

Exploring Social Vulnerability to Earthquakes in the Capital Regional District, British  
Columbia Canada

by

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BA, University of Victoria, 2008

A Thesis Submitted in Partial Fulfillment  
of the Requirements for the Degree of

MASTER OF ARTS

in the Department of Geography

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## **Supervisory Committee**

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## Abstract

### Supervisory Committee

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*Objective:* The primary goal of this research is to identify social vulnerability and resilience to earthquake hazards within the Capital Regional District (CRD) and to generate recommendations for how the provincial health system and various local and regional government agencies can support the continued enhancement of disaster-resilient communities.

*Methods:* Both quantitative and qualitative research methods were employed to evaluate social vulnerability and resilience. Quantitatively, the methodology developed by Cutter et al., was replicated to create a Social Vulnerability Index (SoVI). These data were supported by qualitative data obtained from focus group interviews in three communities in the CRD. Together, this mixed methods approach provided additional insights into the dimensions of social vulnerability, and resilience within the CRD.

*Results.* From the SoVI, twenty-five census tracts (CTs) within the CRD exhibited 'high social vulnerability'. These highly vulnerable CTs were most likely to be in more densely populated areas, whether they were in inner city neighbourhoods or suburbs of the City. The qualitative results suggest that a large scale seismic hazard will present substantial challenges for the CRD. The smaller, rural and remote communities of Sooke and Port Renfrew appeared to be more interested in emergency preparation than those in the City of Victoria, if judged by their participation rates.

*Conclusion.* The information collected from research participants and the generation of the SoVI complements existing hazard maps and local knowledge well. Both have their place as tools for enhancing understanding of risk-assessment for the area.

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## **Dedication**

I would like to dedicate this thesis to those who have inspired me to embark on this journey and who have patiently encouraged and put up with me along the way. Thank you.

This research is for the people of Victoria, Sooke and Port Renfrew who so readily gave up their time to inform this research and who are passionate about making their communities more resilient to all hazards.

# Chapter 1

## Context and Foundation

### 1.0 Introduction

The southwestern coast of British Columbia is adjacent to the Cascadia subduction zone, where the oceanic Juan de Fuca plate moves beneath the North American plate at a rate of about 45mm per year (Monger and Journeay, 1994). Onur and Seemann (2004) estimate a 54% probability that tectonic activity in the area will cause structural damage to buildings on firm soil in or around the Victoria area in the next one hundred years. Earthquake hazards pose a serious threat to social, economic and physical structures, infrastructure, and ultimately to overall vulnerability.

Risk is determined by the combination of hazard and vulnerability (McEntire, 2001; Cutter, 2000; Mileti, 1999). Preparing the provincial health system<sup>1</sup> and various local and regional government agencies for potential disasters should centre first on identifying the coastal communities which are most at risk, second on identifying the factors affecting the vulnerability of those communities, and third on developing strategies to increase the resilience of the community itself. Communities with many resources (e.g., health care facilities and practitioners, engineering and construction materials, support facilities, food security, protected water supplies, etc.) are often found to be more resilient, to all types of hazards including earthquakes which therefore helps them to reduce their vulnerability (Adams, 2008; Norris et al., 2008). In order to be prepared for any type of emergency situation, a greater awareness of the specific vulnerabilities in a

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<sup>1</sup> For the purpose of this project, the *health system* will be broadly defined by the Mission Statement of the BC Ministry of Health Services as any public effort to “guide and enhance the province’s health services to ensure British Columbians are supported in their efforts to maintain and improve their health”.

community must be established (Adams, 2008). “Social and biophysical vulnerabilities interact and combine to produce the overall place vulnerability” (Cutter et al., 2003, p. 243).

This research project evaluates the social vulnerability of communities within the Capital Regional District of British Columbia to seismic hazards and disasters. This information can be used in a risk assessment for the region to help determine where priorities are in terms of the preparation, mitigation, response and recovery stages of disaster events. The purpose of this introductory chapter is to outline the research goals and objectives for the study, identify the study area and detail the structure of the thesis. Through a thorough review of the literature, this chapter will provide background information to ground the study that takes into account the physical and social parameters related to earthquake hazards in the research area and present an overview of the methods employed in the development of this thesis.

## **1.1 Terminology Defined**

### **1.1.1 Vulnerability**

Social Vulnerability refers to the characteristics of a community that create increased potential for disruption and harm (Cutter, 2008). In day-to-day life, or a disaster situation, this could manifest as anything from a language barrier to a pre-disposed health condition. In relation to environmental hazards, vulnerability can be viewed as the potential for loss (Cutter et al., 2003). In 2003, Cutter et. al. identified three main tenets of vulnerability: “the identification of conditions that make people or places vulnerable to extreme natural events, an exposure model (Burton, Kates, and White, 1993; Anderson, 2000); the assumption that vulnerability is a social condition, a measure of

societal resistance or resilience to hazards (Blaikie et al., 1994; Hewitt, 1997); and the integration of potential exposures and societal resilience with a specific focus on particular places or regions (Kasperson, Kasperson, and Turner, 1995; Cutter, Mitchell, and Scott, 2000).”

### **1.1.2 Resilience**

Resilience, a scientific term originally adapted to ecological systems by ecologist C.S. Holling is defined as a “measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables” (Holling, 1973, p. 14).

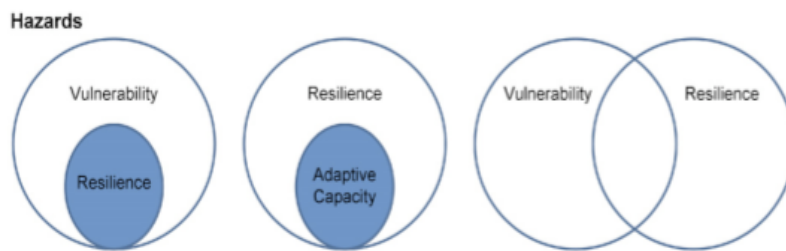
Since its origins, the concept of resilience has been used to define various scales of economic, ecological and social systems—from the individual to large cities (Norris et al., 2007). Essentially, resilience can be defined as the ability of a community or ecosystem to absorb disturbance and re-organize into a system functioning with the same primary function as prior to the disturbance (Adger, 2005; Cutter et al., 2008; Holling, 1973).

### **1.1.3 Adaptive Capacity**

Adaptive capacity is defined as the “ability of a system to adjust to change, moderate the effects and cope with a disturbance” (Cutter, 2008). Adaptive capacity refers to a systems’ ability to react and adjust in the event of a disturbance, but unlike resilience, does not infer anything about the quality of the post-event state.

#### 1.1.4 Linking the Terminology

Resilience and vulnerability may be viewed as separate, yet linked concepts (Fuchs, 2009; Cutter et al., 2008). Vulnerability is thought to embody resilience as the ability to bounce back or cope with a hazard event. Although these terms seem to oppose one another at surface value, this is actually not the case. Communities that are highly vulnerable can also be highly resilient and communities that are highly resilient are not always vulnerable. Figure 1.1 below illustrates the concepts of vulnerability, resilience and adaptive capacity as well as the relationships between them.

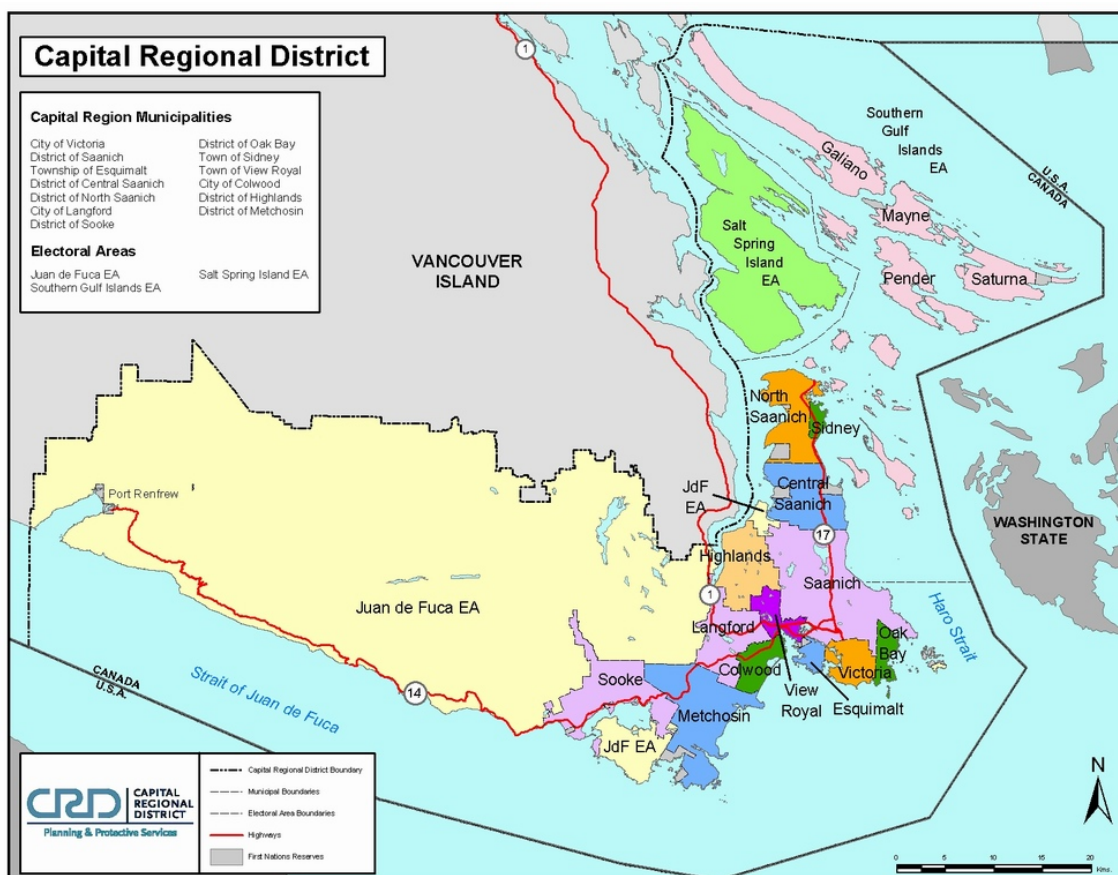


**Figure 1 Conceptual linkages between vulnerability, resilience and adaptive capacity (Cutter et al., 2008).**

The relationships between these concepts, as expressed in the diagram, are complex. Vulnerability and resilience are linked (right side of the diagram) in that they are often evaluated using similar indicators and criteria. However, being resilient is not inherently exclusive of vulnerability and vice versa. The left side of the diagram shows that vulnerability encompasses resilience. This simply demonstrates that vulnerability can be an indicator of resilience in itself. The middle of the diagram displays adaptive capacity as a concept nested within resilience. Adaptive capacity refers to a systems' ability to adjust to actual or expected disturbances or perturbations (Gallopín, 2006).

## 1.2 Study Area

This research is focused on the Capital Regional District (CRD) of Victoria on Southern Vancouver Island in the province of British Columbia, Canada. Figure 1 shows the region, comprised of 13 municipalities and two electoral areas.



**Figure 2 Study area, Capital Regional District, Vancouver Island, BC (Source: CRD, 2010)**

The CRD was chosen as the study area as it is located along the Pacific Rim of Fire (see section 1.4) and is at significant risk of seismic hazard. Additionally, little research has been undertaken in this region to examine social vulnerability to seismic hazards. Further, the agencies and organizations mandated to work on earthquake preparedness, mitigation, response and recovery often lack clarity in their organizational goals and communication channels are less effective than would be desirable.

### 1.3 Research Goals and Objectives

The primary goal of this research is to identify social vulnerability to earthquake hazards within the Capital Regional District (CRD) and to generate recommendations for how the provincial health system and various local and regional government agencies can use this information to support the enhancement of disaster-resilient communities<sup>2</sup>. To achieve this goal, both quantitative and qualitative research methods were employed to evaluate social vulnerability in the CRD. Chapters 2 and 3 focus on the quantitative and qualitative analysis of results, respectively. The quantitative research in Chapter 2 presents a spatial analysis of social vulnerability in the CRD using a wide range of indicators developed using census data combined with GIS mapping tools. The methodology used in this second chapter closely follows that employed by Dr. Cutter et. al. in the Social Vulnerability Index (2003). The qualitative research in Chapter 3 supports a thematic analysis from interviews with key informants and local citizens. These data focuses on perspectives of hazard, risk, vulnerability and resilience. The three research objectives of the project are:

*Theoretical.* Explore a range of methods (quantitative and qualitative) to determine their relevance to traditional vulnerability assessment techniques in the context of seismic hazards.

*Empirical.* Apply the adapted vulnerability assessment techniques to analyze the social vulnerability of communities in the Capital Regional District (CRD) to seismic hazard.

*Policy-Oriented.* Identify the policy implications of the research findings by highlighting gaps in knowledge and awareness. Second, to generate recommendations for the provincial health system and local and regional government agencies to support the development of more disaster-resilient communities.

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<sup>2</sup> For the purposes of this paper, a *disaster-resilient community* is defined as a community that is able to absorb change and disturbance and advance through learning and adaptation in its' recovery process (adopted from Holling, 1973 and Cutter et. al., 2008).

## **1.4 Research Context: Frameworks in Disaster Planning and Risk Analysis**

Disaster planning is a complex field and can be approached from many different angles. In essence, the field seeks to analyze, understand and reduce aspects of risk, which is, “in the broadest sense, continuously and socially constructed. It promotes an active and adaptive view of the responsibilities of human societies” (Hewitt, 1997, p.22). Such dynamic phenomena as risk and disaster require a multi-faceted approach. Hewitt describes the elements of risk as follows: hazards, vulnerability and adaptability, intervening conditions of danger and human coping and adjustments (1997, p. 24). Each of these four elements makes up a research specialty on its own, yet today there are three general frameworks in disasters research that are elaborated on in the following sections. Each approaches and defines risk from a slightly different angle.

### **1.4.1 Hazards Framework**

The hazards framework focuses on the scientific analysis of the characteristics of hazards (e.g. magnitude, frequency, duration, areal extent, speed of onset, spatial dispersion and temporal spacing) (Burton et al., 1993). “A ‘hazards’ view emphasizes phenomena, usually ‘physical agents’, in the natural or artificial environment that pose threats” (Hewitt, 1997, p. 25). This framework permeates most writing in the field and is scientifically based. Risk of disasters is measured as a function of physical hazard and exposure ( $\text{Risk} = \text{Hazard} + \text{Exposure}$ ). For many years, “hazard-based and hazard-specific work has been so pervasive that a hazard perspective prevails” (Hewitt, 1997, p.25). More recently, researchers have regarded the hazards framework to be

“incomplete, reactive and [exclusive] of all the variables and disciplines related to disaster” (McEntire et al., 2002, p.10). A shift towards the social forces that promote human vulnerability brings us to the second framework.

#### **1.4.2 Vulnerability Framework**

Over the past few decades, the vulnerability framework of disasters research has gained a strong foothold. More and more, vulnerability research and hazards research are being used to complement one another. “Vulnerability involves, perhaps above all, the general and active capacities of people—what enables them to avoid, resist or recover from harm. Whereas a hazards perspective tends to explain risk and disaster in terms of external agents and their impacts, vulnerability looks to the internal state of a society” (Hewitt, 1997, pp27-28). Essentially, the vulnerability framework does not ignore the importance of the physical hazards, but it emphasizes the human dimensions of vulnerability to reduce risk (Blaikie et al., 1994; McEntire, 2001). A premise of the vulnerability framework is that without a human component, a natural hazard would not cause a disaster. The vulnerability framework evaluates risk as a product of hazard and vulnerability ( $\text{Risk} = \text{Hazard} \times \text{Vulnerability}$ ), in which vulnerability represents the human component. This approach is also referred to as *comprehensive vulnerability management*, a framework that seeks to expand the “research agenda of disaster studies because there are numerous factors from both the physical and social environments that interact to determine the degree of vulnerability” (McEntire et al., 2002, p. 11). Comprehensive vulnerability management includes investigation of the “factors that produce risk and susceptibility, as well as the characteristics that promote resistance and

resilience, and the complex interactions of liabilities and capabilities” (McEntire et al., 2002, p.11).

### **1.4.3 Resilience Framework**

Cutter et. al. (2008) have pioneered a theoretically grounded approach for measuring community resilience using a variety of community indicators. In their research, entitled *Disaster Resilience of Place* (Cutter et al., 2008) the focus is on the ecological, social, economic, institutional, infrastructure and community competence attributes of place. Some examples include biodiversity, erosion rates, demographics, employment rates, transportation networks, health and wellness, and quality of life (Cutter et al., 2008). Others have identified the resilience framework as the emerging approach for “understanding the dynamics of social-ecological systems” (Folke, 2006; Berkes, et al., 2003, Berkes, 2005).

## **1.5 Research Context: Physical Hazard Assessment**

British Columbia’s Pacific Coast is part of the *Pacific Ring of Fire*, the most earthquake-prone region of Canada (NRCan—C, 2008). Indeed, three distinctive types of earthquakes occur here: shallow earthquakes within the continental crust overlying the North American plate (crustal earthquakes); deep earthquakes within the subducting Juan de Fuca plate (intra-plate or sub-crustal earthquakes); and rare, but very large magnitude thrust events at the interface between the oceanic and continental plates in the offshore region (plate-boundary or subduction earthquakes) (Onur et al., 2005; Cascadia Region Earthquake Working group [CREW], n.d.; Rogers, 1998; Sheldlock & Weaver, 1991).

Being prone to three types of seismic activity is quite unique and poses additional hazard possibilities, especially in coastal areas (Rogers, 1998; Clague, 2006).

Some researchers express the view that the greatest hazard may not in fact be a looming *megathrust* quake, however much of the research still focuses on understanding this particular tectonic event because of its potential for damage (Clague, 2002).

Historically, all earthquakes experienced in southwestern B.C. are the result of crustal and intraplate activity (Clague, 2002; CREW, n.d.).

Current research measuring rates of tectonic plate movement using Global Positioning Systems (GPS) indicate that “points on the outer coast of the North American Margin which overlie the locked portion of the Cascadia Subduction Zone, move at rates of over 10mm/yr in a northeasterly direction” (NRCan—A, 2008, par. 5). Inland sites of measurement seem to be moving at only about half that rate, indicating that the “outer margin is slowly being compressed like a spring” (NRCan—A, 2008, par. 5). The next giant earthquake is predicted to cause the release of the total accumulated compression, resulting in the outer coast of southern Vancouver Island moving up to 5 meters to the southwest (NRC, 2008) and that the west coast of the Island may subside about 1m (Clague, 2002)<sup>3</sup>.

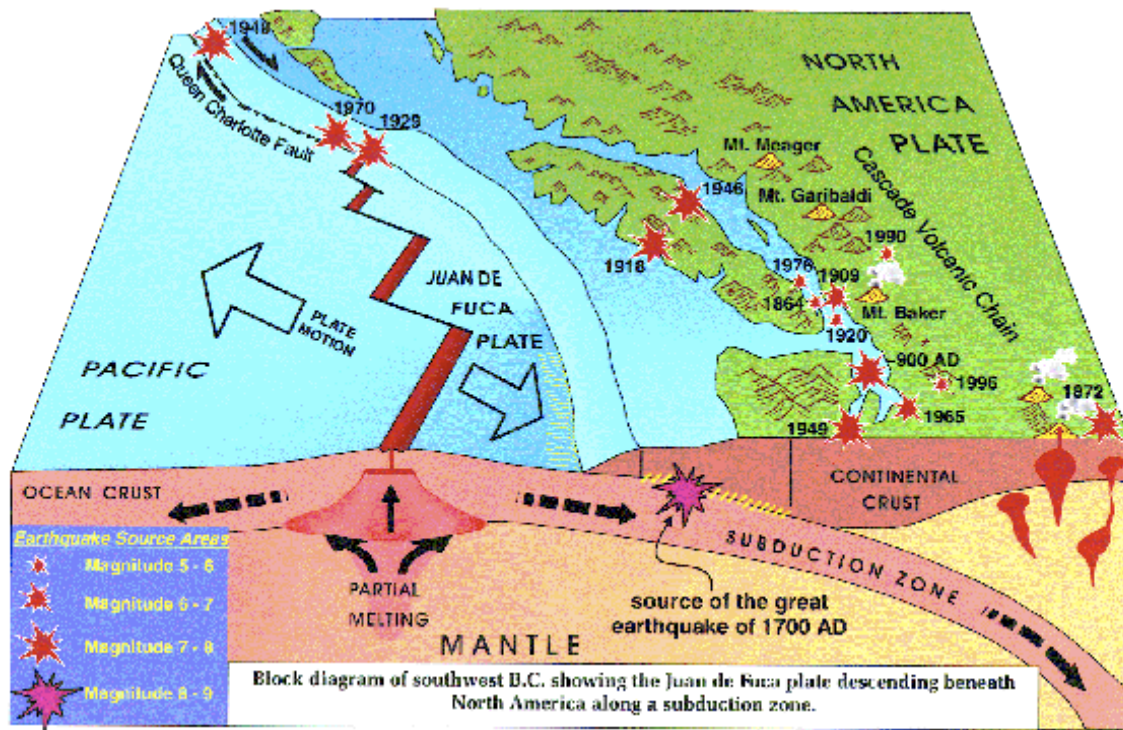
Large earthquakes also occur on faults within the North America plate. Most of these earthquakes are probably caused by northerly clockwise rotation of a large crustal block against the southern Coast Mountains of B.C. Crustal earthquakes commonly occur along east-trending reverse faults or northwest-trending complex structures.

—*Clague, 2002, p.10*

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<sup>3</sup> Note that coastal sedimentary evidence indicates that this type of land subsidence happened as a result of the last great subduction earthquake in 1700 +/-

### 1.5.1 History of Earthquakes in the Region



**Figure 3** Cascadia subduction zone and historical earthquake events (Source: Clague, 2002)

Earthquakes occur in British Columbia on a regular basis. In fact, seismologists record over 200 earthquakes in southwestern B.C. each year (Rogers, 1998). In the past 70 years more than 100 earthquakes large enough to cause structural damage had they been closer to land (i.e., magnitude 5 or greater) have been recorded (CREW, n.d.). However, most of them are too small (Clague, 2002) or too far off the coast (CREW, n.d.) to be felt. Nonetheless, it is estimated that “an earthquake capable of causing structural damage [to buildings, transportation infrastructure and life lines] can be expected to occur somewhere in the region about once every 10 years” (PEP, 2000, p.1). Recent structurally damaging earthquakes in the region include the 1946 earthquake on Central Vancouver Island and the 2001 Nisqually earthquake in Washington State. The 1946

earthquake is Vancouver Island's largest historic earthquake, with a magnitude of 7.3 (NRCAN—D, 2010). The ground shaking from this quake knocked down many chimneys and brick buildings in the surrounding area, caused much panic and was felt as far away as Portland, Oregon (NRCAN—D, 2010). The 2001 Nisqually earthquake caused light to moderate damage throughout the Seattle-Tacoma metropolitan area (USGS, 2009). Figure 1.2 (above) is useful in visualizing the historical location of quakes in the area and highlighting the geotechnical aspects of the movement of the Pacific and Juan de Fuca plates.

### **1.5.2 Earthquake Hazard Probabilities**

It is generally accepted that the probability of a giant earthquake impacting the coast of BC in the next 200 years is high (PEP, 2000). The last subduction zone earthquake occurred in 1700, with a repeat cycle estimated between 300 and 800 years (PEP, 2000). Table 1 (below) illustrates the average recurrence of different types of earthquakes in the area based on historic record. The science of measuring earthquake magnitudes has evolved since the time of the popular *Richter Scale*. Today, moment magnitude (or  $M_w$ ) is used in the Pacific Northwest to quantify the size of an earthquake (Clague, 2006). This measurement is based on the actual length of the fault rupture and the total energy released by the quake.

Type and size of earthquake (moment magnitude)	Average recurrence <sup>1</sup> (years)	Area of damage <sup>1</sup> (km <sup>2</sup> )
Subduction, M <sub>w</sub> 8-9+	500	100,000
Crustal/ intraplate, M <sub>w</sub> 7-7.5	30-40	20,000
Crustal/ intraplate, M <sub>w</sub> 6	20	5,000
Crustal/ intraplate, M <sub>w</sub> 5	5	1,000

**Table 1 Comparison of average recurrence and affected area for different earthquakes in southwestern British Columbia and north-western Washington (Source: Clague, 2002)**

<sup>1</sup> Values are approximate

Although there is a high probability that a large magnitude earthquake (i.e., 7-9) will occur as a result of the Cascadia fault rupturing in the future, this type of tectonic activity is not considered to be the biggest earthquake hazard faced by the west coast as the fault is located so far offshore (NRCan, 2008). British Columbia's biggest earthquake hazards are from smaller, more frequently occurring crustal earthquakes (NRCan, 2008). As a reference, consider the 2001 Nisqually Earthquake. This hazard event had a magnitude 6.8 in a similar geological setting and caused over \$2 billion in damage (Clague, 2006).

In 2007, the earthquake working group of the B.C. Ministry of Health, Emergency Management Branch built a solid case for the need to design and implement emergency response systems for a probable earthquake in the urban areas of Vancouver and Victoria (Smith et al., 2007). The probability of a damaging earthquake is laid out for both Vancouver and Victoria, for 10, 50 and 100 years by Onur & Seemann (2004). There is a 54% combined probability that a damage-causing earthquake affecting the Victoria region will occur in the next 100 years. Seventeen percent of this probability is attributed to a potential offshore subduction megathrust earthquake, while 37% is attributed to local crustal or sub-crustal fault ruptures (Onur & Seemann, 2004).

### **1.5.3 Secondary Earthquake Hazards**

Although earthquakes themselves can be traumatizing and damaging events, secondary hazards such as landslides, liquefaction, fire, disease outbreak, tsunami and aftershocks are also important and can greatly exacerbate regional response post-earthquake. In addition, many other variables can amplify the effects of seismic activity including the earth's surface materials. Secondary earthquake hazards often severely confound emergency response actions and strongly influence the overall impact of an earthquake disaster. This was evident during the large 2011 earthquake in Sendai, Japan where aftershocks, tsunami, fire and nuclear reactor complications were prevalent hazards over a month after the original earthquake event on March 11<sup>th</sup>. The severity and scale of the triggering earthquake event combined with the secondary earthquake hazards and the given vulnerability, resilience and adaptive capacity of the affected area determines the recovery time. In many areas, it can take years before secondary earthquake hazards are no longer a threat. For example, the 7.0 magnitude earthquake that struck Haiti in 2010 caused tremendous damage, injury and loss of life. Over a year later, the nation continues to suffer from cholera and other disease outbreaks caused by lack of sanitation and access to clean drinking water due to infrastructure damaged during the 2010 quake.

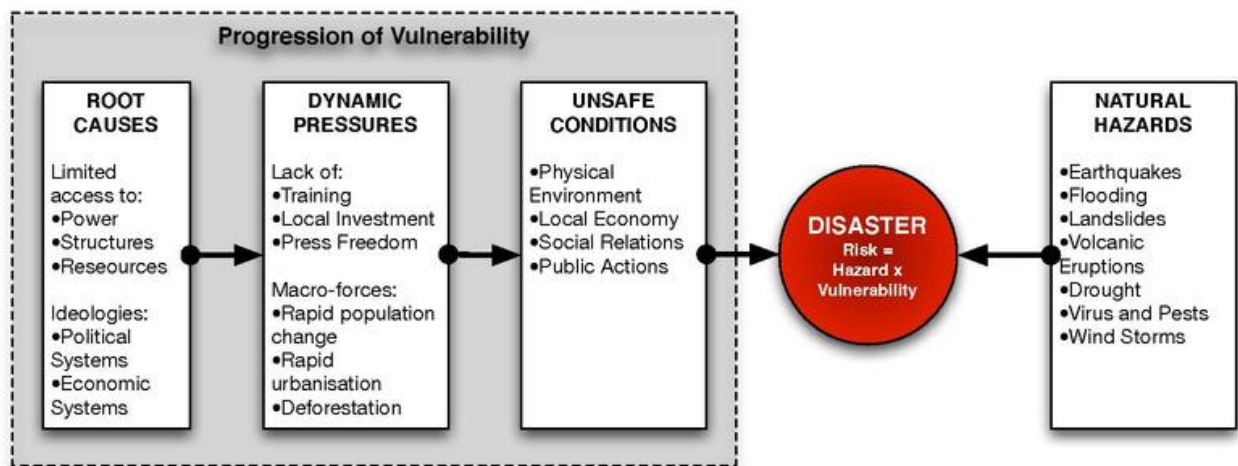
The secondary earthquake hazards that pose the greatest threat to the CRD study area are landslides, liquefaction, fire, tsunami and aftershocks.

## **1.6 Research Context: Vulnerability Assessments**

Risk and vulnerability for any type of disaster are important to assess for greater preparedness, mitigation or response (Adams, 2008). Cutter outlines three tenets to vulnerability research in the hazards field (2003, 242-243):

- 1) *Identification of conditions that make people or places vulnerable to extreme natural events.*
- 2) *The assumption that vulnerability is a social condition, a measure of societal resistance or resilience to hazards.*
- 3) *Integration of potential exposures and societal resilience with a specific focus on particular places or regions.*

The vulnerability component is complex and can be considered to be comprised of root causes, dynamic pressures and unsafe conditions as illustrated in the Pressure and Release Model (Figure 4) developed by Blaikie et al., in 1994 and later refined by Wisner et al., 2004. The PAR Model is good in that it looks to incorporate multiple sources of vulnerability: societal, social, infrastructural and historical. In as much, it places heavy emphasis on the vulnerability aspect of disaster and less emphasis on the hazard component. Applying this framework to the CRD, points to the susceptibility of the region with its heavy reliance upon tourism (dynamic pressure and unsafe conditions in terms of volatile investment and diversification in the local economy). The model underlines the importance of people being a key component in a ‘disaster’ and reinforces the need to make vulnerability assessments a key component in disaster planning.



**Figure 4 Pressure and Release Model (Blaikie et al., 1994; Wisner et al., 2004)**

As the Pressure and Release (PAR) Model shows, assessing vulnerability involves examining the root causes, dynamic pressures and unsafe conditions within a community. Factors contributing to vulnerability can be as straightforward as a lack of training in mitigation, preparedness, response and/ or recovery or as complex as deeply-rooted social and economic issues (Blaikie et al., 1994). The PAR model essentially illustrates that “vulnerability is rooted in social processes and underlying causes which may ultimately be quite remote from the disaster event itself” (Wisner et al., 2004, p 50). This study will attempt to uncover some of the root causes, dynamic pressures and unsafe conditions contributing to the progression of vulnerability in the CRD.

## **1.8 Methodological Approach**

The first phase of this research project features a quantitative spatial analysis of the social vulnerability of populations in the CRD using Census Canada data. The methodology used here closely replicates that used by Drs. Cutter et al., (2003) from the University of South Carolina. A second phase of the study uses qualitative data gathered from focus groups and key informant interviews to examine perceptions of risk and adaptive capacity of individuals living in the study communities. Data from both phases were compiled and presented in each of the study communities. Participants in these workshops engaged in discussion around the validity of the research findings.

## **1.9 The Geographic Focus of the Thesis**

This thesis combines background knowledge of physical geography (seismic hazard) with investigation into the human geography realm (the study of human vulnerability and

resilience). The research project also examines the spatial patterns associated with social vulnerability and perceptions and strengths in urban, rural and remote communities.

The dictionary of human geography defines human geography as the study of: “the spatial differentiation and organization of human activity and its interrelationships with the physical environment” (Johnston et al., 2000, p. 353). This research project examines how people perceive their abilities to cope and adjust when the physical environment, social and economic systems are impacted by a hazard event. Human interactions with the physical environment have implications for how neighbourhoods, communities and cities are currently designed and built. The implications of natural hazards for the planning and design of communities is enormous. Understanding where vulnerabilities exist in relation to hazard modelling and prediction is key to enhancing the resilience of our communities.

Vulnerability is socially constructed (Hewitt et al., 1997) as it is “a condition rooted in historical, cultural, social and economic processes that impinge on the individual’s or society’s ability to cope with disasters and adequately respond to them” (Cutter et al., 1996). Researchers in geography and the broader social sciences are concerned with issues of social construction for a variety of reasons. This interest infiltrated the discipline of geography in the 1970s and 1980s when many social geographers adopted the “view that meaning is constituted by and through social interaction” (Johnston et al., 2000, p. 178). Geographers are concerned with social construction and the issues they present as they create an epistemology from which knowledge is legitimized. It is important, as both a researcher and citizen of society, to recognize that everything we

*know*, we *know* through a lens. This lens can evolve as we grow, change and expand our minds, yet it is always there. As such, knowledge is inherently subjective.

The *Dictionary of Human Geography* defines ‘social construction’ as “the idea that the social context of inquiry, rather than the world which is investigated, determines—constructs—knowledge” (Johnston et al., 2000, p.747). There are no absolutes in knowledge, as knowledge is always relative to its social setting. As a result of its relativity, knowledge is created through “the outcome of an active process of fabrication rather than the discovery of a reality pre-existent and fully formed” (Johnston et al., 2000, p.748). I believe that all knowledge is ‘situated’ i.e., it is affected by ethnicity, gender, ideology, religion and the personal values of the researcher and the context (location, circumstances) in which the research takes place. The research project in question follows this view (attributable to feminist, postmodern and post-structural schools of thought) by investigating social vulnerability on a place-by-place basis to construct knowledge around this topic. The knowledge that arises through this process is conveyed through the lenses of the research subjects as interpreted by the researcher.

### **1.10 Structure of the Thesis**

The purpose of this thesis is to examine social vulnerability to seismic hazards, as well as people’s perceptions of risk, vulnerability, resilience and adaptive capacity. Although these objectives are inextricably linked, as complementary and necessary components of a holistic vulnerability analysis, the methods for each were employed separately with neither part reliant on the other though they do work together to complement each other. Given this viewpoint, chapters two and three were written as stand alone manuscripts complete with their own introductions, literature reviews, methods, results and

conclusions. The downside of this approach is that there is some degree of redundancy, or unavoidable repetition throughout the thesis.

In its entirety, the overall thesis is developed in four chapters as follows:

- Chapter 1 outlines the key research goals and objectives of the project and describes the research context through a review of the literature. This chapter emphasizes the physical vulnerability to earthquake hazards in the CRD, describes the study area and provides a rationale for the research methodology that was chosen.
- Chapter 2 presents an analysis of the social vulnerability of people living in the CRD using proxy variables and indicators developed from 2006 Census of Canada data. The methods employed in this analysis were replicated from Cutter et al., Social Vulnerability Index (2003).
- Chapter 3 develops a qualitative analysis to explore perceptions of risk, vulnerability, adaptive capacity and resilience to seismic hazards within several communities (urban, rural and remote) within the CRD. These data were compiled from qualitative interviews with key informants and from local citizens living in communities in the CRD.
- Chapter 4 discusses the research findings and contributions of the project. It also highlights the policy-related recommendations and project limitations and ends with some ideas on future directions for research.

## **Chapter 2**

### **Mapping Social Vulnerability to Earthquakes in the Capital Regional District**

#### **2.0. Introduction**

Historically, disaster research has been based on the scientific analysis of the characteristics of natural hazards (Burton et al., 1993). Over time, there has been a shift towards incorporating, or even focussing on the human dimension of vulnerability to reduce risk (Blaikie et al., 1994; McEntire, 2001); “...natural disasters should be seen as part of an ongoing relationship between society and nature, not as one-off, extreme events taking place outside of development” (Pelling, 2003, p.47). Without a human component, a natural hazard would not necessarily cause a disaster.

The purpose of this project is to assess the social vulnerability of people living within the Capital Regional District (CRD) using data from the 2006 Census of Canada. This study replicates the methods developed by Drs. Cutter, Mitchell and Shirley of the Hazards Research Lab at the University of South Carolina in 1997 to evaluate social vulnerability (*Social Vulnerability Index (SoVI)*) and assess risk for the CRD.

#### **2.1. Defining the Terms: Social Vulnerability**

In this analysis, vulnerability refers to a dynamic process that is in constant flux. This dynamism means that vulnerability is very complex. Understandably, “Vulnerable groups will vary from society to society, and situation to situation, where very specific differences based on class, caste (if applicable), gender, health status and disability, age, race, nationality and immigration status and location may all have a role” (Wisner et al., 2004, p.340).

Disaster research defines vulnerability as “a susceptibility to harm, a potential for a change or transformation of the system when confronted with a perturbation, rather than as the outcome of the confrontation” (Gallopín, 2006). Social Vulnerability as defined by Cutter et al., is a more holistic way of looking at vulnerability, since it incorporates inequality on a community or place-based scale.

Social vulnerability is partially the product of social inequalities—those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond. However it also includes place inequalities—those characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality, that contribute to the social vulnerability of place.

—Cutter et al. 2003, p.243

Social vulnerability recognizes, but is less focussed on the physical hazard, thereby moving away from the dominant, hazard-centric paradigm of disasters research and emergency management. Social vulnerability refers to the continuous state of human and place-based inequality, which can be both informative and prescriptive independent of hazard. As such, social vulnerability can reflect overall community health. Many of the social and lifestyle indicators used to measure social vulnerability, described in detail below, are tightly tied to the twelve social determinants of health used by the *Public Health Agency of Canada (2001)*. Theoretically, working to mitigate social vulnerability also works towards improving community health and the health of people living within those communities. Healthier communities with lower levels of vulnerability will likely be able to cope and recover more readily in the event of an earthquake. Further, by

building healthier communities with lower levels of vulnerability, demands on the health system would theoretically decrease both for day-to-day usage and post-disaster usage.

### **2.1.1 Social Indicators**

Social indicators have been used since the 1830s across the western world to benchmark and improve public health and social conditions (Cobb & Rixford, 1998). In the 1970s, many international organizations such as the United Nations (UN) and the World Health Organization (WHO) began to develop various sets of indicators as a part of their mission statements. From these efforts, the Human Development Index and Healthy Communities movements were born (Cobb & Rixford, 1998, p.16). Although social indicators are more commonplace today, an agreed upon set of indicators measuring social vulnerability is unavailable “despite the clear need to develop such a robust and replicable set” (Cutter, 2003, p.16). The indicators used here inform the provincial Ministry of Health Services on vulnerability in the Capital Regional District with respect to earthquake hazards.

## **2.2 The Social Vulnerability Index**

As noted, quantifying social vulnerability is a complex process without a clear, widely accepted prescription. In the past, numerous types of vulnerability assessments have been created, each offering differing approaches and emphases. The Social Vulnerability Index (SoVI) was applied across the United States by Drs. Cutter, Boruff and Shirley in 2003. Three tenets for vulnerability research were identified: the conditions that make people or places vulnerable to extreme natural events; the assumption that vulnerability is a social condition, a measure of societal resistance or resilience to hazards; the integration

of potential exposures and societal resilience with a special focus on particular places or regions”. Using these tenets as a foundation, the index uses 42 independent variables to create 11 proxy indicators of vulnerability (race and ethnicity are further broken down to create more categories in the application):

- **Personal wealth:** wealth enables recovery, yet also means there may have been more to lose in the first place
- **Age:** children and older adults are particularly vulnerable
- **Density of the built environment:** high density can complicate evacuation
- **Single-sector economic dependence:** income generation from a single economic sector creates vulnerability
- **Housing stock and tenancy:** most vulnerable are those living in mobile homes, renters and those living in urban areas
- **Race and gender:** Visible minorities, especially females, often experience lack of access to resources, cultural differences, and the social, economic, and political marginalization that is often associated with racial disparities
- **Ethnicity:** Hispanic and native populations enhance vulnerability
- **Occupation:** lower wage service occupations may experience slower recovery
- **Infrastructure dependence:** transportation, utilities and communication

### 2.3 Physical Environment Context: Earthquake Hazards in the Capital Regional District

Three types of earthquakes pose a hazard to the Capital Regional District (CRD): megathrust (subduction), crustal and sub-crustal (Clague, 2002; Hamilton, personal communication, 2010). The megathrust or subduction earthquake is probably the most well known and understood by the general public. However, this type of tectonic activity is not considered to be the biggest earthquake hazard faced by the CRD as the fault is located far offshore, and the CRD is somewhat protected from potential tsunamis by the Olympic peninsula. The CRD’s biggest earthquake hazards thus arise from smaller, more frequently occurring inland earthquakes (NRCan, 2008; Hamilton, personal

communication, 2010). Onur & Seemann (2004) illustrate this point further by calculating shaking probabilities for earthquakes causing structural damage to buildings in Victoria on a 10, 50 and 100-year scale. They calculate there is a 32% combined probability that earthquake shaking will cause structural damage in Victoria in the next 50 years (Onur and Seemann, 2004). Within this probability 11% is attributed to an offshore subduction megathrust earthquake, while 21% is attributed to local crustal or sub-crustal faults (Onur & Seemann, 2004).

Earthquake hazards are not predictable in the manner common to other types of natural hazards. Also, secondary earthquake hazards such as aftershocks, landslides, liquefaction, tsunamis or fires can greatly exacerbate the amount of damage that occurs. In addition, variables such as time of day, the earth's surface materials and shaking intensity can also amplify the effects of seismic activity.

## **2.4 Vulnerability Assessments as a Tool in Risk Analysis**

Vulnerability assessments are an extremely valuable component of risk analysis, at all stages of the disaster cycle. Without adequate consideration of vulnerability, risk analysis is simply focused on the physical hazard. Vulnerability assessments incorporate the human component that lead to disaster, into risk analysis.

The traditional approach to research in the field of emergency management has been through the scientific analysis of the characteristics of hazards (e.g. magnitude, frequency, duration, areal extent, speed of onset, spatial dispersion and temporal spacing) (Burton et al., 1993). This approach is often called hazard mapping. With this focus, the human aspect that is the source of vulnerability is significantly discounted. As a result, the dominant approach to disaster planning is now seen as “incomplete, reactive and

[exclusive] of all the variables and disciplines related to disaster” (McEntire et al., 2002, p.10). Disaster management needs to encompass a much more holistic set of tools and maintain a broader focus upon which to base risk assessments.

The majority of disaster managers tend to believe that disaster risk assessment is synonymous with scientifically generated ‘hazard mapping’, and that this is the sum total of the diagnostic process. This view stems from a technocratic and fundamentally false assumption that once hazards are mapped in terms of their location, duration, frequency, severity and impact characteristics, then the risk assessment process is complete.

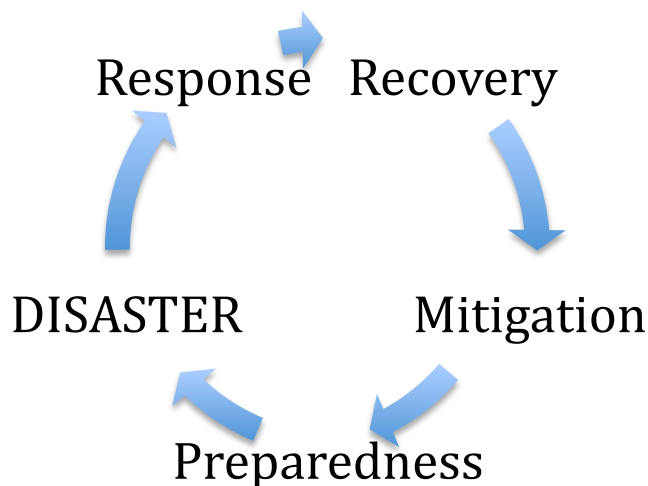
—Wisner et al., 2004, p.333.

Without consideration of the human component, we are left simply with hazards and the notions of risk and disaster are not of concern (Mileti, 1999). In order to be prepared for any type of emergency situation, an awareness of the vulnerabilities of a community must be established (Adams, 2008). The human component needs to be included in risk analysis by taking a closer look at what factors make people in various locations vulnerable to hazards.

By incorporating vulnerability assessments into risk analysis, it is possible to identify communities and/or regions within communities that may require greater assistance in terms of mitigation, preparedness, response and recovery. Further, vulnerability is dynamic, changing on a regular basis, whether daily, seasonally or annually. Another challenge faced in assessing vulnerability is the inherent difficulty of trying to encompass all aspects of such a dynamic phenomena; “vulnerable people often suffer a series of interrelated disasters and that their vulnerability often increases through failure of recovery” (Wisner *et.al.*, 2004, p.340). More often than not, vulnerability assessments

look at smaller segments of the overall picture, generally through a specific lens, e.g. health. As a component of risk analysis, vulnerability assessments also need to look at resilience as some vulnerable communities may have the capacity to rebuild quickly.

#### 2.4.1 Vulnerability Assessments and the Disaster Cycle



**Figure 5 The Disaster Cycle (Change, 2009)**

The disaster cycle, illustrated in Figure 5, is composed of four primary phases: response, recovery, mitigation and preparedness.

Vulnerability assessments have value at every stage of the disaster cycle. The goal of the vulnerability approach “is to reduce people’s vulnerability by increasing their capacities to prepare for, to cope with and to mitigate the

adverse effects of disasters” (Wisner et al., 2004, p.

335). As a component of risk analysis, vulnerability assessments are an important step in the mitigation process. Identifying vulnerabilities and assessing risk create a baseline for mitigation projects. By conducting wide scale vulnerability assessments, the communities and regions that are most vulnerable can be identified and efforts devoted towards effective response, recovery and preparedness.

## 2.5 Indicators influencing Social Vulnerability in the CRD

Vulnerability can vary at all scales; spatial, temporal and social making it difficult to measure. The proxy variables chosen for this project were informed by previous research (Cutter et al., 2003; Fox, 2008). Cutter et al., employed 42 variables and efforts were

made to match these variables from Canadian Census data. Similar to the variables selected by Cutter et al., the variables selected here represent such standard indicators as population density, gender, family structure, housing, employment, etc. Some of the variables used by Cutter et. al. that were not available from the Canadian census include the number of physicians per capita, number of people taking medication per capita, the area of land per capita that was being used for farming, the earnings of local industry and other manufacturing-sector related variables. These additional variables are simply not collected by Canadian census. Further data about physicians and medicated individuals per capita would be useful in informing this research but this type of data is collected by health authority in Canada. These health authorities have very different physical bounds than census tracts and subdivisions making it very difficult to compare this information to census information.

### 2.5.1 Summary of Included indicators

Indicator	Variable
Population Density	Number of people per square metre
Gender	Percentage of the population that is female
	Percentage of females making less than \$20,000 per year
Family structure	Percentage of lone parent families
	Average number of children at home per census family
	Average number of people per census family
	Percentage of people over the age of 65 living alone
Housing	Percentage of rented dwellings
	Percentage of dwelling requiring major repairs
	Percentage of private dwellings built before 1980
	Percentage of private dwellings that have five or more storeys
Socio-economic status	Percentage making less than \$20,000 per year
Race & Ethnicity	Percentage without knowledge of French or English
	Percent that have migrated in past the past five years (internal and external)
	Percentage of immigrants
	Percent identifying as a visible minority
	Percent identifying as aboriginal
Age	Percentage of the population that is 19 years and under
	Percentage of the population that is over 65 years
Education	Percent of people aged 25-64 with less than high school certification
Population Growth	Percent population change from 2001-2006
Social dependence	Percent total income from government transfer payments
Employment	Percent unemployed
	Percentage of people employed in a different subdivision than where they live
	Percent 15 and over not employed in managerial, professional or supervisory positions

**Table 2 Social Vulnerability Indicators and Proxy Variables**

#### 2.5.1.1 Population Density

Population density often dictates whether an area is defined as urban, rural or remote.

Both high and low density can contribute to vulnerability in a disaster situation. High

population density can cause difficulties during an evacuation. Further, with more people concentrated in an area, there is likely to be more damage, injury, demand on resources and overall chaos.

Low-density developments, such as those that characterize rural and remote areas often have reduced access to emergency resources. Rural populations may also be more vulnerable due to lower incomes and given less diversified economies (e.g., dependent on single resource extraction such as logging or fishing) (Cutter et al., 2003).

#### **2.5.1.2 Gender**

Generally speaking, women can have a more difficult time recovering from disasters than men due to their confinement to sector specific jobs, lower income and family responsibilities (Blaikie et al, 1994; Cutter et al., 1997). The proxy variables chosen to represent this indicator are percentage of the population that is female and percentage of females in low income categories (i.e., making less than \$20,000/ year). The low income cut off (LICO) in Canada was \$21,359 in 2008. Census data only provides income distributions in ranges, hence the use of the ‘making less than \$20,000/year’ variable to indicate low income.

#### **2.5.1.3 Family Structure**

Family structure can greatly affect vulnerability. Larger families have more dependants, while single-parent families may have fewer resources to outsource care and may be required to juggle work and family responsibilities (Blaikie et al., 1994; Heinz Center, 2000). Proxy variables chosen to represent this indicator include percentage of lone-parent families, as this is where resources tend to be most stretched. Average number of children living at home per census family, and the average number of people

per census family are also included as these provide an idea of how many dependants are in each family.

### **2.5.1.3 Housing**

Status of occupancy, quality and integrity of housing are taken into account. The percentage of rented dwellings in a census tract is used, as those living in rented homes are often financially less secure and more transient than those that own their homes. The percentage of private dwellings requiring major repairs also helps to evaluate the socioeconomic status of an area and the vulnerability of local structures. Further, buildings requiring major repairs are much more likely to suffer significant damage in the event of an earthquake. The percentage of private dwellings built prior to 1980 is also included as a proxy variable here since this date coincides with the time frame when seismic building codes were introduced in BC and buildings constructed prior to this date are likely to suffer more structural damage during an earthquake (Finn, 2004). The percentage of five or more storeys are included here as they indicate higher population density (see above) and are also vulnerable to structural damage, especially if built prior to 1980.

### **2.5.1.5 Socio-economic Status**

Not surprisingly, those with higher incomes are generally in a better position to cope with, and recover from, losses incurred during a disaster event. On the other hand, people of high socio-economic status may also be seen as having 'more to lose' if the disaster is located in high income areas or disproportionately affects these regions.

#### **2.5.1.6 Race and Ethnicity**

Race and ethnicity can pose language and cultural barriers that may hinder one's ability to respond, cope and recover from an earthquake event. For example, those without knowledge of French or English may face communication barriers. People having recently migrated or immigrated to the region may be unaware of the potential hazards in these areas. Further, newcomers and visible minorities may have a hard time 'fitting in' to the community and may not have a local support system.

#### **2.5.1.7 Age**

Minors and older adults are considered dependants and can therefore increase vulnerability. Not only are dependants generally less able to care for themselves, they also create stress for their carers.

#### **2.5.1.8 Education**

Education is positively correlated with socio-economic status; people with less education generally have lower incomes. Further, lower levels of education may increase the barriers to understanding warning signs of approaching hazards, as well as information flows such as where to go for recovery information.

#### **2.5.1.9 Population Growth**

Regions experiencing rapid population growth may not have adequate resources to accommodate this. Stretched resources in terms of housing, medical facilities, etc. can lead to increased vulnerability. The population growth indicator is measured by determining how the population in a given area has increased or decreased since the last census (five years) and is measured as percent of increase or decline.

#### **2.5.1.10 Social Dependence**

Persons dependent on government transfer payments are already socially and economically marginalized and would normally require extra support in post-disaster recovery. People depending on government transfer payments may be unemployed due to mental illness, mental or physical disability or for a myriad of other reasons that infer higher levels of vulnerability.

#### **2.5.1.11 Employment**

High levels of unemployment can strain resources and social services programs within a community, increasing vulnerability. Those employed in a different census subdivision than where they live means they are generally separated larger distances from their families on a regular (e.g., daily) basis, which can enhance stress and anxiety in the event of a disaster. Being employed in managerial, professional or supervisory positions often (but not always) assumes a certain amount of job security. Those employed at other ranks may be more likely to find their jobs affected post-disaster.

### **2.5.2 Summary of included Variables**

Table 3 displays basic descriptive statistics for variables included in the social vulnerability analysis for this study. Twenty-five variables were chosen to represent 11 indicators of social vulnerability (Table 2). There are a total of 69 census tracts in the CRD and this is the unit of analysis for the Principal Components Analysis that follows.

	N	Minimum	Maximum	Mean	Std. Deviation
Density	69	18.64	7224.49	2175.06	1722.79
% pop female	69	46.71	58.48	52.38	2.30
% females making less than \$20,000/ yr	69	30.47	58.82	41.37	5.29
Avg # ppl/ census family	69	2.30	3.10	2.72	.19
Avg # children at home/ census family	69	.50	1.30	.89	.17
% ppl 65+ living alone	69	12.90	70.00	32.06	14.00
% lone-parent families	69	5.56	32.81	16.00	5.97
% rented dwellings	69	5.68	88.00	32.29	20.39
% dwellings requiring major repairs	69	1.43	13.13	5.75	2.34
% private dwellings built before 1980	69	16.31	95.72	65.18	19.41
% private dwellings 5+ storeys	69	.00	49.64	3.60	8.99
% making less than \$20,000/ yr	69	29.01	56.19	39.41	5.77
% w/o knowledge of French or English	69	.00	3.45	.69	.77
% migrated in past 5yrs (internal and external)	69	11.94	51.09	21.99	6.60
% immigrants	69	7.02	34.06	19.29	5.23
% visible minority	69	.82	29.91	10.48	6.31
% aboriginal identity	69	.73	12.55	4.80	2.68
% pop 19 and under	69	5.2	28.9	14.13	3.98
% pop over 65	69	3.40	37.81	17.73	7.12
% ppl age 25-64 with less than high school certificate	69	.00	16.50	8.20	3.98
Population % change	69	-7.30	33.70	5.52	7.20
% total income from government transfer payments	69	10.50	40.80	24.65	5.84
% unemployed	69	.83	5.94	2.78	1.07
% ppl employed in different subdivision than where they live	69	22.74	78.95	52.82	14.76
% 15 and over not employed in managerial, professional or supervisory positions	69	37.88	80.39	63.26	8.77
Valid N (listwise)	69				

**Table 3 Descriptive statistics for included variables**

### **2.5.3 Excluded Indicators and Proxy Variables**

Some indicators and proxy variables used in other studies were excluded here, as they were either inappropriate to the regional context or unavailable in the Canadian context. Examples of variables that would have been useful, but were unavailable through census data were statistics related to health and health care infrastructure. Some of this information is available through the Canadian Institute for Health Information or the Local Health Authorities; however, these data are not available by census tract. Some information of this type (per capita residents in nursing homes, per capita community hospitals, number of physicians per capita, etc.) is readily available through the U.S. census and was used in the original application of the SoVI method in 2003.

## **2.6 Methods Overview: Social Vulnerability Index (SoVI)**

The SoVI method for examining social vulnerability is a ten-step process in which variables are collected, analyzed and mapped (Cutter, 2008). This process involves collecting socio-economic variables relevant to the research questions. Census data were drawn for the local census tracts and dissemination areas in the Capital Regional District. Variables are converted population densities, per capita or percentages in order to be more comparable and descriptive statistics are used to verify accuracy. Next, the input variables are standardized.

A Principal Components Analysis (PCA) is then performed using SPSS Version 17.0, which allows variables to aggregate or cluster as factors or components (George & Mallery, 2003). PCA is an exploratory data reduction technique that facilitates examining clustering patterns within the range of variables that are considered important in characterizing social vulnerability. The data for these variables are easy to collect and

monitor over time and across spatial scales (Cutter et al., 2003). The components that result from the PCA are named after examining correlations in the loadings matrix. This information establishes the direction of each factor, i.e., factors that increase social vulnerability should have positive values and directions, whereas factors that decrease social vulnerability should have negative values. If this is not the case, direction of the factor can be adjusted to reflect the reality of the factor's ability to increase or decrease social vulnerability. All components, with any necessary directional adjustments taken care of, are then placed in an additive model and summed to generate the overall SoVI score for each geographic area being evaluated. Finally, SoVI scores are then mapped onto base maps with regard to their standard deviations from the mean, scores  $\geq +1$  indicate high social vulnerability and scores  $\leq -1$  indicate low social vulnerability.

## **2.7 Results and Analysis**

For this study, social vulnerability to earthquakes in the CRD was assessed according to the methods discussed in the previous section. The analysis process is detailed below.

### **2.7.1 Data Collection**

To start, variables to be included in the analysis were selected from various socio-economic data available in the 2006 Canadian Census. The variables chosen were informed by previous research (Cutter, 2003; Fox, 2008), which helped to narrow down the extensive number of fields and variables available in the census. In total, 25 variables reflecting socio-economic data attributable to social, health and infrastructure vulnerability were chosen (see Table 4). Values for each variable were gathered for each of the 69 Census Tracts (CTs) in the Capital Regional District. Due to low population

density and consequent privacy infringement issues, a portion of the CRD is left out of Victoria Census Metropolitan Area (CMA) and is therefore not tracted. Rather, these outlying, low-density areas are divided by Dissemination Area (DA), for which census data is not available, even though, these DAs are technically included in the larger study. Port Renfrew is included as a 'remote' study area for the qualitative portion of this project, however it is not included in the Social Vulnerability analysis as it is within the Regional Dissemination Electoral Area Capital H Part 2 and not the tracted Victoria CMA (see Figure 9 for geographical context).

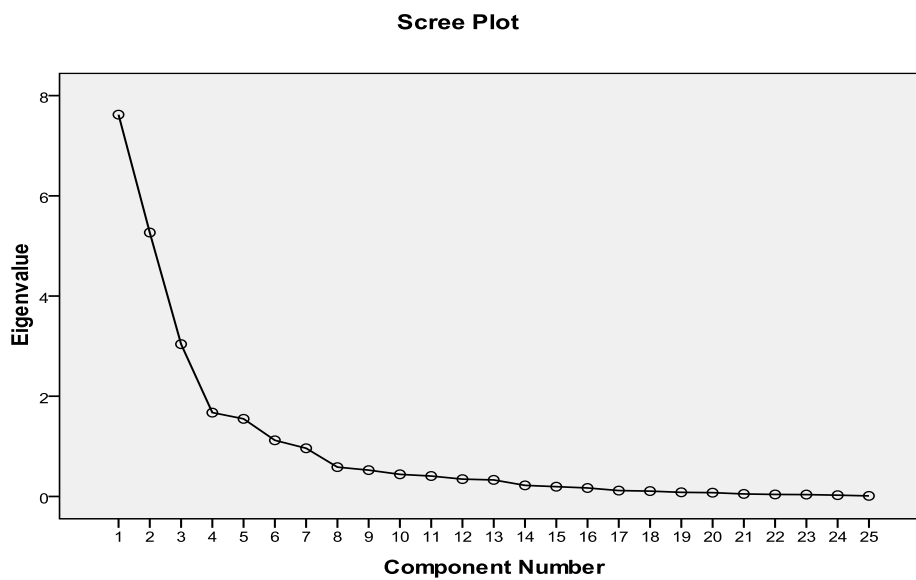
### **2.7.2 Normalization**

The collected variables were compiled into a spreadsheet and standardized to reflect percentage, per capita or density functions where necessary (see table 1). To ensure accuracy of the input variables, descriptive statistics (max, min, mean) were used for comparison. Next, input variables were normalized by transforming them into z-scores.

### **2.7.3 Principal Components Analysis**

From here, the data were entered into SPSS version PASEW Stats 17, where a Factor Analysis was performed using a varimax rotation and Kaiser criterion (values greater than 1) for component selection. The scree plot below demonstrates that the first six components with eigenvalues greater than one explain 84% of the variance with significantly diminishing returns afterwards. The first three components explain the greatest amount of variance, with the first component responsible for 30% of variance,

the second for 21% and the third for 12%.



**Figure 6** Scree plot output from PCA

The resulting rotated component matrix, displayed in Table 4 below, was carefully examined on what each component broadly represents and how each influences vulnerability.

Rotated Component Matrix<sup>a</sup>

	Component					
	1	2	3	4	5	6
Avg # children at home/ census family	-.890	.076	-.087	.249	-.227	-.066
% pop 19 and under	-.870	.183	-.087	-.077	-.295	-.108
Avg # ppl/ census family	-.867	-.099	-.315	.163	-.182	-.113
% ppl employed in different subdivision than where they live	-.713	.063	-.316	-.211	.083	-.070
% private dwellings 5+ storeys	.703	.085	.204	.073	-.068	-.118
% ppl age 25-64 with less than high school certificate	-.085	.908	.072	.074	-.067	-.174
% 15 and over not employed in managerial, professional or supervisory positions	-.157	.863	.213	-.009	.036	-.184
% aboriginal identity	.079	.824	.076	-.249	.030	.012
% immigrants	.310	-.590	-.148	.553	.324	.066
% Females making less than \$20,000/ yr	-.004	.576	.559	.303	.035	.138
% ppl 65+ living alone	.321	.073	.829	.023	.204	.146
% rented dwellings	.390	.234	.826	.145	-.002	.139
% migrated in past 5yrs (internal and external)	.144	.141	.812	-.070	.043	-.067
Density	.559	-.067	.630	.252	.090	.117
% making less than \$20,000/ yr	.268	.491	.548	.496	.029	.118
% lone-parent families	.223	.498	.547	.292	-.018	.118
% unemployed	.022	.237	.480	.464	-.254	.153
% visible minority	-.002	-.179	.074	.921	-.026	-.083
% w/o knowledge of French or English	-.076	.045	.136	.893	.011	.086
% total income from government transfer payments	.100	.393	.201	.124	.812	.114
% pop over 65	.408	-.402	-.104	-.113	.734	.096
% pop F	.295	-.425	.381	-.222	.546	.140
Population % change	.010	.120	.012	-.066	-.328	-.828
% private dwellings built before 1980	.099	-.285	.447	.088	-.057	.735
% dwellings requiring major repairs	.265	.503	.122	-.157	-.328	.526

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 10 iterations.

**Table 4 Rotated Component Matrix**

Correlations in the +/- .5 range were further investigated. Those correlations that were weaker than +/- .5 were not investigated further. Components (or factors) were given labels to reflect the underlying structure and identity of closely correlated variables within each component, as outlined in the Factor Correlation Table below Table 5.

Sign Adjustment	Factor	Name	Dominant Variables	Correlation
-	1	Family structure	Avg # children at home/ census family	-.890
			% pop 19 and under	-.870
			Avg #ppl/census family	-.867
			% ppl employed in different subdivisions than where they live	-.713
			% private dwellings 5+ storeys	.703
+	2	Gender and Ethnicity	% ppl age 25-64 with less than high school certificate	.908
			% 15 and over not employed in managerial, professional or supervisory positions	.863
			% aboriginal identity	.824
			% immigrants	-.590
			% females making less than \$20,000/yr	.576
+	3	Socio-Economic Status	% 65+ living alone	.829
			% rented dwellings	.826
			% migrated in past 5yrs (internal and external)	.812
			Density	.630
			% making less than \$20,000/yr	.548
			% lone-parent families	.547
			% unemployed	.480
+	4	Minority Groups	% visible minority	.922
			% w/o knowledge of French or English	.882
+	5	Aging and Social Dependence	% total income from government transfer payments	.812
			% pop over 65	.734
			% pop female	.546
+	6	Structures & Population Change	Population % change	-.828
			% private dwellings built before 1980	.735
			% dwellings requiring major repairs	.526

**Table 5 Summary of Component Labels, loaded Variables and Correlations**

In order to achieve the goal of having all components aligned so that higher positive values increase social vulnerability and lower negative values decrease social

vulnerability, the cardinality of a factor may need to be adjusted. The only factor requiring a sign adjustment was Factor 1—Family Structure. In this factor, we see variables with strong negative loadings that are generally thought to increase vulnerability. Average number of children at home per census family, percentage of the population under 19 and average number of people per census family all speak to dependency ratios. The higher the dependency ratio, or any of the individual variables associated, the more resources are stretched, increasing vulnerability. A high percentage of people being employed in different subdivisions where they live can pose a huge vulnerability in the event of an earthquake as a result of having to travel a greater distance between work and home. Where variables indicate negative correlations coming out of the factor analysis, yet rationally work to increase vulnerability, these correlation values were multiplied by -1.

Once the direction of each factor is determined and necessary adjustments made, the component scores are saved as a separate input variable file. Components with their directional adjustments are then placed into an additive model and summed by Factor and census tract to generate the overall SoVI score for each census tract.

## **2.8 Factors 1 through 6**

### **2.8.1 Factor 1—Family Structure**

Factor 1 was labelled *Family Structure*. The variables that loaded on this first component are directly related to the size and structure of families and details related to living arrangements. The percentage of private dwellings of five or more storeys in height helps to determine whether or not families (or individuals) live primarily in high-rise apartment buildings, giving an indication of population density as well. The number

of people travelling outside of the census subdivision where they live is another variable loading on this component. This variable is important in family structure as it could help to determine the number of children that could be separated from their families if an earthquake event occurs during typical week day work hours.

### **2.8.2 Factor 2—Gender and Ethnicity**

This factor was named *Gender and Ethnicity* resulting from the aboriginal identity, immigrant, and low-income female variables that loaded on this component. The other variables loaded here are: percentage of those without a high school certificate and those not employed in managerial, professional or supervisory positions. These are closely correlated with each other. People without high school certification are less likely to be employed as managers or supervisors. Immigrants, First Nations and low-income females are also more likely to occupy these positions. The overall direction of this factor expresses increased vulnerability.

### **2.8.3 Factor 3—Socio-economic Status**

This factor was labelled *Socio-economic Status* based on the low income, unemployment and lone parent family variables that loaded here. These variables directly translate to fewer economic resources and therefore lower socio-economic status. The population density variable is also loaded here, which can delineate rural or urban areas. Rural areas have lower population densities and also tend to have lower incomes due to lack of economic diversity and nature of the workforce (e.g., higher levels of employment in agriculture and blue collar jobs). Percentage of people who have migrated in the last five years is pertinent to socio-economic status as these people are likely to be less established in their community in both economic and social terms.

Percentage of rented dwellings is also directly related to socio-economic status as people of higher socio-economic status are more likely to own than rent property. All of the proxy variables loading on this factor increase vulnerability.

#### **2.8.4 Factor 4—Minority Groups**

This factor was labelled as *Minority Groups* as the variables loading here are linked to this label: visible minorities and those without French or English as first languages. Both variables increase vulnerability.

#### **2.8.5 Factor 5—Aging and Social Dependence**

Percentage of people receiving their total income from government transfer payments and percentage of the population over the age of 65 are the dominant variables for this component. This does not necessarily infer social dependence, but females tend to be more vulnerable than males in hazard events. Taken together, these variables increase social vulnerability. Gender also aligns with this factor given that the percentage of females loaded here. Gender loading here shows the complex relationship between the proxy indicators and the factors they have loaded on as gender is represented in Factor 2 as well.

#### **2.8.6 Factor 6—Structures and Population Change**

This factor is named for the dwelling and population variables loading here. Dwellings built before 1980 and dwellings requiring major repairs are related to *Structures*, whereas changes in population (growth or decline) are attributed to the *Change* portion of the name. All variables increase vulnerability.

## **2.9 SoVI Scores and Mapping Social Vulnerability**

Replicating Cutter et al.'s 2003 methodology, SoVI scores and the scores for each Factor were then mapped using classifications based on standard deviations from the mean, where scores  $\geq +1$  standard deviation indicate higher levels of social vulnerability, and scores  $\leq -1$  indicate lower levels of social vulnerability. ArcMap was employed to generate the maps, by incorporating the available Census data and the shape files for census tracts in the Victoria CMA as a base.

Figure 7 Map of the CRD Administrative Boundaries (CRD, 2009)

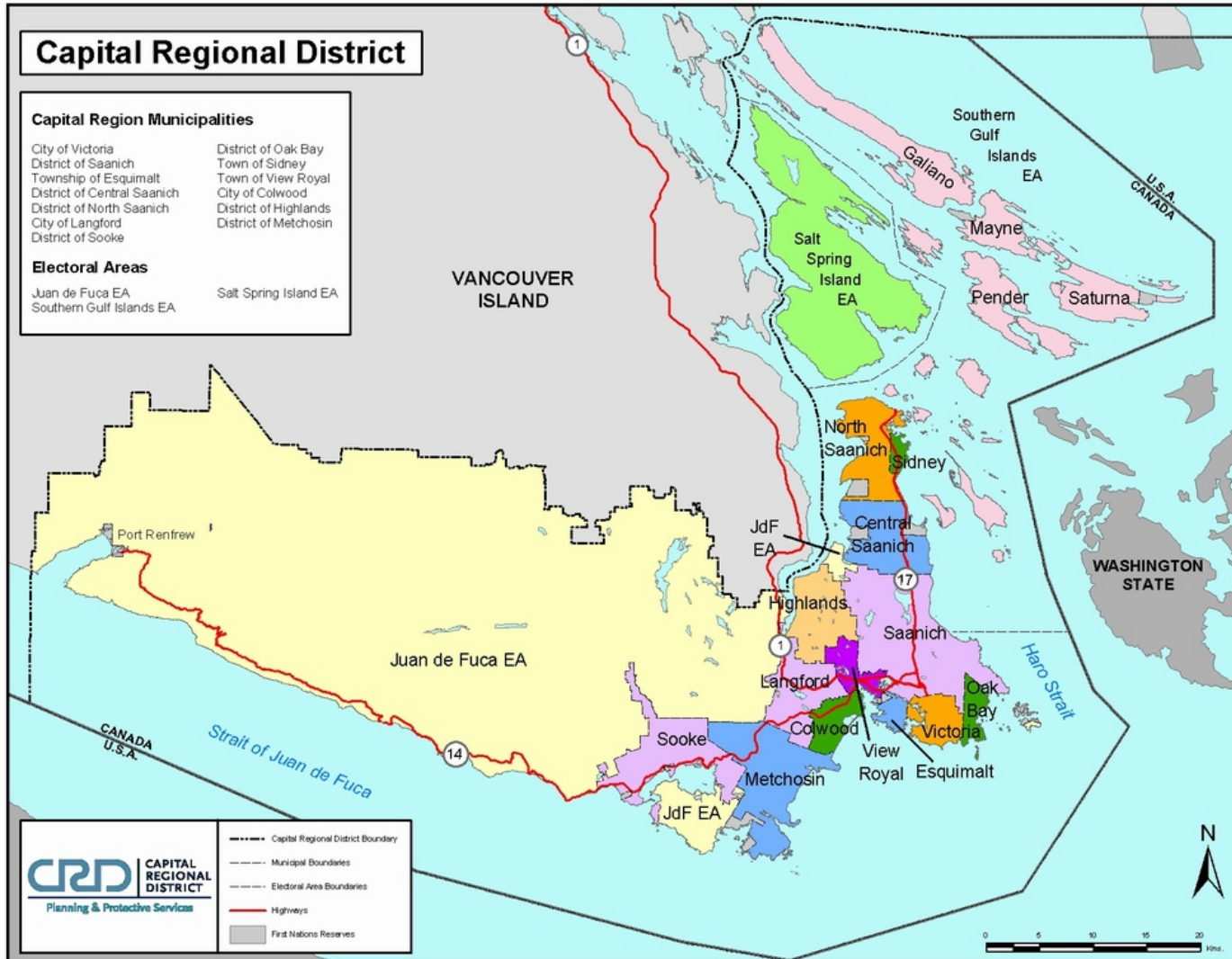
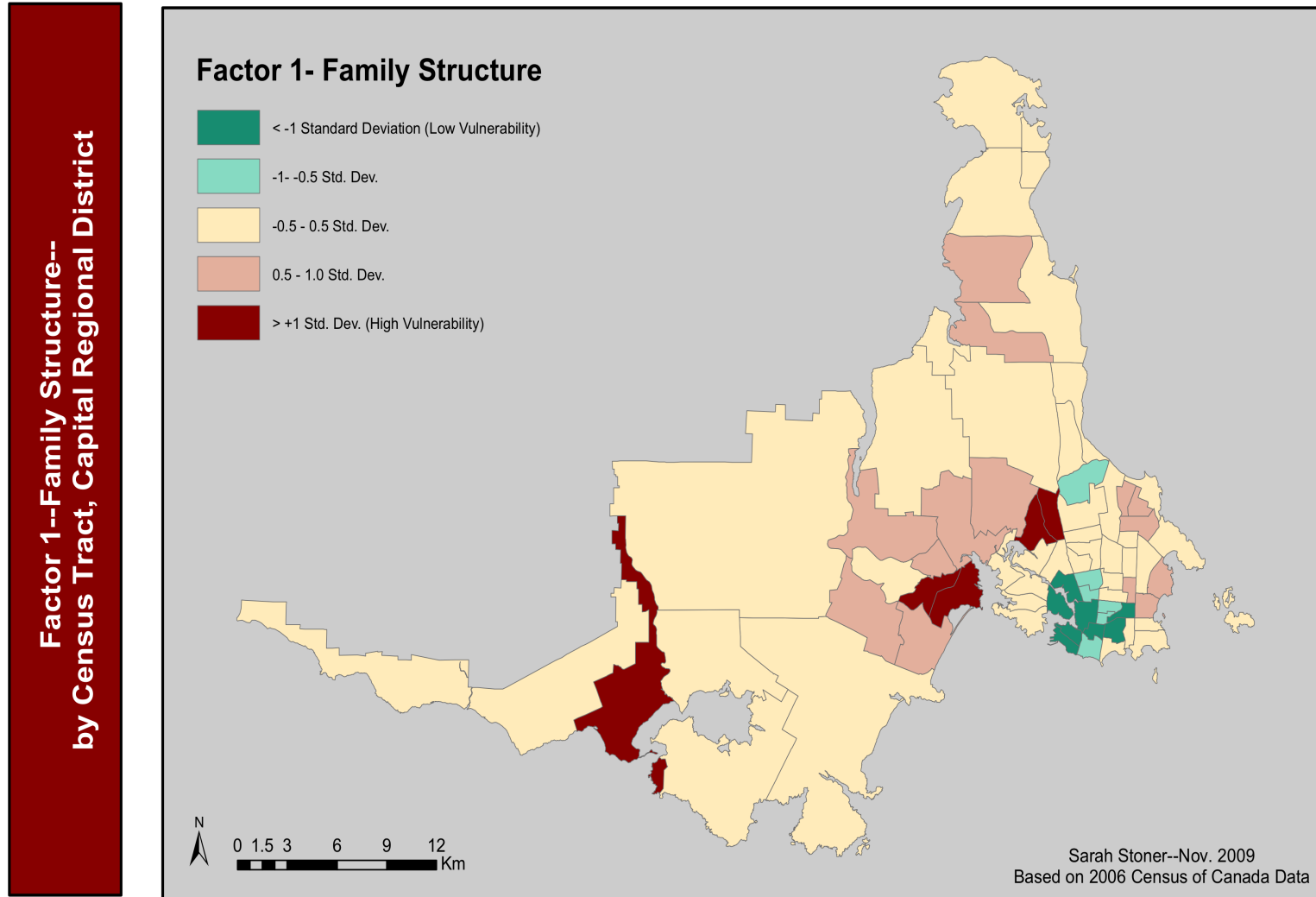


Figure 8 Family Structure by Census Tract, Capital Regional District



Factor 1--Family Structure--  
by Census Tract, Capital Regional District

Figure 9 Gender and Ethnicity by Census Tract, Capital Regional District

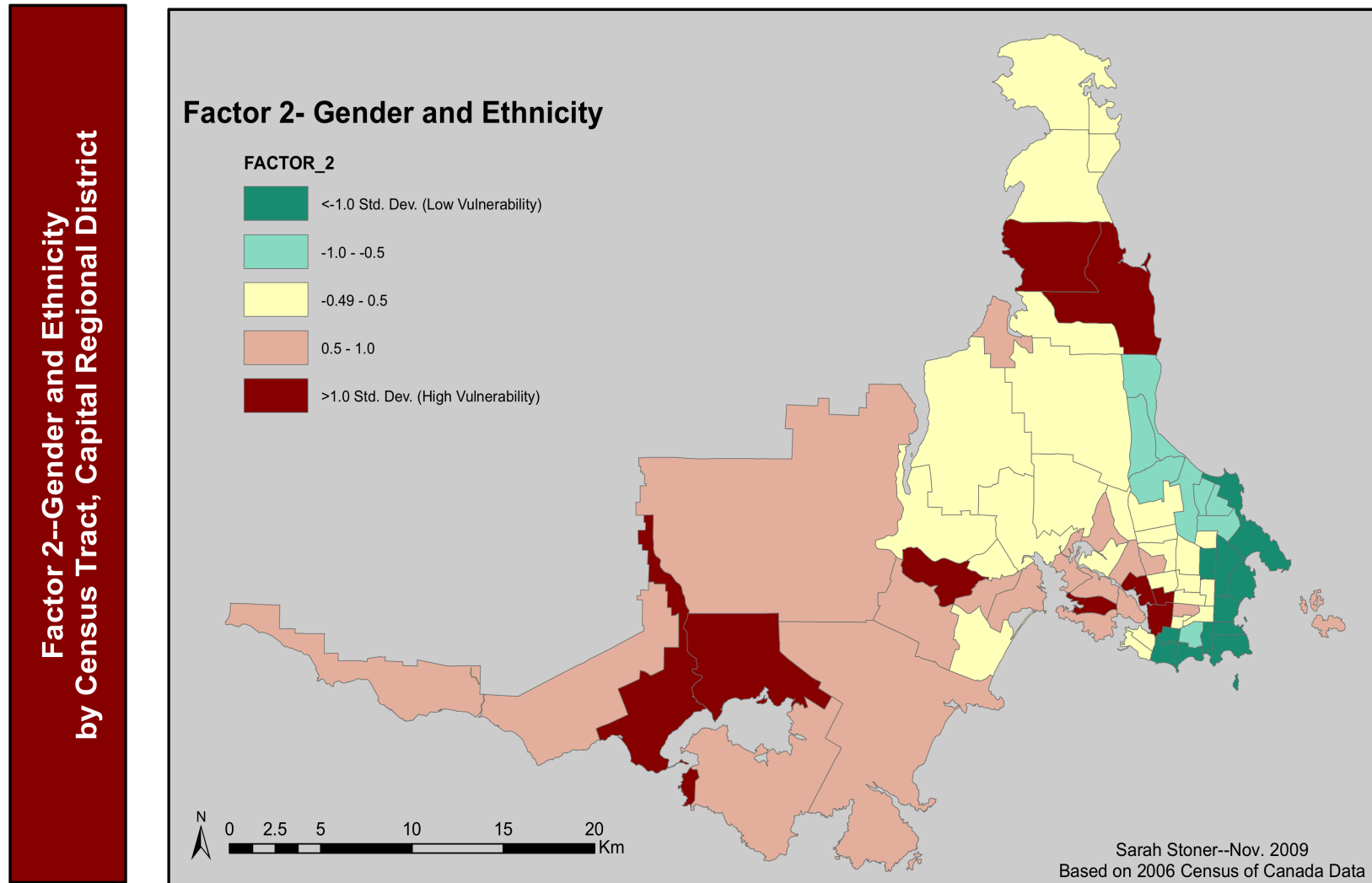


Figure 10 Socio-economic status by Census-Tract, Capital Regional District

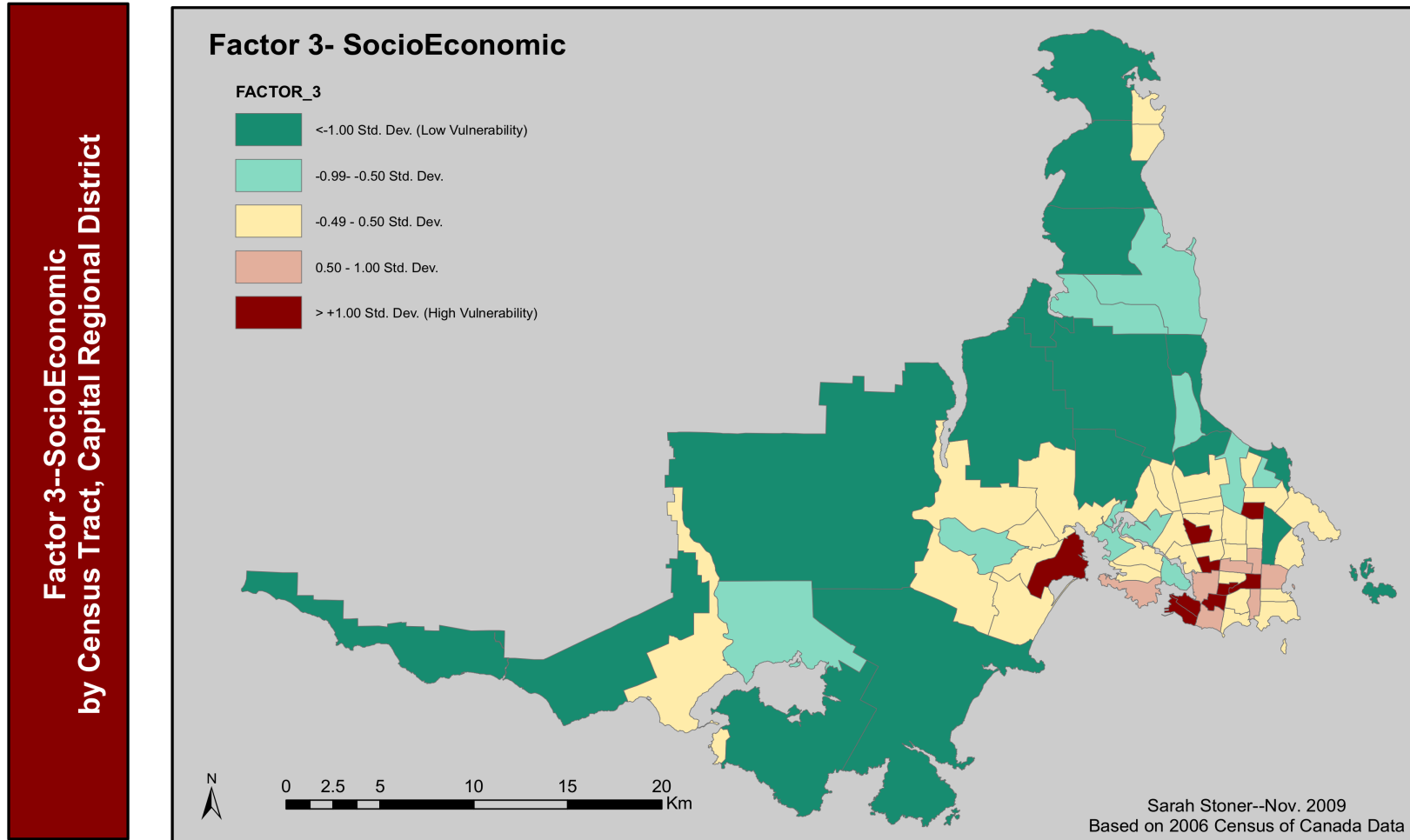


Figure 11 Minority Groups by Census Tract, Capital Regional District

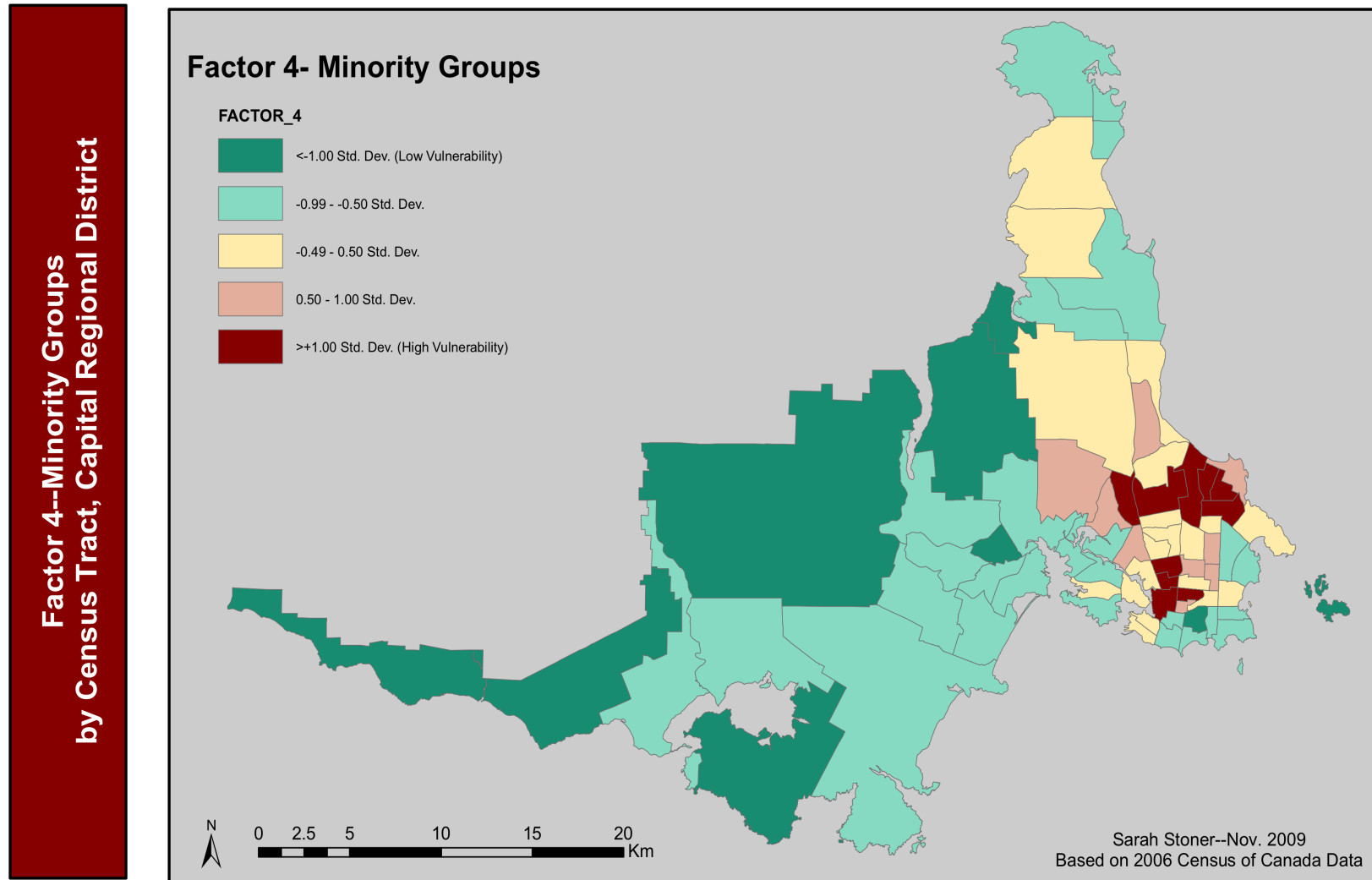


Figure 12 Aging and Social Dependence by Census Tract, Capital Regional District

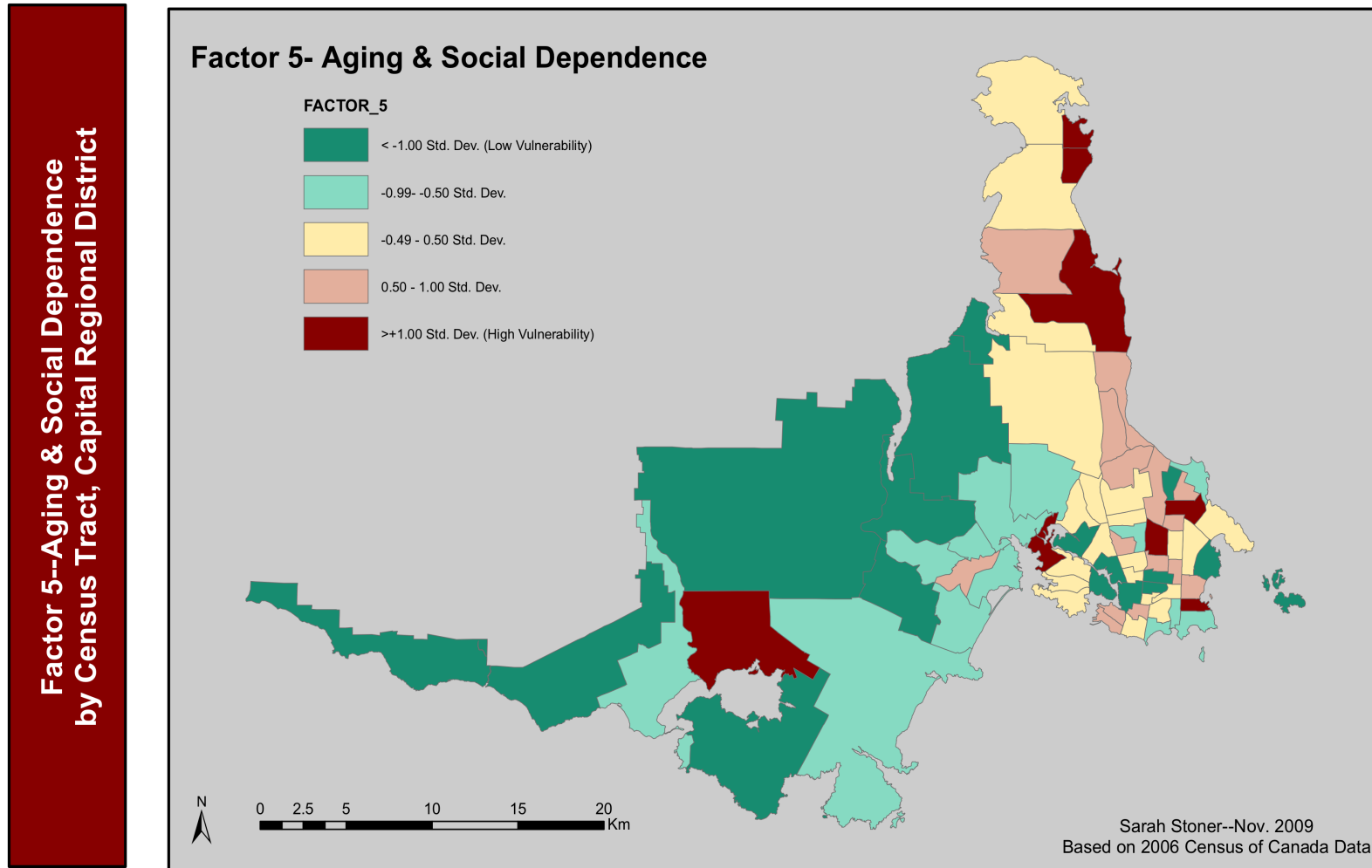


Figure 13—Structures and Change by Census Tract, Capital Regional District

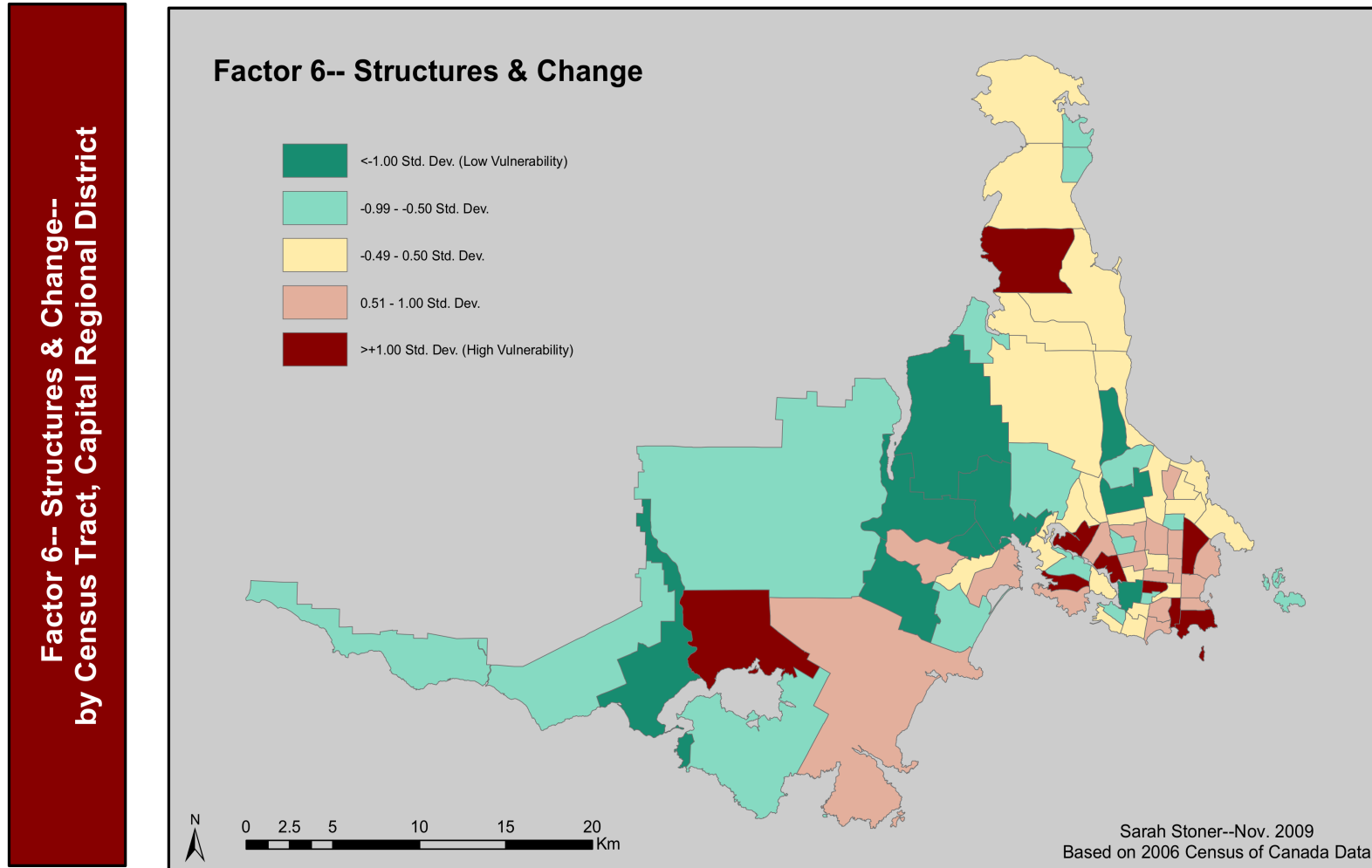
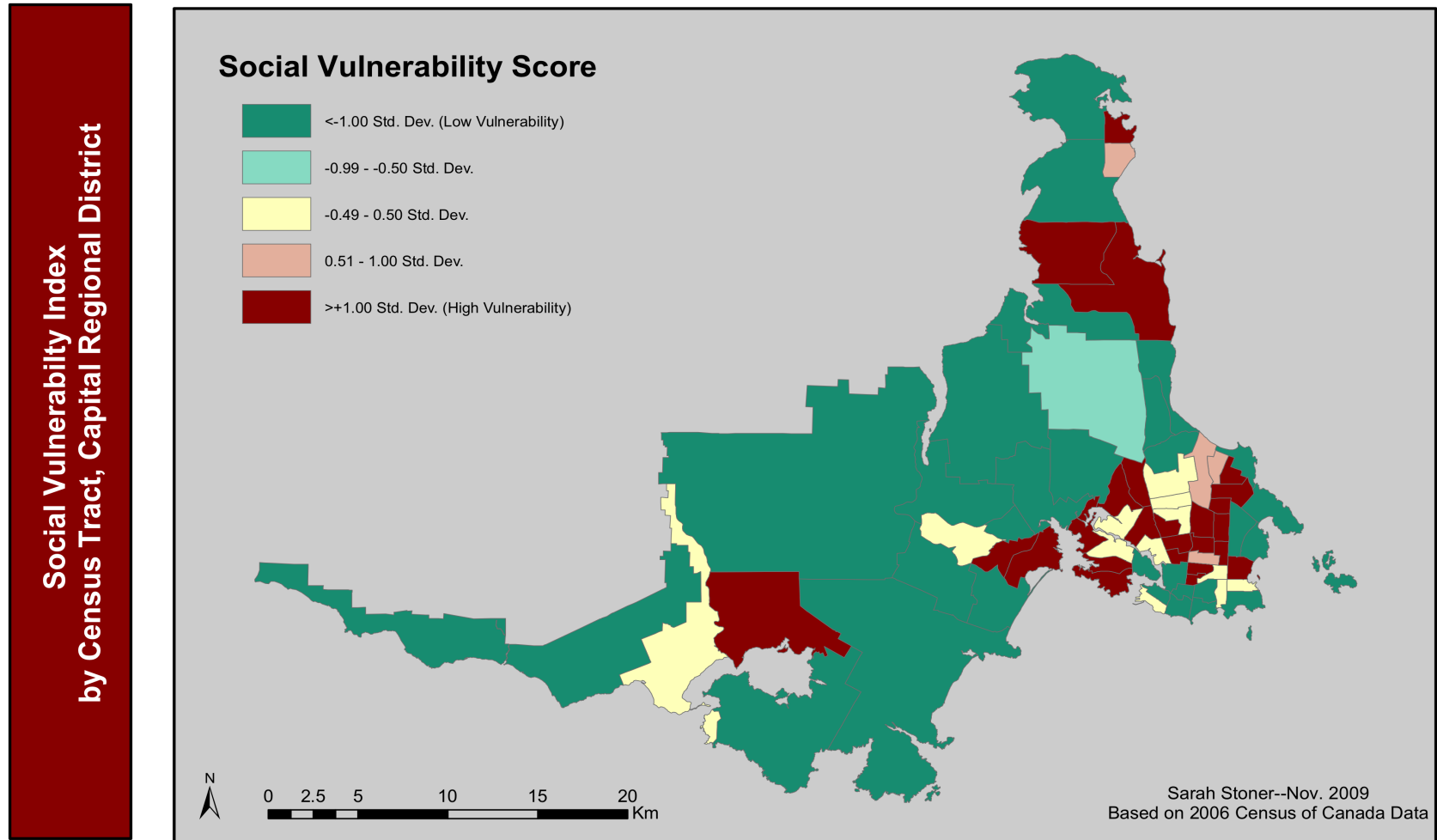


Figure 14 Social Vulnerability by Census Tract, Capital Regional District



## 2.10 Discussion

The created maps illustrate how each factor plays into the aggregated social vulnerability index for the CRD (Figure 13). This discussion section is broken up into two main parts. The first part highlights the highly vulnerable areas by factor (e.g., family structure, gender and ethnicity, etc.) The second part drills down to a finer scale to examine the vulnerable areas by factors and specific census tracts. The discussion focuses on the observed spatial patterns.

The *Family Structure* map (Figure 8) suggests that highly vulnerable areas according to family structure (average number of children at home, % population under age 19, average number of people per census family and % people employed in different census subdivisions than where they live, for example) are located in the municipalities of Sooke, Langford and Saanich.

The *Gender and Ethnicity* map (Figure 9) shows a clear geographic pattern of highly vulnerable CTs clustered together with medium vulnerability CTs surrounding them. This factor takes % aboriginal identity, % immigrants and lower level paying jobs into account. High vulnerability CTs are located in the downtown core, Central Saanich, Langford and the Municipality of Sooke. Lower vulnerability CTs hug the urban coastal areas of the CRD. These are traditional, often more economically advantaged neighbourhoods, comprising the Municipality of Oak Bay and wealthier parts of Saanich and Victoria.

The *Socio-economic Status* map (Figure 10) features % rented dwellings, % migrants in last five years, those making less than \$20,000/year and % unemployed in the population. This map reveals pockets of lower socio-economic status in Langford-Colwood corridor

and census tracts in the City of Victoria. Traditional student neighbourhoods closest to the University of Victoria are also evident.

The *Minority Groups* map (Figure 11) shows two substantial clusters in the Municipality of Saanich and in Victoria's downtown core and inner city neighbourhoods. It is important to note here that Indian Reservations (IRs) are excluded from CTs and therefore from census data although Aboriginal populations living off reserve are included in the census tract data. The municipality of Sooke, for example, would likely show a much higher score here if IRs were included in census data as there is a large reservation here.

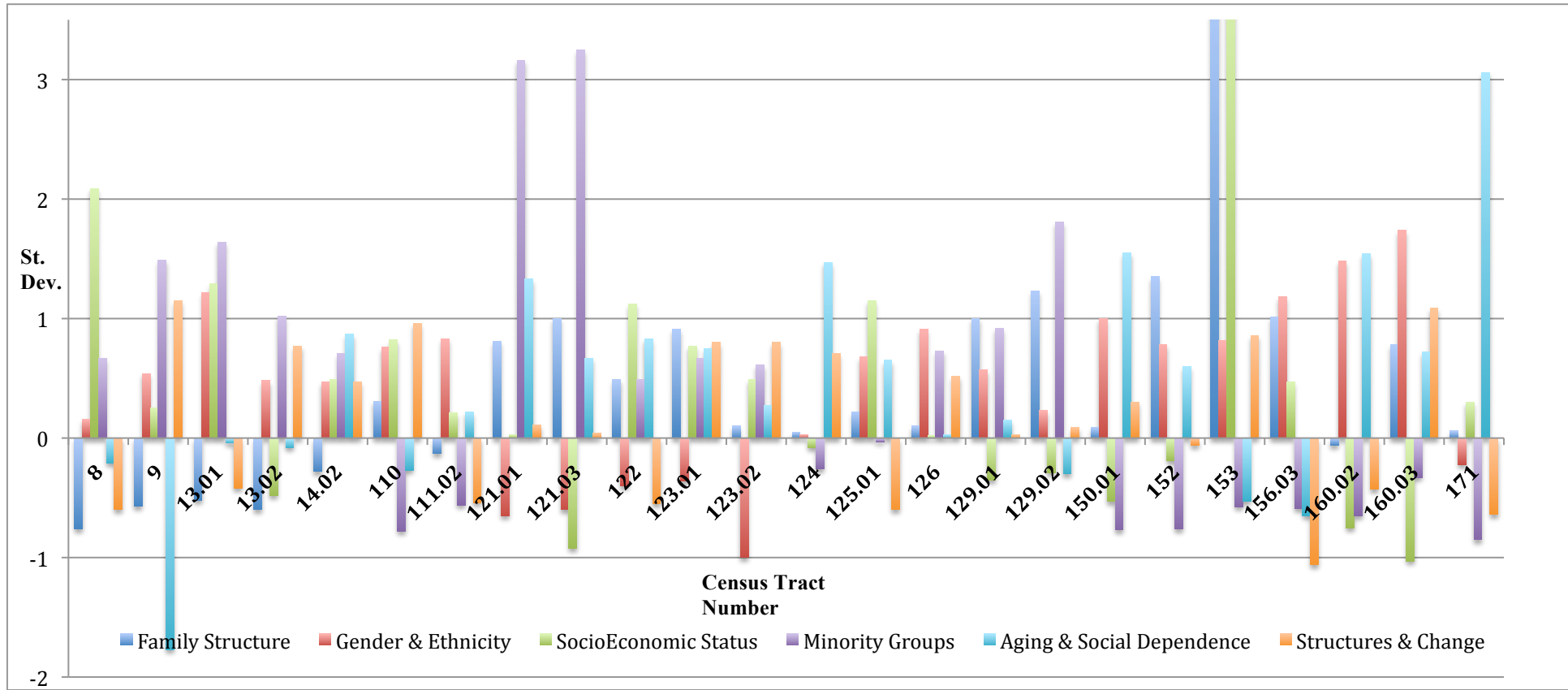
Victoria is anecdotally known as the city of 'newlyweds and nearly dead'. This suggests that there are larger proportions of persons who are both age 25-45 and those who are age 65+ in the overall population. The *Aging and Social Dependence* map (Figure 12) displays CTs with high and medium vulnerability in terms of the % of the population receiving income from government transfer payments, the % population over 65 and the % population who are female. Sidney, rural Saanich, East Sooke and the municipality of Oak Bay amongst a few smaller neighbourhoods are evidently 'highly vulnerable' with consideration to this factor.

The *Dwelling Structures and Population Change* map (Figure 13) shows highly vulnerable CTs based on population change, % private dwellings built before 1980 and % dwellings requiring major repairs. These are concentrated in more dense areas such as the core, and areas of fast growth and development such as the bedroom suburbs of Colwood and Langford. These communities are growing at a very rapid rate, contributing to the

*change* aspect of this factor. Older communities, such as Oak Bay, are also vulnerable on this component based upon the older dwellings.

Vulnerability on a component basis does not necessarily translate into high overall vulnerability when the data are aggregated into the *Social Vulnerability Index Score* which is mapped in Figure 14. This map shows that highly vulnerable CTs are generally clustered in more population dense areas, inner city areas or suburban neighbourhoods. There are several high vulnerability clusters: East Sooke, Central Saanich and Sidney on the peninsula; the Colwood-Langford corridor is also represented as are many communities in Saanich. Wealthier regions along the waterfront generally show lower vulnerability, especially in the core of the region (the City of Victoria, Oak Bay, South Saanich).

**Figure 13 Factor Scores by Highly Vulnerable Census Tracts**



### 2.10.1 Highly Vulnerable Areas

Figure 15 identifies 25 of the 69 CT's in the Capital Regional District as having 'high vulnerability'. The Factors composing the final SoVI score are broken down again into their original factors and presented graphically to depict high, medium or low vulnerability. Census tracts are numbered along the horizontal axis and each displays visually how the six factors play into their overall vulnerability score. The following discussion looks more closely at each of the CT's identified as highly vulnerable.

**CT 9.00**, North Fernwood. Although located adjacent to CT 8.00 (above), this area displays a range of different factors that describe its overall vulnerability. *Socio-economic Status* does not play as prominent of a role, whereas *Minority Groups*, *Gender and Ethnicity*, and *Structures and Change* contribute to vulnerability here.

**CT 13.01 and 13.02**, located in the Hillside/ Quadra neighbourhood show that *Minority Groups* and *Gender and Ethnicity* factors play a prominent role in increasing vulnerability in these CTs. Each of these have a large percentage of migrants and people identifying as aboriginal. Further, both have above average percentages of people employed in lower level occupations i.e., not managerial, professional or supervisory positions. This neighbourhood has the highest percentage of people aged 15-64 without a high school diploma. *Socio-economic status* also plays a role in increasing vulnerability in this CT. This CT has the highest percentage of lone-parent families in the CRD (32.8%), with over 50% of the population making less than \$20,000 per year and over 5.6% being unemployed. *Family Structure* decreases vulnerability in both CTs,

displaying relatively small families and few people travelling outside the census subdivision for work.

**CT 14.02**, in the Oaklands neighbourhood, vulnerability is highlighted in five out of the six factors, except *Family Structure*. Although no single factor seems to push vulnerability into the ‘high’ category, taken together these medium vulnerability factors create an overall situation of higher vulnerability.

**CT 121.01 and 121.03**, located in the Gordon Head/ University of Victoria area display extreme vulnerability on the *Minority Group* factor. Over 3% don’t speak French or English and nearly 30% are visible minorities. *Family Structure* and *Aging and Social Dependence* also contribute to vulnerability in this tract.

**CT 122.00**, also in the Gordon Head neighbourhood, shows that *Socio-economic Status* and *Aging and Social Dependence* contribute greatly to vulnerability. A total of 47.3% of the population in this CT make less than \$20,000 a year and over 44% of dwellings are rented. This again can partly be explained by large student populations congregating in the area around the university. *Gender and Ethnicity* and *Structures and Population Change* decrease vulnerability here. Only 22% of the population are immigrants and only 2.5% identify as aboriginal. Only 5% are without a high school diploma.

**CT 123.01** is located in the North Jubilee area. Each factor independently, (except for *Gender and Ethnicity*) falls within the ‘medium vulnerability’ category in the North Jubilee area. Overall, this is a relatively less vulnerable inner-city neighbourhood. However, the Royal Jubilee hospital is located within this census tract, which could present some unique challenges when it comes to vulnerability to disasters. Such data is not adequately captured in the SoVI and yet, hospital patients represent a large

concentration of potentially vulnerable people in an area who are not captured by the census in this tract. In this CT, a very large proportion of the population (over 66%) are employed in a different census subdivision than where they live. Just over 46% of residents in this area make less than \$20,000 per year, over 3% are unemployed and 28% receive their total income from government transfer payments.

**CT 125.01**, located in the Tattersall neighbourhood, reveals *Socio-economic Status* as the major Factor contributing to high vulnerability. *Gender and Ethnicity* and *Aging and Social Dependence* also play a significant role. Population density in this area is above average for the region, with 3,608 people / km<sup>2</sup>. The unemployment rate is on par with the regional average at 2.7%, yet there is a higher than average percentage of lone-parent families (27%), percentage of people making less than \$20,000 per year (44%) and percentage of rented dwellings (51%). There is also a high percentage of people who identify as aboriginal (9.7%) in this area. *Structures and Change* work to reduce vulnerability in this area. Only 4% of dwellings require major repairs and 54% were built before 1980. There is a fairly significant population change of 6.8%.

**CT 126.00**, located within the Tillicum area shows that several factors are again contributing to overall vulnerability. *Gender and Ethnicity* and *Minority Groups* are the greatest contributors to vulnerability. There is a large percentage of people without high school certificates (12%) and 72% are not employed in managerial, professional or supervisory positions. Forty-four percent of females living within this CT make less than \$20,000 per year, 3% above average for the region. A further 1.2% are without knowledge of French or English and 15% are visible minorities, both much higher than regional averages.

**CTs 152.00 and 153.00** make up the suburb of Colwood. In CT 152.00, East Colwood, *Family Structure* and *Gender and Ethnicity* contribute largely to vulnerability. *Aging and Social Dependence* is also a contributing factor. In this CT, 19.7% of the population is under the age of 19; there is an average of 2.9 people per census family and 70.7% of people work outside of the CT or Census Subdivision where they live. All of these statistics are above average for the region. Population density, percentage of rented dwellings, percentage of people making below \$20,000 per year and unemployment are all below average. There are also very few visible minorities and people without knowledge of French or English compared to the regional average.

**CT 153.00**, West Colwood, has the highest social vulnerability score of any CT in the region with an overall score of 8.21. *Family Structure*, *Gender and Ethnicity*, *Socio-economic Status* and *Structures and Change* all contribute to higher vulnerability. Family Structure and Socio-economic status contribute in a very significant way, both having independent vulnerability scores of over 3.0 standard deviations. This census tract has the maximum value for average number of children at home per census family (1.3), percentage of the population under 19 (28.9%), average number of people per census family (3.1) and is close to the maximum for percentage of people employed in a different subdivision than where they live (73.7%). This census tract displays maximums in the CRD for percentage of people over the age of 65 living alone (70%), percent of rented dwellings (88%) and percent of internal and external migrants in the last five years (51.1%). This CT also displays figures above the regional average in the low income (42% make less than \$20,000 per year) and unemployment (5.4%) indicators.

**CT 156.03** constitutes a significant portion of the Municipality for Sooke. This CT displays three factors contributing to overall vulnerability and three factors mitigating overall vulnerability: *Family Structure*, *Gender and Ethnicity* and *Socio-economic Status*. Mitigating factors are *Minority Groups*, *Aging and Social Dependence* and *Structure and Change*. The average number of children at home per census family (1.1), population under 19 (20.9%), average number of people per census family (2.9) and people employed in a different Census Subdivision than where they live (54.2%) are indicators within the *Family Structure* factor that are all above average for the region. Over 15% do not have high school diplomas, 7.5% are of aboriginal ethnicity. A large proportion, 72.6% are not employed in managerial, professional or supervisory positions. Further, 47.1% of females make less than \$20,000 per year. There is very low population density in this CT with only 308 people per km<sup>2</sup>. Very few dwellings are rented (16.4%) in comparison to the regional average, yet over 41.9% of the population in this CT makes less than \$20,000 per year.

**CT 171.00** is located in the well-known retirement community of Sidney and clearly displays *Aging and Social Dependence* as the key factor having a significant effect on the high vulnerability of this CT. A total of 33.6% of the population is over age 65, and 40.8% receive their total income from government transfer payments (the highest in the region, although in this case it will likely reflect old age pensions rather than welfare payments).

The overall pattern in these data suggests that CTs that rank in the ‘highly vulnerable’ category, as described above, have more than three factors contributing to their comprehensive vulnerability.

## 2.11 Strengths and Limitations of the SoVI

The method applied in the SoVI is effective at covering a large spatial area to facilitate comparing and identifying the most vulnerable regions within the CRD. Another advantage of these data are that the methods can easily be repeated when new census data are released. Further, by incorporating a wide range of variables, the SoVI manages to create a broad-based tool that is not biased towards specific characteristics, or too narrow in its definition of vulnerability. Using social factors as determinants of risk also helps to capture the interconnectedness between social and environmental factors in disaster planning.

Limitations of the SoVI include the potential for ecological fallacy that can occur when attributing data collected on a census tract scale to a smaller unit (e.g. community, neighbourhood or individual). Related to this point, the SoVI does not take community level perspectives into consideration, as each census tract can contain multiple communities or can transect communities and neighbourhoods. The most serious limitations however, are that the SoVI approaches the humanistic concept of population vulnerability in a positivistic and aggregated manner and does not extend to describe levels the census tract level e.g., neighborhoods. By quantifying these complex phenomena, the SoVI is not able to disentangle more nuanced information and understandings that arise from human perceptions and behaviors and how they influence vulnerability. Further, it also fails to address individual vulnerability sufficiently given that the data are aggregated at the census tract level. Thus, in solely approaching social vulnerability from a positivistic and quantitative approach, there is risk that the human aspects that contribute to vulnerability will be significantly discounted. In addition,

social vulnerability is a dynamic condition that changes over space and time, and the SoVI is unable to address this dynamism given that census data are gathered at one point in time and then considered to represent a five-year interval (e.g., 2006, 2001, etc.).

## **2.12 Conclusion**

The Social Vulnerability Index created for the Capital Regional District in this study is a useful tool in providing information to help with vulnerability assessments that form part of the overall risk assessment process and that complement existing hazard mapping. The maps generated here can be used alongside other existing hazard maps to identify high-risk areas and communities that may require more resources to build their resilience, and especially after a major earthquake event. Identifying highly vulnerable areas also helps to determine where mitigation and preparedness efforts can be concentrated to have the greatest impact. Having knowledge of the various components contributing to high social vulnerability in various census tracts is also extremely useful in determining the kinds of resources and programming needed to enhance preparedness and recovery. Further, similar data could be collected and this methodology could be applied in other jurisdictions in British Columbia and Canada for earthquake and other hazard risks. Overall, the SoVI will be a valuable asset in risk assessment, preparedness, response, recovery and mitigation efforts in the CRD, especially if used in conjunction with local expert knowledge of where vulnerabilities and resiliencies lie.

## **Chapter 3**

# **Place-based Perceptions of Vulnerability, Resilience and Adaptive Capacity to Seismic Hazards in the Capital Regional District**

### **3.0 Introduction**

Evaluating the vulnerability, resilience and adaptive capacity of a community is an important step in the process of risk analysis and is valuable in developing appropriate response, recovery, mitigation and preparedness strategies (Adams, 2008). Numerous methods and tools can be employed in assessing community vulnerability ranging from a community profile developed using census data, to lengthy, in-depth qualitative interview approaches aimed at understanding perceptions of vulnerability. Each has its strengths and weaknesses and all provide a unique lens through which to approach risk analysis. A place-based focus to vulnerability analysis is meaningful in that it produces context-specific knowledge to support local management and planning.

The primary goal of this chapter is to identify social vulnerabilities to earthquake hazards within the Capital Regional District (CRD) and to generate recommendations for how the provincial health system and various local and regional government agencies can continue to enhance and support healthy, disaster-resilient communities. The insights from this chapter are based on qualitative information gathered through key informant interviews and focus groups with participants living in three communities in the CRD, these being the towns of Sooke and Port Renfrew and the city of Victoria. The research questions posed to key informant interview and focus group participants can be found in Appendices B,C and D.

Even though the focus of this research is on evaluating social vulnerability, the research questions posed also resulted in offering insights about resilience and adaptive capacity. Thus, this chapter begins with an overview of the commonly used terminology in the context of disaster planning and preparedness. Characteristics of vulnerability, resilience and adaptive capacity gleaned from qualitative interviews each study area will then be discussed within a framework that considers whether they are population-based (i.e., compositional) or place-based (i.e., contextual) qualities. Population-based qualities refer to qualities inherent in an individual or collective of individuals, i.e., the human population making up a community (Curtis & Jones, 1998). Place-based qualities refer to constructs of the social and physical environment external to the individual e.g., physical topography, degree of urbanization, etc. (Curtis & Jones, 1998).

### **3.0.1 Defining Social Vulnerability**

Initially, it is important to recognize that vulnerability is a dynamic process, changing on a regular basis, whether daily, weekly or seasonally, thus making any effort to quantify vulnerability quite complex. Understandably, “Vulnerable groups will vary from society to society, and situation to situation, where very specific differences based on class, caste (if applicable), gender, health status and disability, age, race, nationality and immigration status and location may all have a role” (Wisner et al., 2004, p.340).

In disaster research, vulnerability is defined as “the measure of the capacity to weather, resist, or recover from the impacts of a hazard in the long term as well as the short term” (Mileti, 1999, p.106). A social vulnerability lens outlines a more holistic way of describing vulnerability by incorporating the concept of population inequality and place

into its operationalization. This study will focus on social vulnerability, as defined below:

Social vulnerability is partially the product of social inequalities—those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond. However it also includes place inequalities—those characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality, that contribute to the social vulnerability of place.

—Cutter et al. 2003, p.243

In addition to social vulnerability, three other types of vulnerability are identified in hazards research: structural, institutional and economic (Fuchs, 2009). By keeping a focus on human vulnerability, the three types are linked and “tend to highlight the social construction of vulnerability or the socio-political process by which people are made vulnerable” (Fuchs, 2009, p. 348). Thus, the social vulnerability approach is less focussed on the physical hazard and the hazards framework of disasters research and emergency management. By considering the continuous state of human and place-based inequality, social vulnerability may be considered to align well with ideas about health, i.e., as a proxy for overall community health since many of the social and lifestyle indicators used to measure social vulnerability, described in detail below, are tightly tied to the twelve social determinants of health<sup>4</sup> used by the *Public Health Agency of Canada* (2001). Similarly, mitigating social vulnerability also works towards improving

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<sup>4</sup> The Public Health Agency of Canada identifies 12 social determinants of health: 1) income and social status; 2) social support networks; 3) education and literacy; 4) employment/ working conditions; 5) social environments; 6) physical environments; 7) personal health practices and coping skills; 8) healthy child development; 9) biology and genetic endowment; 10) health services; 11) gender; 12) culture

individual and community health. Ideally, healthier communities with lower levels of vulnerability should be able to cope and recover more readily in the event of an earthquake. Further, by fostering healthier communities with lower vulnerability, demands on the health system would theoretically decrease for day-to-day and post-disaster usage.

### **3.0.2 Defining Resilience and Adaptive Capacity**

One of the earliest conceptualizations of resilience was in physical science where it was used to describe the properties of materials (Norris et al., 2007) and later applied to complex ecological systems (Holling, 1973). Essentially, resilience can be defined as the ability of a community or ecosystem to absorb disturbance and re-organize through learning and adaptation into a system functioning at a more advanced state than that which existed prior to the disturbance (Adger, 2005; Cutter, 2008; Holling, 1973). Since its origins, the concept of resilience has been applied at various scales of economic, ecological and social systems—from the individual to large cities (Norris et al., 2007). Resilience can be seen as both a process and an outcome. Process-related resilience occurs when continued learning helps to make better decisions to improve the capacity to handle hazards. Meanwhile, outcome-related resilience defines the ability of a system or society to bounce back or cope with a hazard event (Cutter, 2008).

Resilience is only just beginning to become a widely used term and descriptor in the disaster-planning field. Thus, prescriptions for evaluating and building disaster resilience are even more varied than vulnerability assessments. However, resilience is most effectively studied when tied to specific places (Cutter, 2008; Norris et al., 2007; Fuchs, 2009). Improving an individual's or community's capacity to adapt can influence

resiliency. Adaptive capacity is defined as the “ability of a system to adjust to change, moderate the effects and cope with a disturbance” (Cutter, 2008).

### **3.1 Methodology**

Researchers such as Blaikie (1994), Wisner (2004), Cutter (2003), McIntire (2002) as well as agencies such as the Red Cross guided the methodological approach adopted in this research project. Traditional research in the field of emergency management has grown through the scientific analysis of the characteristics of hazards (e.g., magnitude, frequency, duration, areal extent, speed of onset, spatial dispersion and temporal spacing) (Burton et al., 1993). Indeed, this approach is still pervasive in the field. Risk of disasters is measured as a function of physical hazard and exposure ( $\text{Risk} = \text{Hazard} + \text{Exposure}$ ). Being rooted in the earth sciences and their associated quantitative methodology, the hazards framework attempts to systematize disaster preparedness and response and thereby significantly discounts human contributions to risk and vulnerability. As a result, the hazards framework to disaster planning is seen as “incomplete, reactive and [exclusive] of the range of variables and disciplines related to disaster” (McEntire et al., 2002, p.10). By examining qualitative data from focus groups and interviews, this research aims to contribute to addressing this gap.

Vulnerability and resilience frameworks have gained a strong foothold in disaster research over the past few decades. These frameworks consider the hazards; yet focus on the human dimension of vulnerability and resilience to reduce risk (Blaikie et al., 1994; McEntire, 2001). It is continuously emphasized within this approach, that without a human component, a natural hazard would not cause a disaster. This approach is multi-disciplinary and is geared towards partnerships and integration for survivors. Different

from the quantitative relationship identified above, this equation evaluates risk as a product of hazard and vulnerability ( $\text{Risk} = \text{Hazard} \times \text{Vulnerability}$ ), in which vulnerability represents the human component. This equation has been termed *comprehensive vulnerability management*, an approach to expand the “research agenda of disaster studies because there are numerous factors that arise from both the physical and social environments that interact to determine the degree of vulnerability” (McEntire et al., 2002, p. 11). In other words, the new approach aims to investigate the “factors that produce risk and susceptibility, the characteristics that promote resistance and resilience, and the complex interactions of liabilities and capabilities” (McEntire et al., 2002, p.11).

### **3.2 Methods**

This chapter highlights results from the second, qualitative phase of a mixed methods study. In Phase 1 (Chapter 2), a quantitative social vulnerability index was created and mapped (after Cutter et al., 2003) to examine attributes of vulnerability to earthquake preparedness. The key informant interviews and focus group questions (See appendices B, C and D for interview and focus group questionnaires) explored a range of questions asking participants to reflect on social changes and overall community health; to consider how a damaging earthquake might impact the physical and mental health of members of their community; and finally, to suggest what assets, resiliencies or vulnerabilities their community may have in coping and adapting to a significant earthquake. An ethics review through the University of Victoria Human Subjects Ethics Review Board was undertaken prior to conducting the interviews and focus groups.

In sum, 13 key informant interviews were completed and six focus groups were held. Of the interviews, three involved participants from Victoria, two from Sooke and two

from Port Renfrew. Six additional persons represented the CRD region in its entirety. Key informants included emergency management professionals from provincial, regional and local levels of government and the non-governmental sector, urban planners, paramedics and other health professionals, and protective services personnel.

The six focus groups were directed towards community members in each study area. Community centres were chosen as neutral and welcoming venues for these data collection initiatives since these establishments are accessible to all and are generally well frequented by the public.

Of the six focus groups, four were held in Victoria with a total of four participants overall; one was held in Sooke with a total of 10 participants (two of whom were also key informants); and one was held in Port Renfrew with a total of seven participants (two of whom were also key informants—the double participation did not seem to influence the results). The focus groups were advertised in each study area using the same strategy. At least two weeks prior to the event, focus groups were advertised by means of posters and flyers that were distributed throughout the communities—at the community centres, at nearby cafes, on mailboxes and bus stops. The flyers asked interested people to RSVP and provided pull-tabs with necessary contact information. Further, emails were circulated through to a few key contacts in each community who were asked to forward the information to their volunteer network listserves. Those notified directly via email were Victoria Emergency Management Emergency Social Services (VEMA ESS) volunteers (about 200 subscribe to the weekly bulletin), Sooke Fire volunteers and Juan de Fuca Emergency Management personnel. Another type of advertising available in Port Renfrew was flyering mailboxes—every resident in the community can be reached

for a nominal fee. Thus, all mailboxes in the community of Port Renfrew were targeted in this manner. These efforts were well received in Port Renfrew and Sooke.

Participants were from varied occupational and socio-demographic backgrounds and this allowed for very interesting and meaningful discussion.

Turnout for the Victoria focus groups was extremely minimal with four focus groups yielding a total number of only four persons.

It is apparent from these results that gaining attention and enhancing participation from people in urban, rural and remote areas requires different strategies. Reasons for lower participation in Victoria are impossible to predict with any level of assurance.

Due to lack of participation in Victoria, a fourth focus group was attempted at the Oaklands Community Centre using a different approach to advertising the event. Every school and church in the City was emailed directly asking a representative from each organization to attend. In addition, advertisements were placed in local newspapers such as the Victoria and Saanich News, Monday Magazine and Eco-news. Further, public service announcements promoting the event were broadcast on three local radio stations. Event information was also sent to all Victoria Emergency Management Association Emergency Social Services volunteers. The invitations concluded with the message ‘all welcome’ and did not ask for an *RSVP*. Despite this multi-pronged strategy, this focus group only turned out three participants, and little diversity (the three participants were young, Caucasian females from a close social circle).

### **3.3 Qualitative Thematic Analysis**

This study employed a thematic data analysis. Thematic analysis is a methodological strategy for developing emerging themes from the data that are important for interpreting

the phenomena in question and/or in addressing the needs of the research (Fereday & Muir-Cochrane, 2006; Daly et al., 1997). The process of thematic analysis involves identification of emerging themes through “careful reading and re-reading of the data” (Fereday & Muir-Cochrane, 2006; Rice & Ezzy, 1999, p. 258). The thematic analysis conducted in this study used an inductive or data-driven approach to generating themes and codes (Boyatzis, 1998).

The first step in this thematic analysis was to create a data dictionary, as defined by Boyatzis (1998). This was done by taking five complete interview transcripts, creating outlines of their key points and comparing the outlines of each against each other and then using this comparative information to move through the remaining transcripts. Topics and conversation points that were repeated in more than one transcript were translated into codes within the data dictionary. Each code was given a short label. The data dictionary then expands on each code giving “a definition of what the theme concerns; a description of how to know when the theme occurs; a description of any qualifications or exclusions to the identification of the theme; and examples, both positive and negative, to eliminate possible confusion when looking for the theme” (Boyatzis, 1998, p 31).

<b>Legend</b>	<b>Excerpt</b>
1. Label a. Description or definition b. Indicators, or flags c. Examples d. Exclusions or special conditions	1. Psychosocial, stress and mental health a. Anything referring to stress, mental health or psychosocial impacts of a disaster, includes anything referring to ability to respond being hampered by stressors b. Social impact, psychosocial, mental health, support, guilt, stress c. Mental stress as a result of disruption to work routine, survival guilt, lack of communication with family/friends; “an earthquake would have a powerful social impact and would need to look at social and mental support of community members” d. Does not identify types of people suffering (e.g., seniors and people with disabilities)—this is addressed in ‘vulnerable’ populations

**Table 6 Data Dictionary Sample**

Further transcripts were analyzed accordingly, following the code laid out in the data dictionary and broken down by geographic study area. As the data analysis proceeded, 18 main themes were identified. These themes were then divided into two broad categories which were labelled either compositional (i.e., population-based) or contextual (i.e., place-based) attributes of the study areas (see Table 7 and Appendix E). These became the overarching organizing themes, and subsequently provided a way of structuring this chapter.

Each theme that is highlighted below by community and according to its compositional and contextual qualities. The points raised below were derived from three avenues a) it was expressed by three or more individuals, or b) was a theme upon which consensus was achieved during a focus group or c) was a unique idea brought to the table from a key informant working in emergency management in the region. Thus, the intention of the

qualitative analysis is to reflect as broad a range as possible of the diverse perspectives held by the research participants (Coffey & Atkinson, 1996).

<b>Population Qualities (i.e. Compositional)</b>	<b>Place-based Qualities (i.e. Contextual )</b>
Types of People Living in Rural Communities	Resilience by size of Community
Community Volunteerism and Engagement	Cooperation between Non-Governmental Organizations (NGOs) and other Government Agencies
Healthy Population	Population Growth
Vulnerable Populations	Repeated Disturbances
Psychosocial Stress and Mental Health	Unsound Emergency Plans/ 72 hours isn't enough
Resiliencies	Strategies for resilience
Complacency & False Sense of Security	Medical Facilities and Staff
	Level of Awareness and Education
	Accountability and Responsiveness
	Funding Cuts
	Provincial/ Municipal Boundaries and Response

**Table 7 Population (i.e., Compositional) and Place-based (i.e., Contextual) Qualities**

### **3.4 Key Findings**

The Capital Regional District and its 13 municipalities are in a unique position when considering seismic hazards and vulnerability. Not only is this area considered to be a physically hazardous region, prone to three types of seismic activity, but it is also located on an island with limited transportation options to the mainland. This poses constraints in terms of bringing in food, medical and building supplies to aid in response and recovery.

From focus group discussions, a recurrent theme that emerged was that long-term residents of smaller communities such as Sooke and Port Renfrew, feel they will be on their own in the event of an earthquake or other disruptive disaster. They expressed the need for them to be self-sufficient. On the other hand, focus group participants from

Victoria, expressed a view that city-dwellers and residents of rural communities alike believe that they will be taken care of in a disaster event.

Analysis of the transcripts uncovered valuable insights into participants' perceptions of risk, hazard, vulnerability and resilience. The following discussion is organized geographically by study community and highlights the most common opinions and perceptions of vulnerability and resilience most closely related to individual health or healthy communities<sup>5</sup>. The narratives highlighted throughout the coming sections reflect the views of a small number of community members and can therefore not be considered to be representative of their communities.

### **3.4.1 The City of Victoria**

#### ***Vulnerable Populations***

A brief comparison of key indicators (as defined by the SoVI methodology in chapter 2 of this thesis) from 2001 and 2006 census data suggests that vulnerable populations are increasing. In Victoria, vulnerable populations are identified as being comprised of: older adults, those who are transient, homeless, living in circumstances of low-income, living with a disability and/or living with dependents.

Vulnerabilities are exacerbated when there is a larger proportion of older adults, but also increase when there are individuals and subgroups who experience social and economic limitations, physical impairments or mobility issues, multiple health conditions

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<sup>5</sup> The term *healthy communities* is defined as “communities that are capable of addressing community problems” by the Healthy Communities Movement (Norris & Pittman, 2000). The Health Communities Movement and BC Healthy Communities works to “build stronger, more resilient communities, regardless of the issue you might be working on” (BC Healthy Communities, 2009).

and decreased sensory awareness (e.g., hearing and seeing problems) (Fernandez et al., 2002). Victoria and the region are an aging community.

[It's] already an old community compared to others and [they've] just done some recent population forecasting that's indicated that of the 100,000 people estimated to come to the CRD over the next 30 years, over 75% of them will be over the age of 60.

— Key Informant

In addition to the influx of older in-migrants to the region, the bulk of the current population will also be joining the 'older adult' category in the next 20-25 years.

Currently, 17% of Victoria's population is over the age of 65, compared to national and provincial averages around 14% (Statistics Canada 2006 Census).

The fact that we've got so many old people here, they're not as physically capable of dealing with the stress if they've got mobility challenges or are frail—it's gonna hit them hard and they're not going to be able to help themselves as they would if they were younger. Financially, they'd be vulnerable too if they are on a fixed income.

—Focus Group participant

It is a common misconception that older adults are wealthier than younger populations (Fernandez, 2002). The reality is that many older adults live on fixed incomes and government transfer payments that provide very little financial cushion. "When people are living on lower income and living in poverty, they're more susceptible to stress because they're already stressed from so many different factors in their lives" (Key informant, 2009). This applies to all of those living on fixed incomes, including older

adults and others. Victoria has a median household income of \$38,885, lower than that of all 13 municipalities in the region and lower than the provincial median (Statistics Canada Census, 2006). The large student population and large older adult populations brings the median household income down. Additionally, a number of research participants expressed the view that they have observed an increase in poverty and homelessness even in the last few years in this region:

We look at the recession and how it's affecting individuals. It's one of the things when we look at personal preparedness and we tell them they need to have a kit and all these things so they can help themselves in a disaster, well if they lose their jobs they're not going to be able to afford to put together [an emergency] kit.

— Key Informant

The inability to put together an emergency kit and have disposable income to access during a disaster means that people living with low income and in poverty are likely to “require substantial government assistance during response and recovery” (John Heinz III Centre for Science, Economics, and the Environment, 2000). Additionally, Victoria has nearly 60% renter-occupied dwellings, which is nearly double that of the provincial average (Statistics Canada Census, 2006). “On a day-to-day basis, vacancy rates for rental places are very low so that would be something that makes a challenge, getting people back into homes after having earthquake damage will be enormously challenging”, said one focus group participant.

*Complacency & False Sense of Security*

Complacency has been studied in the public safety and public health literatures to describe circumstances where the public becomes less alert to “low-probability high impact” events...for natural disasters such as tsunamis and earthquakes (Wang & Kapucu, 2007. P2).” Public complacency in the urban centre of Victoria was suggested by the comments of the research participants and is perhaps also reflected in the low attendance at community meetings despite numerous efforts to recruit and engage the Victoria community in these discussions through multi-media events. Numerous outreach and advertising techniques were tried to no avail.

The following quotes reflect key informant and focus group interview participants’ views on these matters.

I’m not prepared. When I live in a somewhat larger city centre like this I guess I somewhat selfishly assume that there’s going to be somewhere for me to go and resources and food for me to eat and I think if I was in a smaller town or community I would probably just figure that I would have to fend for myself. I just figure that something is going to be done for me if I live in an urban centre. Which is not ok I don’ think, but I still do it.

— Focus Group Participant

I’d like to think that we have access to adequate resources but we are certainly not prepared ourselves.

— Focus Group Participant

I feel like in our little pocket there's a higher population, it's more condensed, so I don't know if that would be a good thing or a bad thing—maybe there would be more help sent out that way? I'm personally not prepared.

— Focus Group Participant

I know there are lots of people that don't have their bookcases attached to their wall... and they have pictures over their beds and these types of things.

— Key Informant

Each of these quotes illustrates a degree of complacency and lack of preparedness. From the literature, the lack of preparedness is not uncommon in places where there has been no serious earthquake in recent memory. This is what happened in Kobe, Japan until an earthquake of 7.2 Mw struck in 1995, killing over 3,500 people (Economist, 1995). Johnstone (1995) expressed the opinion that “because there had been no major earthquake in western Japan in living memory, conventional wisdom [based upon experience] was that quakes simply did not happen there. So the people of Kobe did not bolt their furniture to the wall, as is customary in other parts of the country, or prepare emergency kits containing food, clothing and other survival items. And while aging structures in other parts of the country were strengthened, this was not apparently done in Kobe” (Johnstone, 1995). This mentality would be expected in British Columbia since a damaging earthquake hasn't occurred in the province since 1946. Even though 1946 is still within the living memory of many people; it is not recent enough to affect most people's approach to earthquake preparedness.

In addition to complacency and lack of preparedness, there may also be a lack of understanding surrounding where the responsibilities lie, or the chain of command in the

event of a major earthquake. In the context of disaster planning, individuals do play a large part in the development of preparedness and personal mitigation strategies for themselves and their families.

Wang and Kapucu (2007) advise that governments can work to minimize or reduce complacency by using popular, appropriate modes of communication to deliver information about potential hazards. “First, electronic channels such as television and radio provide more timely communication methods than paper-based mechanisms such as newspaper and governmental newsletters; therefore, the government should use more electronic media in emergency information delivery. Second, information can be delivered in styles that enhance accuracy of information delivery. These include, but are not limited to, the use of visual presentation, message highlights for specific events, and information tailored to specific groups (such as elders or children). Some styles of information delivery may also be more effective than others when seeking to influence public complacency” (Wang & Kapucu, 2007, p. 8). Provincial and municipal governments in BC need to engage in popular forms of media (television, radio, social) to enhance communication on hazards, vulnerabilities, strategies for preparedness and recovery.

### ***Adaptive Capacity & Strategies for Resilience***

Key informants consisted of emergency management professionals, city planners, and provincial government employees. These groups talked about adaptive capacity and resilience. In one research participant’s view, “[Victoria] is a very educated town. We’ve got lower incomes, but a lot of people have got post secondary education and lots of life experiences so those things I think help. There’s a lot of latent knowledge and capacity

in the community, so I think that helps [too]”. All of the research participants expressed the view that Victoria is a very healthy community, in part based on the mild climate that promotes a more active lifestyle. “The health of the population is pretty good, which is an asset” said one research participant.

One of the key components that may be considered to reflect Victoria’s adaptive capacity is the work being done outside of emergency management to build a sense of community and enhance sustainability and food security initiatives in the City. More sustainable and food-secure communities are more self-reliant and thus are likely more resilient and have a higher adaptive capacity than those communities which depend completely on external food sources and are unsustainable within themselves. Research participants believe that it is important to:

[Link] into work that already has been done that maybe isn’t connected into the emergency management (EM) world and highlighting that it also fundamentally results in community resiliency. The urban garden, urban agriculture, these types of things that help with food supply, which is actually an emergency management issue. Anything that helps on a day-to-day basis, helps support and get people into permanent housing and shelters and these types of things ultimately result in resiliency and is a bonus for [emergency managers]. It’s those day-to-day sorts of things that will ultimately help...during a wide, community scale disaster. I think that’s one of the things that [Victoria is] pretty good at, reminding people that yes, that has an EM implication and by doing that you are also helping to support community resiliency. All of those things, you know, if the community is more involved in processes and aware of what’s happening at the political level is ultimate for community resiliency strategy for after an earthquake

—Key informant participant

Not only does planning for sustainable communities enhance disaster resilience, but disaster resilience is a key piece of community sustainability (Public Entity Risk Institute, 2005). The Public Entity Risk Institute (PERI) defines the six principles of sustainability as 1) using a participatory decision-making process, 2) maintaining and enhancing quality of life, 3) building local economic vitality, 4) promoting social and intergenerational equity, 5) protecting environmental quality and 6) incorporating disaster resilience and mitigation (2005). Not only do these principles work towards building a sustainable community, but they also work towards mitigating social and economic vulnerabilities and enhancing overall community resiliency. Planning for sustainable and resilient communities must be ongoing, recognizing that such goals can be attained if these concepts remain paramount to all community planning efforts (Tobin, 1999).

### ***Repeated Disturbances***

Although Victoria hasn't experienced a major earthquake in recent history, the snowstorm of 1996 is remembered by many participants as a recent 'disaster'. This disruptive weather event is the most recent hazard that tested the city's ability to cope. Although there was a lack of leadership in government response during this event (focus group participants, 2009; Dauncey, 2007), many expressed a view of being surprised by the ability of the community to come together in support of each other at this time.

I think the big one... was the snowstorm of 1996. I think that really was sort of a key moment when the community started to look at the socially isolated and social vulnerability and transportation routes and these types of considerations. I think as a result of a community action that happened from that, I think that's a pretty good indication that it [response and recovery] will get done.

— Key Informant

In the snow of '96 people often commented that people they'd never met before came out to help them shovel their driveway or get their car out or to help neighbours that were shut in and couldn't get to the store to get the basic necessities, and so the community came in and came forward in a very altruistic way in the early days of that event. There were no enemies in that event, it's not like say, H1N1 where everyone is potentially a carrier and could make you sick. There was no fear in that event...

— Key Informant

The person that I think was actually a hero [during the blizzard of 1996], which is not a word I use very often, was Allan Perry who was a reporter with CFX radio and he lives out along the Gorge and he hiked back into the radio station and spontaneously formed this wonderful little community network, was talking with everybody, communicating there, getting women to hospital that needed to go in to have labour delivery, they were getting kidney patients in that needed dialysis, they were getting doctors and nurses in—so it was this huge informal community response that came together like that and what I could see there was no communication from the tv station, there was no check tv, there was no communication from government—no provincial government response, no federal government response, no local government response.

— Focus Group Participant

This particular quotation illustrates the point of community champions that can also be considered to have a role in helping with preparedness and recovery.

After the blizzard of 1996, Guy Dauncey, a renowned local figure published an article titled *A Blizzard of Self-Organizing Neighbourhoods*. The premise of this piece was to articulate that when a crisis or emergency does occur, it is at the street, neighbourhood

and community level from which effective response will come. Dauncey writes: “One of the most rewarding aspects of the recent blizzard, while acknowledging the damage and the losses, was the way in which we self-organized ourselves on our street and in our neighbourhoods” (1997). This principle of bottom up approaches and community self-organization in the event of a disaster or emergency also emerged in the research findings for this project. One participant discussed how the intricacies and structure of most emergency management systems is very top-down and having origins in military structure. This approach may be effective under certain conditions, with certain groups, however the majority of people are much more effective organizing in a grass roots capacity (Key Informant). Bottom up organizing is meaningful and often effective, yet it can also be argued that without top-down support a grassroots movement cannot maintain its’ success over a longer term. Repeated disturbances or past hazard events are generally not regarded as a determining factor in most vulnerability frameworks and assessment techniques (Cutter et. al. 2006; Fuchs, 2009). However, it can be argued that repeated disturbance can contribute significantly to adaptive capacity and resilience (Adger et al., 2005; Cutter et al., 2008). Repeated disturbances allow communities to essentially practice their response and recovery methods as well as remind individuals that anything can happen at any time, prompting

In summary, scale, magnitude and nature of the hazard in question play a significant role in the ability of a community to respond, recover and adapt.

### 3.4.2 Rural Community of Sooke

Small, rural and remote communities are not without their conditions that promote vulnerability however, they can also demonstrate degrees of adaptive capacity and potential for resilience given their experiences with small scale repeated or regular disturbances. The communities of Sooke and Port Renfrew experience extreme, destructive weather storms accompanied by extensive power outages on a regular basis. Having to manage and cope on their own, with little government and other support, has made it more likely that residents of smaller communities like this have a clearer sense of needing to be responsible for themselves.

Whatever happens out here, we're gonna solve it ourselves, just like we have everything else!

— Focus Group Participant

We're very self-reliant.

— Focus Group Participant

Even those who are new to the area, they moved here because they know it's a little more isolated and they need to rely on themselves and their neighbours a bit more in these initial stages.

— Focus Group Participant

We had an example of that last January, with the rainstorms. The provincial government, they didn't give a damn for the people out in the communities west of here... Until we get on the news... And then they get embarrassed...

— Focus Group Participant

This repeated disturbance, although small, helps to build the knowledge, competence and resilience of the community.

Focus group participants in Sooke nodded in agreement when one participant said, “We’re very self-reliant. Whatever happens out here, we’re gonna solve it ourselves—just like we have everything else!” Although the value of self-sufficiency is indicated in this perception, such views are often developed out of harsh realities:

You’re gonna get nothing from above local on the government side... If we ever have the big one, we’re toast. We’re completely on our own. And were gonna be that way until everyone else recovers in the Seattle/ Vancouver area, then Victoria, then they might remember us... The Coast is toast.

— Focus Group Participant

This is a powerful statement not just about self-sufficiency, but also conveying a sense of being abandoned for some time, or of being of lesser importance until things settle down in the bigger centres like Victoria.

### ***Dichotomy between Insider and Outsider Perspectives—Vulnerable Populations***

The population of Sooke has grown rapidly over the past 15 years and the town is becoming more and more of a *bedroom community* of Victoria. Those living in the newer developments, east of the main part of town, are often seen as outsiders or newcomers:

Sooke has grown quite a bit in the last few years and a lot of the people that are coming here have more of an urban attitude. They’re not quite as prepared as some people that

have been around for a while and understand that the power goes out sometimes and the roads close.

— Key Informant

This view perpetuates the negative aspects of social capital. Those that have been in the community for some time have formed a tight bond, and from the way in which they interact with one another it is evident that it may be difficult for newcomers to penetrate. The sense of community is strong for those that are a part of it, but for those that aren't it can be quite isolating (Putnam, 2000).

A large percentage of the Sooke population work in a different census subdivision from where they live, with over 4,000 (about 36%) residents commuting to Victoria on a daily basis (Statistics Canada, 2006). Thus, one of the main challenges facing Sooke residents in a time of emergency would be that families may live in Sooke, while parents work in Victoria. Depending on the timing of an emergency, parents could be separated from their offspring for long periods of time (i.e., during school and work hours).

A couple of problems that I can see happening if we can't travel to and from town is that we are going to end up with a lot of young people (17-18 high school age all the way down to preschool) are going to have to be looked after because their parents are in Victoria and can't get back out here and don't know somebody to get a hold of or have not made previous arrangements.

— Focus Group Participant

### 3.4.3 The Remote Community of Port Renfrew

As in Sooke, people in Port Renfrew inhabit a remote coastal town in which they have experienced isolation in the context of storms, power outages and road closures.

Nonetheless, both population (compositional) and place-based (contextual) barriers to strength in a time of disaster exist in Port Renfrew. One of the biggest challenges for Port Renfrew is the transience of the community.

There's quite a transient community because a lot of people will go out there and live for a year and then move. A lot of single people particularly and it seems to be mostly males, they just go out there and they wanna get away from it so they go to Port Renfrew and they rent a place and they're gone the next year... Maybe they don't have families, I don't know, but I imagine if they do, then they're gonna have problems.

— Focus Group Participant

Place-based characteristics of the community create barriers to resilience in the town of Port Renfrew that are generally the result of deeper, systemic issues such as declining population, decline of resource extraction and economic activity or lack of economic diversity. As a result, there is a lack of services and resources in the region. The following quotes were extracted from the Port Renfrew focus group:

The economy is gone.

— Focus Group Participant

We don't have enough adult population in the community and the kids that are smart enough— get the hell out. There's no life for 'em here, there's no work.

— Focus Group Participant

People come into the community six months a year and take, take, take and then leave.... Leaving nothing behind for the economy, taking from what little economy there is... I'd like to see four or five hundred people so we can actually be a community that is blessed with government funding and stuff like that... which it isn't now

— Focus Group Participant

We're the end of the road, we're the end of the list

— Focus Group Participant

This series of comments illustrate the more fatalistic perceptions of people living in Port Renfrew. Disaster threats pose additional challenges in the face of other hardships such as economic decline, and economic diversification that has made slow progress. Economic development of some kind appears needed to get “four or five hundred people [out there] and [you'd have] that population to draw from that would make a difference!” This statement links to the fact that vulnerability has many faces, economic vulnerability being only one of them (Fuchs, 2009). Economic and social vulnerability are inextricably linked, and this is captured by participants living in Port Renfrew. Tangentially, the increase in economic vulnerability has reportedly led to an increase in youth suicide rates among Port Renfrew community members, a very serious sign of social vulnerability and instability (note that this is anecdotal data from focus group and key informant interviews, census data to verify this claim is unavailable as the

community's population is too low to release such information without infringing on privacy).

### ***Medical Facilities and Staff***

Lack of population and economic diversification means there are fewer government services and resources, a common characteristic of rural and remote communities.

While, the town of Port Renfrew does have an ambulance station, none of the paramedics live in the community. It is a unit with high turnover, staffed by freshly trained paramedics with no seniority who generally stick around until they are transferred to another station supported by a larger population where they can obtain more work.

During a focus group, the view was expressed that an ideal situation would have three of four locals working as paramedics. However, there are barriers to local residents taking on such paramedic roles. The following quotes originate from the focus group in Port Renfrew:

I think [being a paramedic] and living in the community is really hard because of the health of the community. You know, suicides and you know these people... Yeah. To be a resident and be part of that... It's a deterrent from being on the ambulance.

— Focus Group Participant

If you're an ambulance paramedic in Victoria and you go in on a call, 99% of the time you won't know the person, up here you know everybody.

— Focus Group Participant

It's more the psychological stress...If you go to four or five suicide calls and at about your sixth one and you've known all those people...

— Focus Group Participant

With its high suicide rates and deep-rooted economic and social vulnerability, Port Renfrew lacks the medical and psychosocial support it needs on a day-to-day basis. In the event of a large-scale seismic event, this community may suffer gravely because it is vulnerable on several fronts already.

Other than economic diversification and population increase, the greatest need in the community as expressed by focus group research participants, was for additional health care resources and facilities.

There are no health care facilities. The ambulance station is not health care.

— Focus Group Participant

Port Renfrew has NO medical facilities other than the ambulance station...the reality is that people come knocking on their door looking for all sorts of medical stuff... now this is something we've talked about, just haven't been able to develop. And obviously this is something we'd have to develop with an agency like the Vancouver Island Health Authority (VIHA), but that's the closest thing. And of course the problem with trying to depend on an ambulance station is that there aren't always people there.

— Focus Group Participant

### ***Adaptive Capacity***

Despite its social vulnerability, along some dimensions e.g., youth suicide and economic vulnerability, one of the core assets in Port Renfrew is the people that inhabit the community. A history of storms and power outages has resulted in many residents having adapted by getting back up power generators, wood burning stoves and stockpiling food supplies. Additionally, residents have been accumulating the tools and equipment needed to start a post- disaster recovery process when needed.

All seven communities now have an emergency container, I'd say they're partially stocked; I'd like to put more equipment in there. And they'll never be fully stocked, there's always more equipment you need but it's got light engineering equipment: shovels, picks, first aid equipment, generators, stoves, that sort of stuff in there.

— Key Informant

Well, what assets we have are what's within the community. Any engineering equipment, any human resources and we've got an emergency container in PR. We've got a school, we've got a community centre and we'll hopefully have a fire department, which will be better situated than it is now and will also have better communications too. And of course, there are a lot of boats up there and we can use marine radios if necessary.

— Key Informant

The above quotations have served to illustrate a spectrum of ways in which Port Renfrew demonstrates both vulnerability and adaptive capacity, originating from key informant interviews in Port Renfrew and illustrate the types of physical and mechanical resources available in Port Renfrew and the surrounding community.

### 3.5 Discussion and Recommendations

This section highlights recommendations brought forth from the research participants.

#### 3.5.1 Recommendations to Improve Place-based Qualities of Community Vulnerability

The research and analysis have indicated there are gaps in two main themes: *education and communications* and *emergency plans and institutional systemic change*. The following section will discuss recommendation to improve place-based qualities of community vulnerability, organized around these two main themes.

##### ***Education and Communications***

The number one recommendation for decreasing vulnerability that came out of the research interviews and focus groups was education. Various sectors of provincial, municipal and local governments have created educational resources for how individuals and families can better prepare themselves for a seismic (or other) hazard event. Nonetheless, in each community there is demand for a large-scale public awareness campaign.

I'm a huge advocate for education and earthquake preparedness. That's a huge thing that needs to be elaborated on in many ways. You look at other places around the world and other things that they've done... California's had a huge public education campaign over the last two years and that's something that [we're] dying to do here, and it's just when is it the time for us to do something like that. I definitely see us going in the direction where that can happen, so I feel like the change is coming.

— Key Informant

After the data collection for this research took place, the BC provincial government launched a large-scale awareness and exercise campaign—The Great BC ShakeOut. In January and October of 2011, participating organizations, institutions and families participated in a province wide earthquake drill. This was a step forward for increasing awareness and education on best practices of what to do during a seismic event.

Although the resources and structure for this event were laid out and prepared in an easily accessible format, it was a self-organizing event in which participants voluntarily signed on to participate. About 500,000 people of nearly 4.5 million British Columbians registered to participate in each of the two drills (BC Earthquake Alliance, 2010). This underscores the concerns about public complacency and the need to use novel and popular channels and styles of communication to improve awareness and then preparedness.

Many participants agreed that reaching children in schools is an effective route for raising awareness and education on the topic.

We have to go through the kids, because the adults aren't listening. They're either too busy or they think it doesn't apply to them.

— Key Informant

[Port Renfrew] probably will be the first in North America to run a youth program...we wanna start with what we call Dolphins first, and that'll be the young group and then we'll move on to what we call the Orcas and the idea is that you give 'em a hand, to the teacher and they will have a program where they go out into the community and identify certain dangers [and solutions], what have you. The younger ones will have to sit down with their parents and draft up some sort of emergency plan for their household and identify that type of information.

— Key Informant

Others thought that a multi-pronged approach involving training in radio communications, emergency operation centre protocols and emergency social services would be more effective and is the way to go.

I guess you would need a multi-pronged strategy. One would be going through kids and having a reminder. You could also go through church—that would reach a small percentage. A lot of women and men my age went through girl guides and boy scouts, so that whole thing about being prepared. You might be able to do something fun in there—be prepared, do you have a phone? I think part of it too is making it fun and interesting.

— Focus Group Participant

Through the education and training. You educate the public on what they need to do and train our community volunteers as fast or faster than they could be today

— Key Informant

### ***Emergency Plans and Institutional Systemic Change***

Additional local context features that were discussed by research participants include investigating points of overlap in emergency plans and any systemic redundancies that could lead to reduced adaptive capacity. Improving emergency plans involves encouraging institutions, organizations and individuals with emergency plans to consult any agencies or organizations that are referenced in their plans and to create formal agreements or partnerships with them. Creating legislation around developing sound and thorough emergency plans for public and private institutions and organizations could help to improve the accountability of those institutions and organizations.

I have come across dozens, literally dozens of plans from small communities to airports to... and without fail, I've never yet come across one that doesn't say the ambulance service will come in to triage, treat and transport. How do you expect [them] to get there! In this province, British Columbia Ambulance Service (BCAS) is legislated to do that function, but frequently, up until fairly recent years, we're almost like an afterthought of somebody's plan because they realize that they have to get injured people to the hospital- then there'd be some little blip, sometimes it was nothing more than a sentence in their plans

— Key Informant

If agencies such as the BCAS are aware of emergency plans within which they have been referenced they may be able to prioritize dispatching responders more effectively and efficiently.

Another deep-rooted, systemic problem to reducing vulnerability lies in addressing the level of inefficiency and redundancy in local, municipal and provincial governments.

There's actually more capacity in the system than we are currently tapped into, but the way the system is currently structured we're not reaching the full capacity that we could... I believe that there is capacity [in Victoria and the Region] that's not being fully organized well... there's a huge political piece to [this].

— Key Informant

In essence, the discussion above tells us that there is a need for a far more coordinated planning and response effort at a broader scale in order to minimize community based social vulnerability to earthquakes in the CRD.

### 3.6 Summary and Conclusion

This chapter began with definitions for vulnerability, resilience and adaptive capacity in the context of disaster planning and preparedness. Various local place-based and population dimensions of vulnerability emerged from the research process, which were then highlighted through a place-based analysis of findings from the City of Victoria and the towns of Sooke and Port Renfrew. Common perceptions in the overall area have led towards a conclusion that the population has various means of increasing capacity and reducing vulnerability to a seismic hazard and that these vary from site to site.

Evidence suggests that far more can be done to increase individual and population level preparedness to seismic hazards in all communities, and especially in Victoria.

Participants from Sooke and Port Renfrew, the rural and remote communities within the study are accustomed to regular, but smaller scale repeated disturbances, inconveniences and emergencies which may give them a leg up in the context of experience with preparedness. Sooke is also unique in that those who commute outside of the community, may require additional consideration and preparedness strategies in the context of a disaster event separating parents from their children, for example. This dichotomy between insiders and outsiders, locals and newcomers, contributes to an emerging picture of different degrees of vulnerability. The strong social ties that are evident in Sooke can be fostered to support the community in a time of crisis, however when these ties are not uniform, it can magnify the sense of outsidership for newcomers.

Among the communities that participated, Port Renfrew's population exhibits greater levels of vulnerability. The population is small and remote, and while this community is also used to having to adapt to minor crises caused by storms and power outages, and is

used to 'doing without,' they are also experiencing economic challenges due to lack of a diverse and vibrant economy, as well as some specific social challenges, e.g., higher rates of suicide among youth that impact the psychosocial health and well-being of residents as well as emergency support personnel (e.g., ambulance staff, paramedics, etc). Overall, the three coastal communities are perceived to have varying degrees of vulnerability.

Despite these respective vulnerabilities, past experiences have forced them to cope and adapt with disturbances and disruptive events. Knowing where their social and economic vulnerabilities lie is crucial now, and in the future, for creating a comprehensive disaster management plan for mitigation, response, recovery and preparedness.

## **Chapter 4 Discussion**

### **4.0 Introduction**

Seismic hazards in the Cascadia region, BC and the Capital Regional District (CRD) have been and will continue to be well-researched by seismologists. While science continues to deliver improved probabilities and damage estimates, a comprehensive understanding and assessment of community vulnerability to earthquake hazards for the CRD is lacking.

In disasters research, risk is seen as a product of hazard and vulnerability (Blaikie et al., 1994). Social vulnerability is not well understood in the CRD. Through evaluating quantitative data from the census and qualitative data from focus groups and key informant interviews, this research has documented social vulnerabilities and adaptive capacities of communities within the CRD.

This concluding chapter is structured to show how the results relate to the original research objectives, offer an explanation as to how the findings contribute to the understanding of vulnerability in the context of earthquakes in the CRD and discuss some of the limitations and highlight areas for future research.

### **4.1 Addressing the Research Objectives**

The objectives of this research are theoretical, empirical and policy-oriented, each of which is discussed below.

#### **4.1.1 Theoretical**

*Explore a range of methods (quantitative and qualitative) to determine their relevance to traditional vulnerability assessment techniques in the context of seismic hazards.*

To achieve this objective, both quantitative and qualitative research methods were employed. Replicating past work, e.g., by Cutter et al., 2003, allowed for the development of a social vulnerability index (SoVI) with relevance for the CRD. The SoVI pointed out areas of vulnerability in the CRD, in terms of separate indicators, and in regards to overall vulnerability. For example, the Colwood region is vulnerable overall, and specifically as a result of vulnerabilities in proxy indicators of family structure, gender and ethnicity and socioeconomic status.

To support the quantitative SoVI profile, qualitative data were also collected to explore perceptions of vulnerability in urban, rural and remote communities in the CRD. Focus group and key informant interview questions were developed to gain insight into people's perceptions of their individual and community vulnerability to earthquake hazards.

#### **4.1.2 Empirical**

*Apply the adapted vulnerability assessment techniques to analyze the social vulnerability of communities in the Capital Regional District (CRD) to seismic hazard.*

The results of the quantitative and qualitative data collection were analyzed to develop a more in-depth understanding of vulnerabilities in the CRD. A summary of the results is presented here.

#### ***Quantitative Findings***

Quantitative data were compiled and maps were generated to illustrate where social vulnerabilities lie within the Victoria Census Metropolitan Area. The aggregated SoVI map (Figure 13), shows that census tracts with higher levels of vulnerability are generally clustered in areas with higher population density, inner city and suburban

neighbourhoods. Wealthier areas along the waterfront generally show lower vulnerability, especially in the core of the region.

Figure 13 displays a composite of the six independent factors (the overall index), recognizing the degree to which each factor exerts a role in determining social vulnerability: family structure, gender and ethnicity, socio-economic status, minority groups, aging and social dependence, structures and population change. Each factor is displayed on a separate map to show how each factor contributes to vulnerability by census tract.

The *Family Structure* map (Figure 8) shows the average number of people per census family, the percentage of the population under age 19 and the percentage of people employed in different census subdivisions than where they live. This map suggests that smaller families with lower dependency ratios are located in the core of the City of Victoria, and these people have a shorter distance to travel to, and from work from, due to their proximity to the central business district (CBD). People living in the suburban ‘bedroom communities’ of Colwood, Sooke and Burnside-Gorge are located further from the central business district (CBD). This suggests that residents of these communities must travel farther to work, creating a large physical distance between them, their homes and children during the workday. Thus, people in this category tend to have a higher vulnerability score. Combining high dependency ratios with a large distance between work and home presents vulnerability, but high dependency ratios also indicate vulnerability as children and the elderly are inherently more vulnerable.

The *Gender and Ethnicity* map (Figure 9) displays variables including the percentage of immigrants, the percentage of females making less than \$20,000 per year, the

percentage of people identifying as aboriginal, etc. This map shows a clear geographic pattern of highly vulnerable ( $>+1$  standard deviation) CTs clustered together with medium vulnerability (0.5-1.0 standard deviations) CTs surrounding them. High vulnerability CTs are located in the downtown core, Central Saanich and the Municipality of Sooke. Lower vulnerability ( $<-0.5$  standard deviations) CTs are proximate to the urban coastal areas of the CRD. The latter are traditional, often more economically advantaged neighbourhoods, including the Municipality of Oak Bay, and wealthier parts of Saanich and Victoria, that are characterized by higher incomes, higher rates of post-secondary education, less ethnic variability, etc.

The *Socio-economic Status* map (Figure 10) displays pockets of low income, generally concentrated in the core of the City of Victoria, the suburb of Colwood and the traditional student neighbourhoods closest to the University of Victoria. Income levels in the CRD are deflated by the large student population and ever-increasing homeless population in the downtown core. Lower income and transient homeless and student populations can lead to higher vulnerability due to restricted resources and support.

The map depicting *Minority Groups* (Figure 11) shows clustering of high vulnerability CTs in the Municipality of Saanich and in Victoria's downtown core and inner city neighbourhoods. Minority groups are assumed to have heightened vulnerability due to a lack of language skills to communicate in the event of an earthquake. Some minority populations may also experience more limited financial and social resources and have lower incomes generally, all of which can contribute to higher vulnerability. It is important to note here that persons living on Indian Reservations (IRs) are excluded from Statistics Canada counts for CTs although Aboriginal populations living off reserve are

included in the census tract data. The municipality of Sooke, for example, would likely show a much higher vulnerability score here if IRs were included in census data as there is a large reservation here and most aboriginal communities experience higher levels of vulnerability compared to others.

Victoria has a high proportion of both young and older adults with larger proportions of persons in the ages between 25-45 and over the age of 65. The map depicting *Aging and Social Dependence* (Figure 12) denotes CTs with high and medium vulnerability as referring to Sidney, rural Saanich, East Sooke and the municipality of Oak Bay. Older adults, especially those that are dependent, contribute to higher vulnerability as this demographic is often marginalized, under-supported and under-resourced. Further, older adults often suffer from higher rates of physical and mental disability and illness compared against younger populations thus contributing to the vulnerability of this demographic group.

The map depicting *Dwelling Structures and Population Change* (Figure 13) conveys highly vulnerable CTs to be concentrated in more dense areas such as the downtown core, and areas of fast growth and development such as the suburban communities of Colwood and Langford. These communities are growing at a very rapid rate, contributing to the *change* aspect of this factor. Communities with high growth rates indicate that new residents are settling in these regions who may or may not be aware of the earthquake hazards present in the region. This lack of understanding and awareness can contribute to vulnerability. Further, the social fabric of a community experiencing rapid growth is often fragmented between ‘old-timers’ and ‘newcomers’, making it challenging for newcomers to contribute to and be a part of the social capital of the

community (Key Informants; Focus Group Participants; Putnam, 2000). Older communities such as Oak Bay are also highly vulnerable on this component as the infrastructure is ageing in this CT and is less likely to withstand the impacts of a high intensity shaking.

The SoVI offers a robust methodology that has been replicated here. As pointed out earlier, some of its limitations are based on the scale of data analysis (e.g., census tract) and the fact that data are only collected every five years, and therefore they cannot tell us much about dynamic processes. Secondly, it is not always obvious if data are contributing to social vulnerability. One example of this arises when considering the proportions of the population who are under age 19 and over age 65 (i.e., the dependency ratio) to connote vulnerability. High proportions of seniors can enhance vulnerability in a community, but it is also true from a qualitative research perspective, that seniors often form the backbone of the volunteer system in many communities, thereby enhancing coping capacity.

Additionally, indices are developed from multiple variables and when combined their directionality is not always clearcut in terms of whether they enhance or decrease vulnerability. For example, in principal components analysis a certain degree of covariance is necessary for variables to cluster together, however, this can inflate their explanatory power relative to their real effects on social vulnerability. Some degree of interpretation is also required to suggest which variables cluster together well and errors can arise here with the covariance problem as well.

**Qualitative Findings**

One-on-one interviews with key informants took place with experts working in the fields of emergency management, planning and health and with focus groups comprised of members of the general public. These focus groups were conducted in urban, rural and remote areas of the CRD. The data arising from these meetings lends support to the view that the population is generally in good health, though there is the potential for psychosocial stress and increased mental health issues in the event of a large-scale seismic hazard, especially in the most remote communities like Port Renfrew.

Lower than desired attendance at focus group meetings (and thus a small sample) was a problem in this study despite efforts to recruit participants and to hold multiple meetings to allow individuals to have a voice. It is impossible to know with certainty the reasons why individuals did not participate in these forums, however, it was speculated that it may have something to do with the format of data collection, i.e., that people do not like to attend local community focus groups, or may say something of the perceptions of the local population about the importance of this issue, or may reflect other unknown dimensions of the communities in question. Comments from the key informants did suggest that there is a high level of complacency, especially in Victoria—the urban core of the region—around the issue of emergency preparedness. In this regard, the rural and remote communities of Sooke and Port Renfrew appear to have a higher adaptive capacity to disasters given their higher level of experience with regular repeated disturbances, inconveniences and emergencies in those areas (e.g. regular road washouts, power outages, etc.).

The rural community of Sooke reveals some unique features. For example, there appears to be a dichotomy between insiders (i.e., longer term residents) and outsiders (i.e.,

newer population members who also outcommute to Victoria etc.) that may be linked to different degrees of vulnerability. Both focus groups and interviews with key informants emphasized the importance of strong social ties exemplified by how the community has pulled together to support one another in various severe storms and power outages throughout the years. Interestingly, when these ties are so strong, it can also magnify the sense of outsidership for newcomers. Port Renfrew's population exhibits qualities that reflect high vulnerability compared with Sooke and Victoria. Like Sooke, they may have greater adaptive capacity given their experiences of extended periods without electricity, lack of proximate medical facilities and options, and delayed transport for external supplies (e.g, food and medical supplies). Yet, their economic challenges highlighted by the lack of resource diversity and their social vulnerability highlighted in higher than average suicide rates suggest vulnerability and a reduced ability to adapt. Knowing where these vulnerabilities exist is crucial for creating a comprehensive disaster management plan for mitigation, response, recovery and preparedness.

The qualitative research completed as a part of this study is not substantial enough to stand on its own due to the small sample size and broad nature of participants' responses to the research questions. Taken together however, the methods are complementary. In order for qualitative research of this nature to be more robust and capable of standing on its own, a broader sample with greater representation in the study communities would have been desirable. Individual surveys could also have been undertaken to increase the sample size and confidence in the study results.

***Synergies between the Quantitative and Qualitative Approaches***

The quantitative and qualitative aspects of this research project can be viewed discretely or as components of one larger study. When viewed separately, the two methods of vulnerability assessment offer valuable insights in their own right, as discussed above. When taken together, the two methods to vulnerability analysis afford a more holistic, mixed methods approach that fosters the principles of data triangulation and improves the validity of the overall study. The quantitative SoVI is a well researched methodology but requires the qualitative insights provided in this study (and beyond) to add nuance and depth. Meanwhile, the qualitative data are based on perceptions and the sample size is small, which limits confidence in these data to some degree. Nevertheless, in using the qualitative data as a complement to the quantitative SoVI, a clearer picture of capacities and vulnerabilities in the CRD emerges.

Complex social and economic phenomena were highlighted in the qualitative phase that would be difficult to address using only quantitative census data alone. For example, the qualitative research results highlighted information about social capital amongst long-term community members in Sooke and suggested that that some of the characteristics of this social capital actually created perceived barriers for newcomers to the community. This perceptual and experiential information offers unique insights from census data. When combined with the statistical information obtained from the SoVI that indicates Sooke is 'highly vulnerable', these data present complimentary results. For Sooke, both types of data develop a clearer picture or portrait of vulnerability and suggest there may be deeper divisions within the Sooke community that need to be better understood, i.e., the relationships between insiders and outsiders, in order to reduce vulnerability and foster resilience. Those who have lived in the region for a shorter period of time, are

likely to have more limited ties and be potentially excluded from the main systems of social networks and social support in the community, impacting their capacity for resilience in the face of a major earthquake.

#### **4.1.3 Policy Oriented**

*Identify the policy implications of the research findings by detecting gaps in knowledge and awareness, areas of improvement; and generate recommendations for the provincial health system and local and regional government agencies to support the development of more disaster-resilient communities.*

Participants repeatedly expressed that “There’s actually more capacity in the system than we are currently tapped into, but the way the system is currently structured we’re not reaching the full capacity that we could... I believe that there is capacity [in Victoria and the Region] that’s not being fully organized well... there’s a huge political piece to [this]” (Key Informant). Thus, the key recommendation emerging as an extension from this research is to foster multi-stakeholder, cross-ministry and interdisciplinary relationships and working groups to address vulnerability and promote local and individual resilience.

As this research has shown, the types of quantitative variables and indicators that foster vulnerability (e.g., unemployment, low income, high dependency ratios) cut across many government departments and ministries—from environment, health, education and housing to economic development, sustainability and food security. Thus, in order for them to be addressed, collaboration is paramount. Such collaboration would help to continue to build adaptive capacity and resilience into our communities and regions.

A second recommendation emerging from the research relates to education. Several research participants suggested that a large-scale public outreach campaign be developed and implemented. After the data collection for this study had taken place, the provincial

government launched the *Great BC Shakeout*, an earthquake awareness exercise and campaign. This campaign is an example of an event that research participants in this study agree should be done on an annual basis. Learning from the well established *Great California Shakeout* and the inaugural *Great BC Shaekout*, we know that employing the most current tools and strategies for public engagement including social media, TV and radio advertising are effective ways of engaging citizens. A more substantive recommendation echoed by multiple participants was for the fundamentals of earthquake preparedness and post-disaster response and recovery to be taught more thoroughly through the school system at all levels and reinforced in the efforts of other organized groups such as churches and recreation centres.

Some evidence suggests that recent earthquake events such as those in Haiti, New Zealand and Japan may also help to enhance awareness. It seems that a multi-pronged and sustained approach would be meaningful to increasing both awareness and preparedness.

A third and final recommendation emerging from the qualitative interviews in this research project is to mandate all public agencies and institutions to create or revise their emergency plans. This would involve consulting with any agencies or organizations that are referenced in these plans as well and helping to establish formal agreements or partnerships within and between them. Indeed, creating new plans should be done collaboratively between organizations that may affect one another, including those in the private and non-profit sector.

## 4.2 Scope, Limitations and Areas for Future Research

This study is largely bound by place and time. The geographic boundaries of the study were set to delineate the Capital Regional District and to maintain a manageable project. Focus groups and key informant interviews proved to be an effective means to explore perceptions of earthquake vulnerability and preparedness.

One limitation in qualitative research is that the participants in the focus groups are not representative of the overall population, and in fact, they represent only a very small proportion of the population. Most of the *key-informants* or *sector experts* in the region were included as research participants, yet the number of general public participants was quite limited. Further, what the research participants provided to the study were valuable perceptions and personal insights, rather than information based in fact. It is also important to note some of the inherent limitations with focus group and interview methods. Focus groups can easily silence disagreement, thus evoking “misguided notions of a collective or community consensus” (Desai & Potter, 2006, p.155). Effective facilitation and moderation of the focus group helped to minimize this, yet it must be accepted that any conclusions and recommendations arising from these represent the views of a small group of participants and cannot be said to reflect the views of the community and region. In hindsight, most surprising and disappointing from the focus group component was the wide range of participation levels between study areas, with the largest area of Victoria, having the lowest level of participation.

Further limitations include those of a technical nature, which relate to the census data used in the generation of the SoVI. Census tracts are delineated in Census Metropolitan Areas (CMAs) where the population is dense enough to respect the confidentiality of census respondents. Unfortunately, the CRD extends beyond the tracted Victoria CMA

which means that census data is unavailable for all regions in the CRD. Areas such as Port Renfrew are not large enough to have their census information released. Further, the confidentiality of census data does not allow us to examine social vulnerability on a more granular scale (census blocks, for example). Other technical limitations include the limited types of indicators that are available from the census data in Canada compared with the data that Cutter et al., (2003) were able to use in the United States. Additionally, the census area boundaries are not parallel to health area boundaries, thus limiting the types of information that could again be used in the calculations for the Social Vulnerability Index (e.g., number of physicians per capita, number of people reliant on medication per capita). For example, variables relating to evident indicators of health vulnerability, such as the percentage of a population living with physical and/or mental disabilities, the number of physicians per capita or the percentage of people dependant on prescription medication is unavailable from census. This information is available at the health authority level, but this is incompatible with census area boundaries therefore posing complications for inclusion in the study as well as for data analysis and interpretation.

The maps generated for the SoVI are static. One area for future research would be to combine the SoVI map findings with hazard maps for the region, to capitalize on the opportunity to develop composite maps with multiple layers of information. These would still provide static maps but their level of detail would be enhanced to offer a greater understanding of earthquake vulnerability in the CRD. Combining these two maps—one illustrating hazard and one illustrating vulnerability—would complete the risk equation where  $Risk = Hazard \times Vulnerability$  and thus provide a more

comprehensive foundation for a risk analysis for the region. A second area for creating a more dynamic and informative visual mapping tool by annotating maps with qualitative information to illustrate the complexity of social vulnerability. Another opportunity for future research would involve replicating the methods on a provincial scale to create a SoVI for the province of BC.

### **4.3 Summary**

The SoVI assessment undertaken in this study provides valuable information to develop a clearer understanding of the risk to earthquake hazards in the CRD. As noted, the maps generated for the SoVI can be used alongside existing hazard maps to identify high-risk areas and communities that may require more resources to decrease their vulnerabilities and thereby build their resilience. Similarly, these maps can be used to identify vulnerable areas in order to determine where mitigation and preparedness efforts can and should be concentrated to have the greatest impact. Having knowledge of the various components contributing to high social vulnerability in various census tracts is also extremely useful in determining the kinds of resources and programming needed to enhance preparedness and recovery. Overall, the SoVI will be a valuable asset in risk assessment, preparedness, response, recovery and mitigation efforts in the CRD, especially if used in conjunction with local expert knowledge of where vulnerabilities exist. Moreover, research to refine and improve the sensitivity of the SoVI should continue.

In this study, the qualitative research complements the SoVI. Various place-based and population features of vulnerability emerged from the research process, which were then highlighted through a specific focus on the communities of Victoria, Sooke and Port

Renfrew. While participants viewed themselves as being fairly healthy overall, evidence also suggests that there is the potential for psychosocial stress and mental health issues in the event of a large scale seismic hazard, especially in the smaller communities and or Census Tracts within Victoria that were identified as being more vulnerable. Knowing where these vulnerabilities exist is crucial for creating a comprehensive disaster management plan for mitigation, response, recovery and preparedness.

This research has initiated a process to develop community profiles in the CRD that can be used by decision makers, planners and the general public to increase awareness and address the overall goal of understanding vulnerability and fostering resilience to seismic hazards. Such research has applicability for any geographic area where seismic hazards are a possibility. Both individuals and organizations within communities must work more effectively together to increase awareness and address these challenges.

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## Appendix A

### Regional Key Informant Interview Questions

Target participants: members of council, district and municipal officials and planners, health service providers, emergency responders

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#### Section A: Background information

1. What is your position/ job title?
2. How long have you been in this position?
3. What is the role of your position/job in terms of disaster preparedness and emergency response?
4. In which community do you reside?
5. Do you participate in this community outside of your roles as \_\_\_\_\_?

#### Section B: Perceptions of community changes and health

*I am interested in your perceptions of changes that have occurred in the community and how these changes may have impacted the health of this community. \*Health is defined broadly here to encompass physical, psychological, economic and social factors that contribute to human health, as well as health services.*

*\*\*The following questions should be answered from a point of view in which community refers to the place and people you engage most with in your disaster preparedness/ emergency response role.*

6. What, if any, major social changes have occurred in this region over your time in this position (health, education, cultural, socio-economic demographics, social support and/or services)? Please describe.
  - a. When did you first notice these changes?
  - b. What do you think caused them?
7. What do you feel generally contributes to and detracts from the health of a community?
8. What factors affect the health of people in the areas being studied (environmental, socio-economic, lifestyle, and health care factors)?
9. How would you assess the level of available resources, services and support to these areas from government agencies, community organization, and any other agencies?
10. How would you assess the level and type of interaction between public agencies and community organizations in these areas?
11. How do individuals living in these areas cope with or adapt to disruptive changes?

## Section C: Community hazard profiling

*I am interested in your perceptions of earthquake hazards and how they may affect you and your community.*

12. Are you aware of the potential threat of an earthquake in this area?
  - a. Are you concerned about an earthquake occurring in this community? Why or why not?

*I am going to illustrate a plausible scenario of what could happen as a result of an earthquake in this area*

The scenario chosen is an earthquake of the same size that occurred in the Forbidden Plateau area west of Courtenay and Campbell River on June 23<sup>rd</sup>, 1946. It had a magnitude of 7.3. We have located this scenario earthquake xx km north of Sooke at 10:42 on a Thursday morning in September. The shaking lasts about 48 seconds. It is a relatively shallow earthquake that is felt over a wide area, with most damage occurring within 100km of the epicentre (most of the CRD would experience shaking and some damage). Damage would not be uniform across the affected area. Rather, pockets of greater damage would transpire as a result of hazardous ground conditions, topography and building construction. The greatest damage will occur within 50km of the epicentre, where some buildings and infrastructure will suffer moderate damage. Secondary hazards such as soil liquefaction, landslides, fires and aftershock can increase levels of damage and hinder response. It is expected that older buildings will be more susceptible to damage, especially those constructed of block and brick. Transportation infrastructure is likely to be closed, requiring inspection and repairs. Utilities will be overwhelmed, especially phone lines, which can hinder communication. A small number of people will be injured or killed by falling objects and many will be distressed and unsure of what they should do.

13. In the event of an emergency, such as the earthquake scenario outlined, what is the role of your position in this community?
14. Do you feel that you have access to adequate resources and support to effectively carry out your responsibilities?
15. Do you feel the location of any of these communities make them more or less vulnerable to earthquakes? How?
  - a. Victoria?
  - b. Sooke?
  - c. Port Renfrew?
16. How do you foresee a significantly damaging earthquake in the area impacting the physical health of members of these communities?

It is likely that most of the longer-term effects of an earthquake will result in stress for many impacted.

17. In your opinion, what might cause stress to individuals, families and communities after an earthquake, such as the one described previously?
18. How do you foresee a significantly damaging earthquake affecting the mental health of those impacted?

**Section D: Vulnerability, adaptive capacity, resilience and community assets**

19. What, if any, are the characteristics of these areas that may make them susceptible to damaging impacts in the event of an earthquake?
20. What assets and resources do these areas have to respond to and recover from a potentially destructive earthquake, such as the one described above?
21. What, if any, previous events are the basis for your assessment of how these areas might respond to an earthquake?
22. What are your overall suggestions on how to reduce vulnerability to earthquake impacts and to increase the ability of these areas to deal with future hazardous event or changes, such as a damaging earthquake?

**Section E: Moving Forward**

23. Could you suggest any individuals or organizations that I could contact to provide further insight or opinions on the matters addressed in this questionnaire?

## Appendix B

### Community Key Informant Interview Questions

Target participants: emergency managers, local BCAS reps, local fire dept. reps, local planners (land use and community), health service providers, members of council, CBOs (Red Cross, SAR?)

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#### Section A: Background information

1. What is your position/ job title?
2. How long have you been in this position?
3. What is the role of your position/job in terms of disaster preparedness and emergency response?
4. Do you live in the community where you work?
  - a. If not, do you feel you are a part of the community where you work?
  - b. What community are you a part of?
5. Are you involved in this community outside of your role as \_\_\_\_\_? How?

#### Section B: Perceptions of community, change and health

*I am interested in your perception of changes that have occurred in the community and how these changes may have impacted the health of this community.*

*\*Health is defined broadly as a 'state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity' (WHO).*

6. Have you observed any major social changes in this community over your time here? (health, education, cultural, socio-economic demographics, social support and/or services) If yes, please describe.
  - a. When did you first notice these changes?
  - b. What do you think caused them?
7. What factors do you feel contribute to or detract from the health of this community?
8. What factors affect the health of people in this community (environmental, socio-economic, life-style, and health care factors)?
9. How would you assess the level of available resources, services and support to this community from government agencies, community organization or other agencies that you feel are important?
10. How would you assess the level of interaction among community members in relation to:
  - a. sharing information about local issues,
  - b. people volunteering in the community,

- c. involvement in community organizations,
  - d. political participation,
  - e. community events,
  - f. other activities
11. How do individuals within this community cope with or adapt to disruptive changes?
12. How does this community cope with or adapt to disruptive changes?

### **Section C: Community hazard profiling**

*I am particularly interested in your perception of earthquake hazards and how they may affect you and your community.*

13. Are you aware of the potential threat of an earthquake in this area?
- a. Are you concerned about an earthquake occurring in this community? Why or why not?

*I am going to illustrate a plausible scenario of what could happen as a result of an earthquake in this area*

The scenario chosen is an earthquake of the same size that occurred in the Forbidden Plateau area west of Courtenay and Campbell River on June 23<sup>rd</sup>, 1946. It had a magnitude of 7.3. We have located this scenario earthquake 24 km northeast of Sooke at 10:42 on a Thursday morning in September. The shaking lasts about 48 seconds. It is a relatively shallow earthquake that is felt over a wide area, with most damage occurring within 100km of the epicentre (most of the CRD would experience shaking and some damage). Damage would not be uniform across the affected area. Rather, pockets of greater damage would occur as a result of hazardous ground conditions, topography and building construction. The greatest damage will occur within 50km of the epicentre, where some buildings and infrastructure will suffer moderate damage. Secondary hazards such as soil liquefaction, landslides, fires and aftershock can increase levels of damage and hinder response. It is expected that older buildings will be more susceptible to damage, especially those constructed of block and brick. Transportation infrastructure is likely to be closed, requiring inspection and repairs. Utilities will be overwhelmed, especially phone lines, which can hinder communication. A small number of people will be injured or killed by falling objects and many will be distressed and unsure of what they should do.

14. In the event of an emergency, such as the earthquake scenario outlined, what is your role as \_\_\_\_\_ *position* \_\_\_\_\_ for \_\_\_\_\_ *community* \_\_\_\_\_?
15. Do you feel that you have access to adequate resources and support to effectively carry out your responsibilities?
16. Do you feel the location of this community makes it more or less vulnerable to earthquakes? How?
17. How do you foresee a significantly damaging earthquake in the area impacting the physical health of members of this community?

It is likely that most of the longer-term effects of an earthquake will result in stress for many impacted.

18. How do you foresee a significantly damaging earthquake impacting the mental health of members of this community?

**Section D: Vulnerability, adaptive capacity, resilience and community assets**

19. What, if any, characteristics of your community make it more susceptible in the event of an earthquake?
20. What assets and resources does this community have to respond to and recover from a potentially destructive earthquake, such as the one described above?
21. What events have occurred in this community that provide a basis for your assessment of its assets and resources in the face of hazardous events?
22. What are your overall suggestions on how to reduce vulnerability to earthquake impacts and to increase the ability of the community to deal with future hazardous events or changes, such as a damaging earthquake?

**Section E: Moving forward**

23. Could you suggest any individuals or organizations that I could contact to provide further insight or opinions on the matters addressed in this questionnaire?

## Appendix C Focus Group Questions

### Section A: Background information

1. What community do you live in?
2. How long have you lived in this community?
3. Do you work/ volunteer/ participate in your community?
  - a. If so, how and in what capacity?

### Section B: Perceptions of community, change and health

*I am interested in your perceptions of changes that have occurred in the community and how these changes may have impacted the health of this community.*

*\*Health is defined broadly as a 'state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity' (WHO)*

4. Have you observed any major social changes in this community over your time here? (health, education, cultural, socio-economic demographics, social support and/or services) If yes, please describe.
  - a. When did you first notice these changes?
  - b. What do you think caused them?
5. What factors do you feel contribute to or detract from the health of the community as a whole?
6. What factors affect the health of people in this community (environmental, socio-economic, life-style, and health care factors)?
7. How would you assess the level of available resources, services and support to this community from government agencies, community organizations or other agencies that you feel are important?
8. How would you assess the level of interaction among community members in relation to:
  - a. Sharing information about local issues,
  - b. People volunteering in the community,
  - c. Involvement in community organizations,
  - d. Political participation,
  - e. Community events,
  - f. Other activities
9. How do individuals within this community cope with or adapt to disruptive changes?
10. How does this community cope with or adapt to disruptive changes?

### Section C: Community Hazard Profiling

*I am particularly interested in your perceptions of earthquake hazards and how they may affect you and your community.*

11. Are you aware of the potential threat of an earthquake in this area?
  - a. Are you concerned about an earthquake occurring in this community?
  - b. Why or why not?

*I am going to describe a plausible scenario of what could happen as a result of an earthquake in this area.*

The scenario chosen is an earthquake of the same size as the one that occurred in the Forbidden Plateau area west of Courtenay and Campbell River on June 23<sup>rd</sup>, 1946. It has a magnitude of 7.3. We have located this scenario earthquake 24km northeast of Sooke at 10:42 am on a Thursday morning in September. The shaking lasts about 48 seconds. It is a relatively shallow earthquake that is felt over a wide area, with most damage occurring within 100km of the epicentre (most of the CRD would experience shaking and some damage). Damage would not be uniform across the affected area. Rather, pockets of greater damage would transpire as a result of hazardous ground conditions, topography and building construction. The greatest damage will occur within 50km of the epicentre, where some buildings and infrastructure will suffer moderate damage. Secondary hazards such as soil liquefaction, landslides, fires and aftershock can increase levels of damage and hinder response. It is expected that older buildings will be more susceptible to damage, especially those constructed of block and brick. Transportation infrastructure is likely to be closed, requiring inspection and repairs. Utilities will be overwhelmed, especially phone lines, which can hinder communication. A small number of people will be injured or killed by falling objects and many will be distressed and unsure of what they should do.

12. Does this scenario change your level of concern?
13. Do you feel that you would have access to adequate resources and support in the event of a disruptive earthquake?
14. Do you feel the location of this community makes it more or less vulnerable to earthquakes? How?
15. How do you foresee a significantly damaging earthquake in the area impacting the physical health of members in this community?

It is likely that most of the longer-term effects of an earthquake will result in stress for many impacted.

16. How do you foresee a significantly damaging earthquake impacting the mental health of members of this community?

#### **Section D: Vulnerability, adaptive capacity, resilience and community assets**

17. What, if any, characteristics of your community make it more susceptible in the event of an earthquake?
18. What assets and resources does this community have to respond and recover from a potentially destructive earthquake, such as the one described in the scenario?

19. What events have occurred in this community that provide a basis for your assessment of its assets and resources in the face of hazardous events?
20. What are your overall suggestions (from experience or observation) on how to reduce vulnerability to earthquake impacts and to increase the resilience of this community following a damaging earthquake?

## Appendix D Data Dictionary

### Legend

1. Label
  - a. Description or definition
  - b. Indicators, or flags
  - c. Examples
  - d. Exclusions or special conditions

### Compositional Attributes

2. First Nations
  - a. First nations communities or reserves are referred to as having different or additional challenges in terms of overall community health
  - b. First nations, Native reserves, mixed communities, difference
  - c. “Native reserves are more susceptible”; “for a variety of reasons, a direct impact more on some of the first nations communities than it does on other mixed communities”
  - d. Interviewees seem cautious when speaking about first nations peoples, using terminology such as ‘different’ to infer added vulnerabilities or being more susceptible to disruptions. Use difference as an indicator of this theme, but ensure there is follow up qualifying the term.
3. Rural People
  - a. Rural populations, or the types of people that live in rural communities, are frequently described as being more resilient and reliant
  - b. Reliant, prepared, resources, generators, resilient
  - c. “And the other resource that I think is very significant in rural areas are the people, they’re more resilient by nature. They’re less reliant on the immediate helping hand. Most of them can, if the power goes out for two days are just fine. Most of them have made preparations to be isolated and that’s the biggest resources—the people.”
4. Community Volunteerism & Engagement
  - a. Comments referring to community volunteering and engagement, or lack thereof
  - b. Volunteer, train, engagement, participation, involvement, active
  - c. “few volunteers... 3 or 4 people doing the job of 180 volunteers”; “lots of potential volunteers, lack facilities to use and train them”; Victoria ESS has strong volunteer team

5. Psychosocial, stress and mental health
  - a. Anything referring to stress, mental health or psychosocial impacts of a disaster, includes anything referring to ability to respond being hampered by stressors
  - b. Social impact, psychosocial, mental health, support, guilt, stress
  - c. Mental stress as a result of disruption to work routine, survival guilt, lack of communication with family/ friends; “an earthquake would have a powerful social impact and would need to look at social and mental support of community members”
  - d. Does not identify types of people suffering (e.g. seniors and people with disabilities)—this is addressed in ‘vulnerable’ populations
6. Healthy Population
  - a. Referring to lifestyles and things that affect health positively within a community or more general comments about good population health
  - b. Active lifestyle,
  - c. “General health is good, compared to other societies”
7. Vulnerable Populations
  - a. Comments referring to groups of people that would be particularly impacted
  - b. Poverty, child poverty, inequity, low-income, transients, homeless, ageing, seniors, disability, student
  - c. “Low income people more susceptible to stress, already stressed”; “Increased number of transients, homeless and ageing demographic of the city are at risk populations”; “Port Renfrew is the most vulnerable community in the CRD to earthquakes”
8. Resiliencies
  - a. Discussion or examples of inherent or explicit resiliencies within a community, or lack thereof.
  - b. Neighbours, community, food security, sustainability
  - c. “Well I thought it was really interesting with the self organizing system how people came together and just rose to the occasion. It was tremendously reassuring”; I think again, that sort of community resiliency that Victoria has in terms of their strong neighbourhood associations”
9. Complacency
  - a. There are many circumstances in which individual unpreparedness was attributed to complacency or an expectancy on public services and support to be available during an emergency event.
  - b. City types/ mentality, expectance/reliance on government, invisible
  - c. “People think it’s not going to happen here, it’s not going to happen to them, it’s not going to happen during their time span and if it does the government is going to take care of them... there’s all of these illusions

that it's not real or it's too big I can't do anything about it anyway.”;  
 “The ones in the cities, the bigger places, tend to expect government to see to their needs”

## Contextual Attributes

### 10. NGOs and Government Cooperation

- a. NGOs and government agencies working together in the event of a disturbance to maximize potential resources. NGO's likely include Red Cross, Salvation Army, Church groups. This theme has been identified in a subsample of key informant interviews with employees of various government agencies.
- b. NGOs, resources, services, working together
- c. “There are other organizations that I can call on because it's sort of an informal agreement”
- d. Exclude comments referring to availability of resources in various sized communities. This theme does not have to do with the volume of organizations or resources in urban, rural and remote areas but rather the idea of cooperation.

### 11. Population growth

- a. Population growth is commonly perceived as a significant change in various study communities.
- b. Demographics, population growth, expansion
- c. “It's ever expanding... growth is primarily single family”; “the biggest change of course is just straight demographics: population growth...”

### 12. Smaller communities more resilient

- a. Smaller communities are thought to be more resilient as their residents are generally aware and have chosen to live in areas with less resources and support available from government and NGOs. Statements or reasoning as to why smaller communities are more resilient are to be included if unrelated to repeated disturbance or medical care and facilities
- b. Close-knit, small, rural, remote, self- reliant, Sooke, Port-Renfrew
- c. “... smaller communities and the people in those smaller communities are going to be better prepared to actually deal with it because they know that they aren't going to get the help “
- d. “People in the smaller communities are probably more resilient, because they've had to face it more frequently”. This statement would be excluded from this theme as it has to do with frequency of disturbance.

### 13. Repeated disturbance

- a. Communities that have suffered major disturbances or disruptions on a more frequent or regular basis have an advantage when it comes to preparedness.
- b. 1996 Blizzard, transportation issue, rain, wind
- c. "People in the smaller communities are probably more resilient, because they've had to face it more frequently"; "Everybody draws back to the lessons of the blizzard of '96... I think that spurred a lot of agencies in this area anyway to put a little bit more time and effort into planning".

#### 14. 72 hours

- a. PEP and other government agencies recommend individuals be prepared to support themselves for 72 hours after an emergency event. This is thought of to be a minimum and people working in the field imagine it could be more like 7 days!
- b. 72 hours, three days,
- c. "And of course the three days is sort of a palatable thing for governments to say, you know... you have to look after yourself for 72 hours. In reality, it's gonna be longer than that for most people"; "Generally in an emergency you are expected to look after yourself from 72 hrs up to 7 days depending on your distance from a central location".
- d. Does not include comments on public education or other campaigns required to achieve this goal.

#### 15. Unsound emergency plans

- a. Comments or statements referring to inadequacy or contradictions in various emergency plans.
- b. Emergency plan
- c. "I have come across dozens; literally dozens of plans from small communities to airports to... and without fail, I've never yet come across one that doesn't say the ambulance service will come in to triage, treat and transport. How do you expect us to get there! In this province, BCAS is legislated to do that function, but frequently, up until fairly recent years, we're almost like an afterthought of somebody's plan because they realize that they have to get injured people to the hospital- then there'd be some little blip, sometimes it was nothing more than a sentence in their plans"

#### 16. Medical Facilities & Staff

- a. Comments relating to lack of medical facilities or staff shortage, barriers to access medical facilities and the need for additional medical resources
- b. Hospital, medical facilities, medical staff don't live in areas where they work

- c. "Port Renfrew has NO medical facilities other than the ambulance station...the reality is that people come knocking on their door looking for all sorts of medical stuff... "; "...none of the paramedics that work there live in the community"

#### 17. Provincial/ municipal boundaries and response

- a. Comments regarding services and response efforts that do or do not cross municipal boundaries. Disasters don't respect municipal boundaries, but many response efforts have been identified as adhering to these boundaries, hindering effectiveness of response
- b. Boundaries, municipal barriers
- c. "Flooding didn't respect municipal boundaries. It went through from one area, through Sooke and back out through another area. It showed how well [municipalities] can work together"; "And the other advantage of being a provincial service rather than a municipal service is that we can cross boundaries".

#### 18. Awareness and Education

- a. Comments referring to the level of education and awareness within any given community
- b. Education, public, aware, unaware
- c. "One of the things that makes Victoria vulnerable is the number of people that live here that are unaware. And that's a different way of looking at earthquake vulnerability."
- d. Does not include comments referring to education or awareness building as a solution or preparedness/ resilience building strategy

#### 19. Funding Cuts

- a. Comments referring to cuts in funding or resources from any level of government
- b. Scaling back, funding issue, cut backs
- c. "Federal and provincial gov have been scaling back... "; "Government doesn't have same depth of resources as it once did"

#### 20. Strategies for Resilience

- a. Comments that refer directly or indirectly to increasing community resilience
- b. Food security, resiliency, self-organizing, informal response, faith,
- c. "community gardens in PR increase food security"; "Tap into work that has already been done that isn't currently connected to EM but ultimately results in community resiliency"

#### 21. Accountability & Responsiveness

- a. Comments referring to any level of government or citizen engagement
- b. Responsive, accountability, citizen engagement

- c. “Local government is more responsive than provincial and federal”;  
“Communication between front line and public is crucial for accountability”

## Appendix E

### Focus Group Outreach and Recruitment Materials

Figure 14 Saanich + Victoria News Paid Advertisement

community resilience  
and earthquake  
preparedness  
focus group



**building healthy, disaster resilient communities  
in the face of earthquake hazards in the CRD**

Are you interested in helping to create strategies for your community to better withstand the potentially damaging effects of the *big one*? This project looks to evaluate health and social vulnerability and resilience to earthquakes in the Capital Regional District by talking to members of various communities—people like you!


**wednesday dec. 2<sup>nd</sup> — 7 til 9pm**  
snacks & refreshments will be served.  
Oaklands community centre, 1-2827 Belmont Ave.  
near hillside & shelbourne.



University  
of Victoria

all welcome. info:

Figure 15 Focus group poster



# Community Resilience & Earthquake Preparedness Focus Group

**Building healthy, disaster resilient communities in the  
face of earthquake hazards in the CRD**

Are you interested in helping to create strategies for your community to better cope with the potentially damaging effects of *the big one*? This project looks to evaluate health and social vulnerability and resilience to earthquakes in the CRD by talking to members of various communities—people like you!

Wednesday, Dec. 2<sup>nd</sup>—7 til 9 p.m.  
Snacks and Refreshments will be served!

Oaklands Community Centre  
#1- 2827 Belmont Avenue, Victoria  
(near hillside and shelbourne)

RSVP: [REDACTED]

**Figure 16 Victoria Workshop Poster**

## Building Earthquake Resilient Communities, From the Ground Up

### Where?

Fairfield Community Place—Garry Oak Room  
1135 Thurlow Road

### When?

Wednesday May 19<sup>th</sup>, 7-9pm

### What?

Sarah Stoner, MA Candidate in Geography at the University of Victoria will present her research on human vulnerability to earthquakes in the Victoria area, answer questions on what we can do to build resilience and be better prepared.

Refreshments Will Be Served

Sarah Stoner,  
UVic Geography