emergency preparedness kit that included first aid supplies, extra water, battery operated radios, etc. Interestingly in most cases this kit was collected in order to prepare for an earthquake instead of a flood. In the words of one participant:

“...we always keep a ready supply of candles and things like that because they say you pretty much have to figure you’re going to need to be self-sufficient for 72 hours.”

When the flooding started, some participants called emergency services since they recognized that they would require more support and assistance. The immediate concerns of the emergency services personnel was to warn people of the rising water levels and advise residents to evacuate to higher ground, and to also warn residents of the other threats posed by electrical problems and gas leaks. Firefighters reportedly went door to door to shut off utilities (gas and electric) to the homes to protect people from being hurt or killed. The Mayor

also reportedly went to the area and used a mega-phone to communicate information about what was going on to the residents. At that point, some participants heeded the advice of the emergency services personnel and moving to elevated areas, however most stayed within the neighbourhood.

The participants who stayed on their property during the flooding tried to minimize damage by removing debris and logs from their property as the water was rushing past their house. This was done to lessen the chance that the debris would act as a dam along the sides of their house and cause the water to rise on their property. Some participants found this to be quite a successful technique because as soon as they stopped removing debris, the water levels rose quickly. Others obtained sand and sandbags to create small scale diversions around their house to protect openings to crawlspaces and doorways. It is important to mention that as there was little to no flood warning for many participants, some participants reported having difficulty obtaining the sand and sandbags. The reason for the difficulties, as explained by the residents, was reportedly that the storm occurred on a Saturday morning and the supplies were located on the Corporation of Delta's work yard. Thus the first residents who were looking for supplies travelled to the work yard to get them. After these initial residents collected some supplies, the Corporation was made aware of the situation and subsequently responded by transporting more sand and sandbags to the neighbourhoods for residents to use. Unfortunately participants reported that by the time these supplies arrived, the flooding and resulting damage had already

occurred. The speed of onset of this type of flooding is quick and the water does not generally stay overland for a long period of time. This means that sandbagging is only useful prior to the start of the flood to divert water away from properties and infrastructure. One participant reported that they were going about their typical morning routine and as they watched the water level rise they decided to go to the local hardware store to buy a pump in case the water splashed over the seawall.

A few of the residents who did not get sandbags prior to the flood were able to use the materials that they had on hand to build small diversions. For example, one resident made makeshift walls on their property to block entrances using gardening rocks and plastic tarp material. For this participant, the wall was successful in preventing water from entering one of their doorways and causing damage to their floors. Residents were also able to cope with the situation by relying on their neighbours and family members for help. This will be discussed in further detail in chapter six.

Some participants' homes were spared of any serious damage because the house itself was able to divert the water away. One resident stated that the water was rushing around their home quite quickly and they were worried about the flood waters seeping through the doorways so they placed towels at the base of the doorway which was sufficient enough to collect any water coming into the home. For others who had a more substantial volume of water in their yard, the increased pressure of the water forced the water into their homes and flooded the

lower levels with a few inches of water in some places up to a few feet in others. Some of the participants who had water come into their home simply moved whatever possessions they could to unaffected areas of their homes, however they still had damage to flooring, drywall, and electrical wiring.

Some moved their vehicle(s) from their car park or garage area to higher ground away from the waterfront. However a few vehicles were damaged because the owners were away at the time of the flood and since the event occurred so quickly it was not possible for family, friends or neighbours to move the vehicles out of the way. During the flood residents were not only taking action to protect themselves and their property but many also attempted to help their neighbours. In the case of one participant, their spouse was able to move their car out of the way of the floodwater; however one of their neighbours was left with a destroyed vehicle.

“People who weren’t here who had cars in their garage there...they were towing it away and they didn’t realize it [the car] was in there [the garage] ‘til several hours later and as the tow truck was pulling it away they had the doors open and water just gushing out of this beautiful car...”

After the water had subsided, the extent of the flooding was known and was quite varied throughout the two neighbourhoods. The damage ranged from minimal with fences being knocked down and landscape damage to more extensive damage where vehicles, appliances, flooring, electrical wiring, and some homes were damaged enough to require major repairs. Some residents also lost personal items such as photographs and family heirlooms. After the flood

there were meetings held in the community to discuss residents' concerns about the flood and about the provincial disaster assistance program. Residents were encouraged to file claims to receive financial support. Some of the affected residents applied for and received support under the program, but others were able to obtain coverage through their insurance.

How Participants Perceive the Flood Risk and Their Coping Strategies after the Storm

After the flood, residents evaluated how successful the various mitigation techniques were at protecting property. Based on the successes or failures of mitigation techniques, participants began planning for future events. The berm built by the Corporation of Delta protects a small stretch of homes in the Boundary Bay Village neighbourhood. Some participants were uncertain about the future status of the berm. One participant said,

“The city manager has stated that the city can't absorb the costs constantly either so it's increasingly, it's gonna be more and more down to the homeowners to protect themselves.”

The berm costs approximately ten thousand dollars to put up and take down every winter (Raphael and Bryan, 2006). After the flood in 2006, a few of the participants in Boundary Bay Village did not have the same confidence in the berm as they may have had before. One participant said,

“That's a joke you know. I mean can you imagine sand, a sand berm, well I mean two good waves and it's flat. It's just a joke and I mean it's a terrible, to my mind a terrible waste of our tax money.”

The uncertainty and lack of perceived effectiveness of the berm encouraged some participants to take their own actions to mitigate the risk. Ultimately it was the concern that people had in regards to another storm occurring and resulting in a similar flood, or one is more severe, that persuaded the changes.

After the flood, participants were very supportive of mitigation offered by the seawall – in both Beach Grove and Boundary Bay. The participants who lived in Beach Grove neighbourhood were pleased with the protection that the seawall offered during the storm in February. Even though there was flood damage to their properties and neighbouring properties, the seawall was able minimize the volume of water and thereby minimized the extent of the damage. The participants living in the Boundary Bay Village area who had little or no structural mitigation along the waterfront side of their property acknowledged that their neighbours' seawalls were effective and said that they would like to have a seawall. One resident stated, *“My next door neighbour, they have a really strong seawall so of course they didn't get any problems.”* This support for a seawall contrasts with the views of residents in the 1970s when they were opposed to a seawall for aesthetic reasons, and because they were willing to clean up after a flood every ten years (Raphael and Bryan, 2006). Interview participants noted that there were two severe storms in 2006 and one resulted in significant flooding, and they believed that the frequency of such events may increase in the future.

One of the risks related to the flood event in February was the consequence that as the storm surged water onto the shores, large logs and branches remained along the beach when the water receded. For some of the residents that meant that during the summer months youth in the area would go to the beach at night and use that wood to start fires. The problem for the residents was that during the evening hours the wind typically blows from the water inland and sparks would travel in the direction of the homes. One resident mentioned that the fire crews were often out during the summer responding to calls by residents concerned that one of these fires on the beach could result in a house fire. Hence the storm surge hazard may result in indirect impacts that could occur long after the flooding.

During a few of the interviews, it was clear that participants coped with this flood event by comparing it to the impacts of other hazards, including Hurricane Katrina and the Asian Tsunami. Interview participants often compared flooding to other hazards, and generally said that flooding was not of great concern. In comparison to these disasters, their flood experience was perceived to be minor, which helped them to cope. Specifically, participants expressed greater concern for earthquakes, tsunamis, and liquefaction.

Liquefaction is the process where water-saturated sediments can lose strength and cohesion because of strong shaking and behave like a fluid (Smith, 2001).

One resident said,

“It would make far more sense to worry about this earthquake; you know that we are so vulnerable there. If you are going to do

that well then you should move away from here you shouldn't live here."

If an earthquake were to occur, participants felt they would be affected by the earthquake but the risks posed by liquefaction or a tsunami were of greater concern. They anticipated that the consequences of an earthquake and related hazards would be damage to the structure of their homes that may not be repairable. In the case of a tsunami, they realized that there is some risk but they also perceive that their location within a Bay and further inland of other islands may reduce the impact of a tsunami.

After the flood, some participants seemed to perceive there to be a low flood risk in the area. The lowered risk perception seemed to occur when participants experienced minimal flood damage. Minimal flood damage refers to damages done outside the home (landscaping) and those who only had to deal with clean-up. The participants who had minimal damage were generally satisfied with the mitigation that they had in place and as a result they said that they are unlikely to make any additional changes to reduce their flood risk. This may be a growing concern in the future as storms of this nature are predicted to become more severe and occur with greater frequency in the future due to climate change (Environment Canada, 2003). This population also lives along the waterfront in British Columbia where sea-levels are expected to rise (Chiotti, 1998; Nicholls, 1995), adding to the risk. Other participants who had experienced more damage or were surprised by the extent of the flooding were

more interested in making modifications to existing structural mitigation and were more critical of the mitigation that failed.

After the immediate effects of this flood event were dealt with, meetings were held by local community groups to discuss lessons learnt from this event and determine what the local community needs in order to be better prepared for the next time there is a threat of flooding. This appears to indicate that after the flood in February 2006, residents perceived there to be a significant flood risk in their community, and they wanted to present their concerns and recommendations to the Corporation of Delta so the government would be able to take action to protect them. This strategy is an example of problem focused coping implemented by a group of concerned residents.

Interview participants discussed a few of the recommendations that they would like to see implemented, which were also mentioned during these meetings. One suggestion was to make modifications to sidewalks and pathways to prevent water from flowing down so easily along these access points. For some of the residents who lived a few blocks inland, the water flowed through these pathways because there were no barriers. One of the suggestions to remediate that problem was to create a slight hill on the pathways to block some of the water. Another suggestion made by the residents was the need for some type of auxiliary generator in case the power goes off. Some felt that if there had been power for their pumps they would have been able to pump the water off their properties and reduce the damage. At the time of this project

a generator had been purchased by the Corporation of Delta and was stationed in Boundary Bay Village.

At the time of the flooding there was also no local emergency co-ordinator, and instead these duties were performed by the Fire Chief. The residents suggested that they might be better served if there was an emergency co-ordinator. Someone dedicated to that position would be a local resource where residents could obtain information regarding mitigation, preparedness and response activities. At the time of the interviews, an emergency coordinator had just been hired.

In addition to support for government action, some participants were in the process of determining what strategies they themselves might undertake to help mitigate flooding in the future. Many of the participants who experienced little to no damage on their properties during the flood stated that they were not going to take any further actions. This lack of planned action was due to the perception that the structural measures, their seawalls, were sufficient during this event and hence would be effective in the event of future flooding. However other participants, mostly those who experienced some degree of damage during this flood, had chosen to modify their existing seawall by making it higher or adding a “lip”, which is a modification to the top of the wall that is angled towards the water. A “lip” is meant to divert the splash of the water back towards the ocean. Many participants who at the time of the flood did not have any type of seawall or structural barrier on their properties have since made

attempts to gather information about what would be required to build a seawall and potential sources of funding. Since the initial development of the seawalls in Beach Grove, which was funded by the federal government, residents themselves have been responsible for the costs of building structural mitigation measures on their properties. During the interviews for this study, approximately a year and a half after the flood, only a few improvements had been made to deal with the flood risk. These improvements included the “lip” additions and modifying decorative landscape to block any future flooding. This may be partly due to uncertainty about what mitigation should be implemented and what options are available to them, which was noted by some of the interview participants.

The topic of global warming was an interesting point of discussion with interview participants. Some were quite apathetic to the issue because they are uncertain of what to expect in the future and feel that there is nothing that they can personally do to reduce the negative impacts of global climate change. Others were concerned because of the unknown impacts of global warming. One resident stated, *“Then there’s the big fear of global warming. You know they say in 10 to 20 years the ocean could very easily be right at our doorstep...and that gives a whole new meaning to waterfront.”*

Others stated that the impacts of climate change would be mitigated using technology and structures, but they were not confident that those strategies will reduce their risk. One participant stated that,

“Well all the estimates I’ve read show somewhere around 30 centimetre rise in the next century or half century and that’s, they can’t build dykes fast enough to, to save us here from that.”

However another participant felt that global warming will not add to the flood risk: *“I don’t think that affects tides. That’s lunar, you’re talking lunar, and you know we’re not in control of that.”* This individual did not perceive that the issue of global warming would impact on flooding because this flood was caused by the storm occurring at the same time as high tide, which is not controlled by human activity.

The November Threat

An interesting component of this study was that another severe storm occurred nine months later in November 2006 which had the potential to result in flooding. During this storm in November, the media and the Corporation of Delta’s crews were in the waterfront neighbourhoods in anticipation of potential flooding. Interview participants commented that the media were in the area to get some good footage of the dramatic spray of the waves crashing on the seawalls. The municipality responded to the storm warning by issuing warnings of potential flooding, and municipal crews brought sand and sandbags down to the neighbourhoods well before any flooding would have occurred. The Municipality also had two excavators on the berm and during the storm and the excavators were filling in any weak points on the berm to ensure that it would remain intact and prevent flooding.

Some interview participants used the sandbags in order to protect their property in the event of flooding. These residents mainly included the individuals who were newer to the area and also those who had suffered damages during the previous flood. Other participants, generally those who have resided in the area for a while, did not perceive a high risk of flooding because according to their previous experiences the characteristics of this storm were unlikely to result in flooding. They recognized that the direction of the wind was different, that the wind was not as strong as the previous storm and the high tide was not going to occur at the peak of the storm. Ultimately, the conditions of this storm did not result in any flooding. This result suggests that those who have previous experience with floods have developed knowledge about what to expect in case storm surge conditions repeat themselves in the future.

Summary

This study identified how individuals perceived and coped with the storm surge flood. Interview participants who were newer to the area or who had experienced considerable damage due to past floods tended to perceive a higher flood risk. Those who were more experienced or had little damage from previous floods tended to have low risk perceptions. Coping responses included ignoring the problem and taking no action to mitigate, to those who had implemented structural mitigation efforts prior to the storm and action during the flooding to try and prevent or minimize the impacts. The participants who

seemed better able to cope were those who were more experienced or had little damage to recover from. Whereas the participants who were newer to the area or those who had more damage were also those who had more difficulty determining what type of strategies would help them deal with the situation during and after the flooding. Subsequently after the flooding these were the residents who wanted to take action to mitigate and prepare for future floods.

Chapter Six: Factors That Influence Risk Perception and Coping

Government Intervention

The Corporation of Delta influenced how residents perceived and coped with the flood risk in Beach Grove and Boundary Bay Village. The government has been dealing with the flood risk since the 1970's by establishing a flood management policy that resulted in a seawall being built in Beach Grove and conducting studies to determine what further mitigation may be appropriate for Boundary Bay Village. The government therefore defined flooding as a problem and identified that Beach Grove and Boundary Bay Village are vulnerable to flooding to an extent requiring mitigation. In Beach Grove a seawall was determined by local residents to be the best suited mitigation strategy and in Boundary Bay Village the residents collectively chose to forgo structural mitigation measures and deal with the flooding as it occurred.

On the day of the flood, government agencies also influenced how the participants perceived and coped with the flooding both positively and negatively. That morning fire and police crews were the first agencies to respond. The role of the firefighters and police officers was to ensure the immediate safety of residents within Boundary Bay Village and Beach Grove. The primary actions of these officials were to close down the streets and not allow people to travel by vehicle into the affected area, and the fire crews went

door to door to ensure that the residents had shut off their utilities and to see whether any residents needed assistance (The Corporation of Delta, 2007). One interview participant talked about the response of emergency crews:

“The fire department was outstanding I mean they came down, they warned everybody they came down and told you to shut off your gas and electricity and all the rest...as far as my observations are concerned the fire department was number one. They were unbelievable and they didn’t stop they went right straight through, couple of shifts they were just phenomenal, very well organized.”

Other municipal crews that came to the area helped by hauling sand and sandbags into the area for residents to use, cleaned debris, and pumped water from the affected areas (The Corporation of Delta, 2007). One participant stated that,

“They had all the municipal crew out. They were really helpful. They put sand, brought truckloads of sand in so that they [the residents] could bag if they wanted. It helped very much.”

For both of these participants the response by emergency services helped them respond to the flood, firstly by protecting lives and secondly by providing resources residents could use to protect their properties.

However not all participants felt that the municipal workers were helpful.

One participant said,

“The delta crew...rude, get your own sandbags and you know, you have to go to the yard to get it [sand and sandbags] and I was really, I was quite perturbed because they knew [it was going to happen]...”

In this instance the participant felt as if they were left on their own to seek out and retrieve resources to deal with the problem with little to no help from

municipal workers. The interview participant in this case had to go to the Municipal work yard where equipment is stored, to retrieve the supplies but workers there apparently offered no assistance. The process of retrieving materials took the resident away from their property and as storm surge flooding occurs quickly a timely response is important. Some participants felt that the workers from the Corporation of Delta did not help and even hindered their response efforts. It has been found that when the public believes their concerns have been minimized and neglected they challenge the experts (Williams et al., 1999). Many studies acknowledge that an important component of successful emergency management implementation is a positive, respectful relationship between the public and government officials/representatives (Williams et al. 1999; Cottrell, 2005; Fordham, 1999). This was apparently not the case in some instances.

Family, Friends and Neighbours

Family, friends and neighbours influenced how interview participants perceived and coped with the flood risk well before, during and after the flood in 2006.

With respect to risk perception, in the 1970s, neighbours in Beach Grove and Boundary Bay met to decide whether or not they were in support of mitigation offers by government. Residents in Beach Grove agreed to support the establishment of a seawall. In contrast, those in Boundary Bay Village were

opposed to building a seawall, as noted in local newspaper articles and reiterated by interview participants, because they felt that the risk was not high enough and that it would impede their views. Over time the views of the residents in Boundary Bay appear to have changed as more and more residents have built seawalls or rock walls. One participant stated that in one area of Boundary Bay Village the neighbours agreed to build a rock wall together.

However there were also instances where residents disagreed on an appropriate response. One participant who was considering building a seawall on their property noted that the only way building a wall on their property will be effective is if their neighbour also decides to do so. If their neighbour chooses not to build a sea wall, then the water may flow through the unprotected property and cause flooding along the street side thereby making their investment in a seawall effectively worthless. A similar situation can also occur when a neighbour who lives on the waterfront does not mitigate and neighbours behind them are flooded. Participants also mentioned that because some properties along the waterfront have inadequate or no structures their neighbours are vulnerable. It is the residents along the waterfront that are making choices which make the residents around them vulnerable. This issue may cause conflict in the community. The conflict would be rooted in the inactions of some residents which may in turn increase the risk to others. Therefore the risk of flooding may be considered to be imposed on some residents. This is called risk impositions (Teuber, 1990). This is an important concept to consider because as

residents are choosing which mitigation strategies to adopt, it is important that they recognize their role and the responsibility they have to others in their neighbourhood.

From a positive perspective residents also sought information from neighbours about the conditions of the storm and subsequent flooding. Many participants commented that their neighbours informed them about what was happening during the flood. This information helped others to anticipate what was about to happen and therefore helped them to cope with the situation. For example, interview participants mentioned that neighbours communicated how they expected the worst of the flooding to occur at the same time as the expected high tide and that the water would begin to recede when the tide began to move out.

In November, nine months after this flood, there had been threat of another flood occurring due to a winter storm affecting the area. During this storm, information from neighbours reduced one participant's perceptions of risk:

“Cause our friends from across the street said it was not that bad. It's not rising very high compared to our concrete wall and they know because they've been here a long time and they said don't worry about it.”

These participants did not take any protective action based on the advice of their neighbours.

Interview participants also spoke about friends in the community and surrounding area who helped them to cope by assisting them to fill sandbags or storing personal items out of the community. As one participant said:

“I had friends drive out from [another community] in trucks ready to [help] if I needed furniture or anything moved they were ready to help me so that was nice that my friends came up from that far...they were awesome.”

In this community there are many people who have settled in the area because their families have resided here since it was a summer vacation spot. As the community has transitioned to an area where more people live permanently, many residents have family members close by. Some interview participants mentioned that they were able to discuss the flood and associated feelings and stress with family members, which helped them to cope (Schwarzer and Schwarzer, 1996). Research indicates that strong social ties help to provide social support when faced with hazardous situations (McGee and Russell, 2003). In this area many residents relied on their family, friends and neighbours for information to help identify if they were at risk or not and during the flood for resources to help them respond.

Conversations also occurred with neighbours after the flood. During the interviews, when participants were asked about the extent of the damage in their neighbourhoods, they would often comment on not only their own losses but also on the circumstances of their neighbours. Some interview participants compared their losses to those of their neighbours. For example if the damage for the participant included destroyed carpeting they would often comment on how

their neighbour lost something more significant such as photographs or a more expensive item such as a car. From this perspective it seemed that people were able to cope with their own situation by sympathizing with their neighbours' situation and although property damage was common, they felt sympathy towards individuals who lost more personal items or items that would be more of a financial burden to replace.

In the months after the flood, the Boundary Bay Village community association held meetings to discuss the consequences of the flood and what lessons had been learned in order to determine what could be done better when a flood occurs in the future. The result of those meetings was a list of recommendations for the municipal government based on residents' experiences. This type of coordination within the neighbourhood contributes to strengthening local emergency management (Murphy, 2007). This is relevant as it has been previously established that successful emergency management is reliant on public participation (Murphy, 2007). It is important because residents are able to take an active role in emphasizing that storm surge floods are a threat to the area and they are participants in identifying what resources and support they need to help them cope.

Cottrell (2005) found that public meetings directed by local residents were successful in attracting high levels of participation and feedback in response to a flood that had occurred in Australia. The study highlighted that the residents themselves were able to identify the cause of flooding, and were

concerned about increased frequency and greater impacts (Cottrell, 2005). The study also reports that residents were impressed by the response of their local council to take into account their recommendations, and in conjunction with studies and research done by the council itself, a local flood strategy was developed (Cottrell, 2005). Ultimately the suggestions, as identified during the community meetings were addressed by the local government and some of their suggestions were applied. For example, the residents requested that a generator be brought into the area to compensate for any power outages and the local government bought a generator. Through the process of active public response to the flood and a receptive local government response the two groups were able to negotiate the needs and interests of both groups to help prepare and mitigate for future events.

Although neighbours and family offered considerable support to those directly affected by the flood, it appeared that there might have been a lack of support to those living along the waterfront because they chose to live there voluntarily despite the risk. In the words of one participant:

“There’s not a lot of sympathy in the rest of the community...I mean there were people in the community that said well [it’s] their problem they got that you know.”

For some interview participants the lack of community support may negatively affect their ability to cope with the impacts of the flooding and may negatively impact any suggestions that are made with respect to how the areas should

mitigate future threats. This is an example of the social undermining that can be detrimental to how individuals cope.

Thus family, friends, and neighbours have an important influence on how the participants perceived and coped with the flooding. It is also important to note that this influence was both positive and negative. In order to facilitate positive relationships between the stakeholders, including the residents who live along the waterfront, those who live in the vulnerable flood zone, and the rest of the community, there needs to be an opportunity for all stakeholders to come together and discuss concerns. In this instance the public forums after the flooding were one opportunity but more needs to be done to ensure that all the opinions are heard.

Benefits of living in the area

This project examined the risk perceptions and coping actions of residents who voluntarily reside in a hazardous area. The interview participants who have chosen to settle along the waterfront have done so because of their connection to the area and the financial benefits. During the course of the interviews, it was apparent that participants had a strong attachment to their community. The concept of topophilia, the bond between an individual and their environment (Tuan, 1974), may be relevant in this case. In some instances the sense of topophilia is so strong that even when people are aware that their well-being is at risk from a hazard, they still do not want to leave that area.

During the majority of the interviews, the participants articulated the benefits of living in the area in the context of being willing to take the risk of having to deal with occasional flood events because the benefits outweigh the risks of living along the coastline. Many participants stated that the area is beautiful. In addition, it was quiet and it feels calm and peaceful. Some participants have strong family ties to the area and also appreciated its close proximity to large urban centers.

During the interviews, almost all of the participants talked about the beauty of the area. One resident stated that “*waterfront is irreplaceable and it’s very desirable.*” The peaceful nature of living on the water was highlighted by another participant:

“There is something very, very peaceful living on the ocean it’s very therapeutic and being from BC I’ve always lived by the water or on the water and it’s a wonderful place for children. It’s very peaceful, it’s extremely peaceful.”

Several participants indicated that they live in the area because they grew up in or around the community and have family ties to the region. For that reason they are familiar with the environment and owning property directly on or close to the waterfront is highly desirable. Many interview participants were able to discuss their family history and how they came to live in the area. Other participants discussed the history of the community including where fishing used to take place and what the homes used to look like. This information indicates that these residents have a connection not only to the natural environment but also to the social-cultural environment.

Some participants also noted that this community was especially attractive because it is close to larger urban centres of Vancouver, Victoria, and Richmond. Boundary Bay Village and Beach Grove residents work in and visit the large urban centres, but at the same time they note how the friendliness of the area and style of the neighbourhood is a welcome retreat from the bustle of the city. One resident stated that,

“It’s a very friendly warm neighbourhood...anyway Beach Grove it’s known for [being friendly]...this is by far the friendliest...it’s just like summer camp down here. It’s just really nice and fun.”

Another commented on the houses in the area: *“It’s a really nice neighbourhood it’s really fun and I like the sort of old cottages and it doesn’t have a suburban look about it.”* Another benefit of living within these two neighbourhoods is that there is a regional park that separates both neighbourhoods. Residents are able to walk along paths (which are also the dykes) in the park and appreciate the natural environment.

The positive feelings that the participants had about the area influenced how they perceived the flood risk because they minimized the flood risk and were prepared to deal with the threat due to the benefits of living in the area. Other research has examined similar cases in North America where residents live in areas that are vulnerable to hazards by choice for aesthetic reasons (Fordham, 1999). In some instances these choices are described as residents making a risk-environment trade-off where the threat of flooding is countered by the beauty of

the location (Fordham, 1999). Slovic (1987) identified that individuals weigh the pros and cons of a given threat in order to balance their interests. This leads to the identification of what can be defined as acceptable risk (Slovic, 1987). In this situation living along the waterfront and dealing with the occasional flood was deemed to be an acceptable risk.

Residents also appreciated the financial benefits of living in the area. Interview participants reported that the value of waterfront properties have increased considerably since many residents moved to the area. In general research has shown that the value of coastal real estate has increased at an average rate of 7 percent per year over the last 50 years (Bin and Brown Kruse, 2006). Properties along the waterfront can also be valued as much as 45% higher than comparable properties inland (Bin and Brown Kruse, 2006). One participant said that the value of their property had tripled in two years. Interview participants also expected that this rate of increase would likely continue. As one participant stated, *“Prices on houses here are still going through the roof.”*

For interview participants, the costs associated with flooding experienced to date was clearly not enough to detract from the benefits of living in the area. However, one participant noted that regular flooding and local government response to the flood risk may affect property values in the future:

“Well I must say I guess that storm in February, with Delta, now they have advertised for forums on flood management open to the public that there is more talk more awareness they know that this is an issue that isn’t going to go away so they’re trying to

kind of create an awareness without creating a panic. I mean they can't. You know [if] all of the sudden real estate in a community like this drops fifty percent and then what's the impact of that?"

In a study conducted by Bourassa et al. (2004) water views or a location within a short distance of the waterfront have a strong positive impact on housing values. For a few of the participants the attraction to the area is rooted in the valuation and investment in their homes. For these individuals the threat of flooding is a concern because it may reduce the value of their homes.

Experience

Participants' experiences with storms and floods and experiences with water-related hobbies and activities appeared to influence their risk perceptions and coping responses. Some of the participants who had experienced flooding in the past had already decided that they needed to mitigate the impacts of flooding and therefore had built structural barriers. These measures were perceived to be necessary because they felt that their existing mitigation strategies would not be sufficient if another flood were to occur. For some of the participants, that meant after the last flood event in 1999 they built or modified their seawall. For others who had no mitigation and who have only just recently experienced flooding and damage during the storm of 2006 have since realized that their homes are not adequately protected. Therefore their perception of the risk has

increased to the point where they feel they need take action to mitigate for future events.

Interestingly, some participants whose homes were damaged in the 1999 and 2006 flood said that they believe that flooding is a part of living on the waterfront and they expect to have to deal with clean-up and recovery when flooding occurs. For these individuals the general mitigation activities they implemented were minor modifications to their existing mitigation efforts. For example, these individuals added “lips” to their seawalls or extra height. These interview participants felt that future floods would result in minimal damage to their homes as they have in the past. Tierney et al. (2001) also identified this concern where some residents that have some hazard experience tend to believe that what they have previously experienced is the worst that will ever happen. This attitude can also lull people into a false sense of security and mitigation activities may be overlooked or appear unnecessary (Tierney et al. 2001). Therefore people do not take action because they do not perceive a threat as they are in denial or are minimizing the threat (Lazarus and Folkman, 1984).

Experience also provided an important source of knowledge for some participants. Many local residents who have lived in the area or along the coast for a long time are knowledgeable about conditions that lead to flooding in the Boundary Bay area. Martin et al. (2007) distinguish these people as local experts, as compared to new residents who are ‘local novices’. Local experts are those who have local knowledge and are able to make decisions based on that

knowledge whereas local novices lack that knowledge and that decision-making ability (Martin et al 2007). McGee and Russell (2003) had also found that long-term residents are better prepared and more knowledgeable based on their personal experiences and social linkages within their communities.

Local experts had experienced previous storm events and recognized that winter storms are a seasonal occurrence and the higher winds and higher waves are to be expected. In the words of one participant describing the November storm that did not result in flooding:

“Well I think in all fairness we’ve been here long enough we know we can tell by the size of the waves, by the wind, the force of the wind, if it’s going to be a bad one because we’ve seen so many over the years. And yeah it was a bad one for people you know who hadn’t seen it, it was quite a bad storm but you know the waves weren’t coming up nearly as high and shooting up the way well they did [before].”

The implication is that local experts seemed to know what to expect in a storm, whereas novices may not recognize that a storm event occurring at high tide can result in flooding and how to respond to a flood.

During the storm, the risk perceptions of these local experts changed from low to high when they perceived that certain thresholds were being reached. For some that meant that they were aware of and in some cases measured the wind direction and speed. Once this group of participants identified that the conditions would likely result in flooding, they acted to minimize damage to their house such as by placing towels under the door or moving objects off the floor or onto a second story.

Local experts in this community also included participants who have gained knowledge through indirect experiences, not through direct experiences with flooding. Participants who had experience with water-related hobbies tended to be more knowledgeable about wind and water behaviour. One interview participant, thinking back to the morning of the storm, said:

“When we came out of the house the wind was horrific. I don’t think I ever remembered a wind like this. Quite fierce and we are sailors so we know about wind strengths and wind gusts and squalls and things like that.”

Other participants were well versed in how the facets of the storm came together that day to create flooding. As a result they measured wind speeds, noted the direction of the wind, and looked up the tide tables. As result these local experts were able to combine their knowledge with the conditions on that day, which affected their risk perceptions. For instance they knew that this storm would result in flooding because of the high wind speed and wind direction, and they determined that the storm would occur simultaneously with high tide. The implications of local experts possessing this type of knowledge is that they seemed to be able to more accurately assess the risk and decide what measures would be appropriate to cope with the situation.

Local experts’ knowledge also helped them to understand the potential flood risk associated with the storm in November 2006. It was interesting that the Municipal government staff perceived a high flood risk associated with this storm, but local experts did not. The Municipality brought heavy equipment into the area to try and prevent a berm breach. Government employees also brought

sand and sandbags to the neighbourhoods so residents would be able to sandbag prior to the peak of the storm. As one participant said,

“They [the municipality] certainly got worried about it but I think that’s only because it came so close on the heels of the one in February so they weren’t going to get caught again.”

However a local resident expert was not worried because:

“...we had a storm this year when the media were all down here, well I had my wind thing, I have a measure of the speed of the wind and so I was saying I knew what the fetch was and I said well this isn’t going to be a storm at all but they were all out here ready for a big storm.”

This has also been found in research examining how individuals respond to the threat of hurricanes (Tierney et al. 2001). Individuals in those situations, where the hazard is familiar, are able to develop standard ways of coping based on their previous experiences (Tierney et al. 2001). In these instances residents tend to be better prepared (Tierney et al. 2001).

Some of those without experience, however, took their cues from the government officials, had heightened perceptions of flood risk associated with the November storm, and filled sandbags to reduce impacts associated with potential flooding. In this instance the experienced residents knew that although similar storm conditions were expected to occur, there was no high tide, so they knew that that flooding would not occur.

Financial Support

Residents’ access to financial support played a role in how individuals perceived the flood risk and coped with its consequences. Insurance can be used

to compensate individuals for damages associated with hazards. Unfortunately most damage during this flood was overland storm surge flooding and was not covered by household insurance (Ouston, 1983; Hansen, 2006; Pi, 2006). There were exceptions however, in some cases the flooding was a result of sewer backup (Pi, 2006). If a home floods because of sewer backup or broken pipes the losses are then compensated because these causes are included as part of a typical homeowner's insurance policy (Pi, 2006). Most interview participants were aware that they were not eligible for flood insurance. Others thought that they may be able to get insurance coverage but they were not sure of the process or their eligibility. However they felt that even if they would be able to get coverage, the premiums and deductibles would cost more than they could afford. One participant, who was a newer resident, was not aware that they could not obtain flood insurance. This situation illustrates how the insurance industry and residents have different views of floodplain vulnerability. If the insurance industry does not offer insurance, it has identified that development on the floodplain is a problem and they are not willing to compensate for associated losses. However interview participants in the area have varied perception of the risk. Some identified flooding as a threat but were willing to accept it and implement personal mitigation measures. Whereas others viewed flooding as a low risk because they have the means to recover from the impacts or because the damages are so minimal it takes very little effort to recover.

Another way of sharing the losses can be through channels of social assistance. As a result of the Mayor declaring a state of local emergency the residents within the flood affected area were able to apply for compensation from the Provincial Emergency Programs – Disaster Financial Assistance Program (Raphael, 2006). The Disaster Financial Assistance (DFA) Program is aimed at providing assistance to individuals to help them restore or replace items damaged in disasters (Government of British Columbia, undated). Although this program is in place, there are eligibility requirements and limitations to the compensation that is available (Government of British Columbia, undated). The main component of compensation eligibility is that the items must be deemed essential for life and/or livelihood (Government of British Columbia, undated). The DFA program will *not* compensate individuals who have lost items that could have been eligible for coverage by insurance, homes which are not primary residences, luxury items, and land lost due to erosion and landscaping (Government of British Columbia, undated).

Early estimates of damage due to the flood indicated that approximately 150 residents had experienced damage (Hansen, 2006), with an estimated cost of two to three million dollars (Willis, 2006). A month after the flood, 49 residents had filed claims for the Provincial Disaster Financial Assistance Program (Willis, 2006a). In June 2006, twenty-nine residents had received compensation from the provincial government's Disaster Financial Assistant program and nine

claims had still not been settled (the rest of the claims did not qualify) (Willis, 2006b).

Based on the abilities of the participants to successfully recover some of the costs of the impacts they were able to clean-up, repair and/or replace their possessions and the recovery process was positive. Therefore they were able to cope in a positive manner as a result of the financial assistance available.

Individuals who were more likely to express concern about the risks that they face in the future were those who were uncertain about the availability of insurance and other funding.

Summary

This study identified six factors (Government intervention, Family, Friends and Neighbours, Benefits of living in the area, Experience, and Financial Support) that influenced participants, risk perceptions and coping strategies.

Government intervention in this situation both helped and hindered participants' ability to cope with the flooding. Family, friends and neighbours were a source of knowledge and support when planning for and responding to flooding.

However choices regarding mitigation activities may also create conflict amongst the residents. The benefits of living in the area outweighed the risks.

Direct and indirect experience provided valuable awareness and knowledge helped participants cope with the flood. Financial support also helped the

participants determine the risk that they are willing to accept, and emergency funding also helped them cope and recover from the impacts.

Chapter Seven: Conclusion and Recommendations

This study examined how residents perceived the risk of storm surge flooding and coped with storm surge flooding, and identified what factors influence both risk perception and coping strategies.

Risk perception and coping strategies varied amongst the participants of this research. For some of the participants, the threat of flooding was perceived to be a low risk and subsequently they were not motivated to take any protective action. The participants who were most likely to perceive a low risk were individuals who had previous experience with floods and therefore had more knowledge regarding the hazard and what to expect. Other individuals who perceived a low risk were those who were able to recover from both previous floods and the flood in 2006 relatively easily.

Other participants identified flooding as a higher risk and were thus interested in obtaining more information regarding their mitigation options. This group of individuals were generally those who were newer to the area and had little previous experience with flooding or those who had lost their possessions or experienced other property damage during this flood.

Six factors were found to influence risk perceptions and coping strategies: Government intervention, family, friends and neighbours, the benefits of living in the area, experience, and financial support. Government intervention both helped and hindered participants' ability to deal with the flooding. Family, friends and neighbours were a source of knowledge and support when planning

for and responding to flooding however these relationships may also be strained during times of crisis. Participants minimized and rationalized the risks posed by living close to the water due to the benefits of living in these places. Experience provided valuable awareness and knowledge and helped people respond to the flood. The availability of financial support also helped the participants determine the risk that they are willing to accept and emergency funding helped people cope with and recover from the impacts.

As the number of individuals investing and permanently settling in waterfront areas in Canada continues there is a need to support mitigation activities in those areas. This need is further highlighted in response to the threats associated with climate change. This study aims to help meet this need by examining how individuals experience storm surge floods and how they chose to respond to the threats posed by these events. This study examined how individuals within two neighbourhoods of Tsawwassen, British Columbia handled such a situation.

Recommendations

The following recommendations are aimed at local government to help residents obtain accurate information about the hazard and facilitate ways that the residents can cope effectively. Information will be disseminated to local government by sending government officials a copy of the thesis and a written summary of results. Recommendations developed from this study are based on

two concerns. The first is that the last substantial discussions surrounding mitigation activities between government officials and residents took place over thirty years ago. I believe now is the time to re-examine the policy on flood issues in this community specifically in the two waterfront neighbourhoods Beach Grove and Boundary Bay Village. The second concern relates to the fact that this region seems to be experiencing an influx of new residents. Factors noted previously highlighted the value associated with local knowledge, community ties and previous experience. These characteristics are typically associated with residents who have resided in the community for a few years and in this instance have had previous experiences with flooding in the region. Based on the findings, of my research I make the following recommendations:

In response to the flood in 2006 I believe that the events that transpired can act as a catalyst for discussion between residents and government officials to establish a course of action where residents can receive clarification on the governments' intent to maintain current mitigation measures. The Municipal government can also play a role assisting residents, and vice versa, by working together to help develop a strategy, particularly in Boundary Bay Village where mitigation is inconsistent, for a permanent, consistent mitigation strategy. Presumably the Municipality could plan and advocate for funding support for the mitigation projects as well.

Secondly, the government should play a role in educating the residents about the risks that they are vulnerable to and highlight specific activities they

should do to prepare for similar situations. Importantly, these neighbourhoods are going through a phase of transition where some families with considerable experience are leaving the area, and new residents, 'local novices', are moving in. The implication is that as newer residents move to the area they may have little knowledge or awareness of flooding based on previous experiences therefore may not implement effective coping measures. As noted previously, risk perception and coping strategies varied amongst the residents but residents who have lived in the area have developed local knowledge whereas newer residents lack the knowledge and experience needed to understand the hazard. As these communities are in transition and new people are moving to the area it is important that they are made aware of the flood risk. Currently the only program I am aware of was a brochure that was available via the Government of Canada (Public Safety and Emergency Preparedness Canada, 2003) regarding storm surges. I believe that residents can be further educated using similar techniques by sending brochures every two to three years to keep the hazard and mitigation and preparedness activities up-to-date. A brochure specifically designed for the residents of Tsawwassen so that residents, both old and new to the community, receive up-to-date locally relevant information regarding what residents should do. The purpose to provide these newer residents with information and to clarify information with existing residents a brochure might be a cost effective method of communication between the government and the community. A brochure should include a definition of a storm surge,

information on when they are most likely to occur, describe and provide information about where residents can find information on storms surges and on high tides. The brochure could also include contact information for local and provincial government agencies that provide information and resources regarding hazardous events. A brochure may provide clarification to some residents and basic knowledge to others. This style of information encourages people to prepare for disasters (Tierney et al., 2001).

I also believe that the Corporation of Delta should also hold public meetings relating to mitigation strategies along the coastline. I think revisiting the issues and concerns now, prior to any future flood events, will allow the stakeholders in this community the time to make the best possible decisions regarding any investments in future mitigation activities.

The results of this study also show that many residents within this area rely on friends, family and neighbours for information regarding storm surges and for support during disasters so I believe that the Corporation of Delta and the local community groups should encourage community events to foster the development and maintenance of personal relationships amongst the residents. I believe that this would create a community spirit and friendships that could be relied upon if other stressful situations occur in these areas.

Suggestions for Future Research

Based on the results of this research I feel that there are two areas of research that should be examined in the future. The first area is more social science research conducted on residents who live along coastlines in Canada. The majority of research to this point examining coastal hazards focuses on the physical dimensions of the hazards rather than the interactions between humans and the environment. It would also be beneficial for research to focus on the areas in eastern Canada that have been dealing with the remnants of hurricane activity in the Atlantic ocean that have resulted in serious storm surges and flood conditions.

The second area of research that would be valuable to study is the interactions between residents who are experienced, local experts and those who are newcomers and local novices. In this study those who were experienced were the individuals who assisted the other residents in identifying the risk and providing insight to how they should cope. I believe that this factor can relate to a variety of other hazardous situations and may provide insight as to how knowledge can be effectively disseminated amongst residents.

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Appendix A: Information Sheet

Dear Resident:

I would like to invite you to share your views by participating in a research project being conducted by myself, Sharon Romanowski, from the Earth and Atmospheric Science Department at the University of Alberta. This project is aimed at examining how people experience flood events, specifically in relation to the two floods that occurred last year.

The interviews are anticipated to last 1 hour, and will be completed in person. With your permission, the interview will be tape recorded. Your participation is voluntary, and you are free to provide as much or as little information as you wish during the interview. You may withdraw from further participation in the project at any time during the data collection phase of the project. In such a case, I will not use any of the information that you have provided.

The information that you provide during the interview will be kept confidential. The names of the interview participants will not be recorded on the interview tapes or transcribed interview notes. The transcribed interviews will be summarized, analyzed, and presented in a final report and publication. If I use a direct quote from an interview participant in a report or publication a pseudonym will be used to describe the source of the quote. You may ask that I not quote your words at all if you prefer. All interview tapes and transcripts will be stored in a locked filing cabinet in my office during the study. Once the study is completed the data will be moved to a locked filing cabinet in Dr. Tara McGee's office at the University of Alberta, and will only be available to Dr. McGee and Miss. Romanowski for this project. We do not foresee any risks to participants in this study.

The final report from this study will be provided to the Municipality of Delta, to help them gain an understanding of flooding from the perspective of local residents and how they may be able to assist local residents in the future.

Thank you for your interest and participation in this project and please do not hesitate to contact us if you have any questions.

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Sincerely,

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Appendix B: Consent Form

Please initial each line if you agree with the statements and sign your consent at the bottom.

- I have received and read a copy of the introduction letter.
- I am aware that the interview will cover questions about the local area and flood related issues.
- The researcher has answered any questions I have in regard to this study.
- It has been explained fully to me that participation is voluntary.
- I am free to withdraw from this study at any time.
- I am under no obligation to answer any questions that I do not feel comfortable with.
- I may refuse to disclose any information I do not want to.
- I am aware that the interview will be taped.
- I understand that information gathered in the interviews will be confidential and a label such as 'resident' or pseudonyms will be used to protect the participant's identity.
- I understand that the researcher may use short quotes from this interview, but that no information on the participant's identity will be released.

Name of Participant: _____

Signature of Participant: _____

Date: _____

Name of Researcher: _____

Signature of Researcher: _____

Date: _____

Supervisor: Dr. Tara McGee
Phone: 780-492-3042
Dept. of Earth and Atmospheric Sciences
University of Alberta

Appendix C: Interview Guide

Introductory Questions

During the first part of the interview I want to get a sense of what drew these people to the area and develop a bit of a context as to what motivates people to live in waterfront areas.

How long have you lived here?

What originally drew you to the area?

Probes: What are some of the pros and cons of living here?

Transition to the floods

So it's my understanding that there were two floods last year. Were you affected by them?

First Flood February 2006

Can you tell me about your experience with the first flood?

Probes:

Were you aware that a flood might happen? How did you find out?

Did anything happen to your property during the first flood?

Did anything happen to your neighbour's property?

How did you feel when the flooding happened?

How did you feel after?

Were there community officials in the neighbourhood?

When did they come?

What were they doing?

Second Flood November 2006 (Turns out there was no second flood only the threat of one)

Can you tell me about your experience with the second flood?

Probes:

Were you aware that a flood might happen? How did you find out?

Did anything happen to your property during the flood?

Did anything happen to your neighbour's property?

How did you feel when the flooding happened again?

How did you feel after?

Were there community officials in the neighbourhood?

When did they come?

What were they doing?

Overall how did you feel about their involvement?

Present

How do you feel now?

Do you feel better prepared now?

Why or why not?

Are there other hazard concerns in your area?

Did you or are you planning on doing something to reduce the risk in the future?

What did you do?

Why?

Do you feel that you can make a difference?

Why not?

Do you rely on the government and other agencies to decide what should happen?

Do you think this area will flood again?

What makes you think that?

How often do you think it will flood in the future?

Why?

How do you feel about the Municipalities involvement so far?

Was there any difference in their (the Municipalities) response between the first and seconds floods?

What about the involvement from the provincial level?

Overall, how do you feel the government responded to these events?

Do you know what the future flood mitigation plans are for your area?

What would you like to see change or stay the same?

Overall do you feel prepared now?

Why?

Concepts/Terms to Cover

The municipality (community officials)

Federal government

Media

Future Considerations –climate change

Neighbours – community

Individuals

CAN/US relations