Building Resilient Communities: Planning for Natural Hazards Risks in Small and Mid-Sized Municipalities in Alberta, Canada

by

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Abstract

Land-use planning is a vital discipline in the discourse on climate change and disaster risk reduction because of its role as a long-term non-structural mitigation measure. Planners can gather and analyze evidence-based data to influence decision-makers on how to minimize vulnerability via a risk-based approach. The costs of extreme weather events and natural disasters in Canada are on the rise, yet municipalities continue to allow development in high-risk areas such as floodplains, wildland-urban interphase or areas prone to erosion and subsidence. This dissertation is a qualitative study that examined the role of land-use planning in natural hazard mitigation in four small and mid-sized municipalities that experienced major natural disasters (drought, floods, and wildfires) between 2011 and 2016 in the Province of Alberta, Canada. Methods included key informant interviews, focus groups, and content analysis of Municipal Development Plans and land-use bylaws.

Results found that small and mid-sized municipalities are using existing legislative planning authorities to implement various resilient actions in land use planning for floods, wildfire and drought risks. However, three critical gaps remain. There are inconsistencies in the application of risk-based approaches -such as risk avoidance- in local plans and bylaws with respect to flood plain management. The study found that although Alberta has an established FireSmart wildfire management program, more adaptive measures can be legislated in land use bylaws to recognize the wildland urban interface as a constraint that requires mitigation. Small and mid-sized municipalities in the study jurisdiction lack stringent legislative or regulatory guidance to reduce floods and drought risk, on private, municipal land. The study concludes that continued development in hazard areas is not a

failure of land-use planning, but rather, a reflection of the complexities and dynamics of historical settlement patterns, governance, path dependencies and market demand/lifestyle choices.

Recommendations are that small and mid-sized municipalities, as well as higher order governments, must proactively prioritize land-use planning as a natural hazard mitigation measure and as a long-term adaptation strategy, to steer development away from hazard areas. Land-use planners have a profound responsibility to influence, guide and advice decision-makers about risk mitigation measures throughout the land-use development process, starting from bare undeveloped land to the issuance of development permits. Prioritizing public safety and the protection of life and property should always take precedence as a matter of public interest. Therefore, decisions about how and where to build, when considering flood, wildfire or drought risks, must be made within an acceptable level of risk that errs on the reduction of future risk exposure and vulnerability.

Preface

This thesis is an original work by Lynne Njeri Mbajiorgu. The research project, of which this thesis is a part, received ethics approval from the University of Alberta Research Ethics Board 1, “Integrative Land-use Planning and Natural Hazard Mitigation Planning in Small Municipalities,” Pro00066379, on September 1, 2016.

Dedication

"When you go, remember that there is nothing that has been done by another human being that you cannot also do."

These are the sage words of advice from my maternal grandmother, "*Cucu*" which were shared with me before leaving Kenya as a young adult to pursue a Canadian education. *Cucu* is a mother of ten, who learned to read, write and count through an adult education program. I visited her often to see her organic cows, coffee plantations, poultry farm and sugar-cane which grew in the valley of a well-served stream. I had the pleasure of knowing my maternal great-grandmother *Cucu wa Kianda*, who sat by a mango tree daily keenly watching the going ins and outs of the farm. Illiterate, but mentally sharp, *Cucu wa Kianda* informally taught me the beauty of warm hugs, and friends to share tea and sweet yams roasted over a three-stone stove in a little adobe house. I also remember my paternal *Cucu* whom I visited as a little girl, picking tea at the plantation, snacking on fresh wild fruit from bushes and trees, and crossing clear water streams on a wobbly wooden footbridge.

I sincerely thank my parents for taking my brother and me to visit our elders during school breaks. I treasure the precious, short times, spent with these wonderful, great- and grandmothers.

Acknowledgments

I want to express my sincere gratitude to my doctoral supervisory committee for their insights and unwavering support. My academic supervisor, Dr. Sandeep Agrawal, the Inaugural Director of the University of Alberta's School of Urban and Regional Planning Program who recognized and supported the importance of this research for planning practice in an Alberta context. I extend sincere thanks to the members of the supervisory committee: Dr. Naomi Krogman, Department of Resource Economics and Environmental Sociology and Dr. Rob Shields, Henry Marshall Tory Chair, Department of Sociology, for their encouragement and advice to stay focused and intentional about my research. Lastly, thank you to Vinton Spencer for assisting with copy editing under short timelines.

Many thanks to my dear husband Ferdinand Mbajiorgu, for his unwavering support and for stepping in to ensure that our children allowed Mama 'to do her homework.' I thank my mother, Susan Wambui Mwangi for taking care of us so lovingly and selflessly, and my father, Richard Karanja Kiiru, for keeping me grounded and humble. I also extend my gratitude to my extended uncles, aunts, cousins, and friends, for their support through the years.

Above all, I am grateful to the One who holds all things together: my Lord and Saviour Jesus Christ. Like Abraham, I too "*confidently look forward to a city with eternal foundations, a city designed and built by God*" (Hebrews 11:10).

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List of Abbreviations

AEMA	Alberta Emergency Management Agency
FEMA	Federal Emergency Management Agency (US)
IPCC	Intergovernmental Panel on Climate Change
LUB	Land-use Bylaw
MDP	Municipal Development Plan
MGA	Municipal Government Act
SDAB	Subdivision and Development Appeal Board
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction
WUI	Wildland Urban Interface

Glossary of Terms

All-hazards:	An emergency framework which seeks to reduce impacts of all natural and human-made disasters. The term is less about addressing all possible risks, and more about institutions leveraging resources to address different types of disasters.
Climate change adaptation:	"The adjustment in natural or human systems in response to actual or anticipated climatic stimuli or their effects that moderate harm or exploit beneficial opportunities. Adaptation involves reducing vulnerability and strengthening resilience to climate change and variability. Adaptation is best guided by incorporating new scientific information (e.g., future climate models and scenarios) into existing risk management processes" (Government of Canada, 2016a, para. 7).
Community resilience:	The capacity of a municipality to anticipate and prepare against natural hazards through a collaborative, integrative land-use planning system which enables a community to learn, change and adapt.
Disaster Risk Reduction	"Reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through the mitigation and prevention of exposure to hazards, decreasing vulnerability of individuals and society, strategic management of land and the environment, improved preparedness for disaster risks, coordinated response and planning and forward-looking recovery measures" (Public Safety Canada, 2017b).
Disaster:	A significant natural or human-made risk or extreme weather event that results in a substantial impact on life and property.
Hazard:	A climate- or non-climate related event that is a source of potential harm or loss.
Inundation:	The extent and depth of a flood within a specific geographical area in a map.

Land-use planning:	"The scientific, aesthetic and orderly allocation of land, community resources, facilities and services with a view to maintaining and improving the physical environment and the economic and social conditions of urban and rural communities" (Canadian Institute of Planning, 2017).
Mitigation:	Refers to prevention measures that reduce or minimize natural hazard impacts or risks before a disaster occurs. They include structural measures such as major public-works projects, or non-structural changes such as development regulations, land-use planning, building codes, insurance, or education awareness.
Municipalities:	Used interchangeably with "communities." It refers to all urban, rural or specialized municipalities, regardless of population or landmass size.
Policy:	An expression of a local, provincial or federal government through statutory plans, bylaws, laws or regulations.
Risk:	The likelihood of a climate or non-climate related hazard occurring. Risk is a function of hazard, exposure and vulnerability.
Vulnerability:	Factors that increase the susceptibility of municipalities to natural hazards and their relative preparedness to deal with the impacts of disasters.
Wildland Urban Interface:	"Any area where industrial or agricultural installations, recreational developments, or homes are mingled with flammable natural vegetation" (Partners in Protection, 2003, p. iv). The proximity of valuable structures to the vegetation-fuel exposes communities to wildfires.

1 Introduction

This dissertation is a report of a qualitative study about the role of land-use planning in disaster risk reduction through a case study approach of four municipalities which experienced natural disasters in the Province of Alberta, in Canada. The primary methods used were key informant interviews, focus groups and document analysis of local plans and land-use bylaws. The research was conducted at a period after Alberta faced three major disasters within six years (2011-2016). The study focused on one aspect of climate change and disaster risk reduction: land-use planning as a non-structural mitigation measure.

1.1 Background and Context

Canada is a signatory to the 2015 Paris Agreement ratified during the 2015 Conference of Parties of United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement set a target of limiting global average surface temperatures to two degrees Celsius relative to pre-industrial levels (approximately 1750) and "pursuing efforts" to reduce global warming to a maximum of 1.5 degrees Celsius (United Nations, 2015, p. 3). Building on the Paris Agreement, the United Nations Intergovernmental Panel on Climate Change (IPCC) released a special report in 2018 about the global impacts of 1.5 degrees Celsius increase on global warming (Pirani et al., 2018). The mandate of the IPCC is to use the scientific assessment about climate change and provide policymakers with options on climate adaptation (such as greenhouse gas reductions) and mitigation (actions to reduce risk). To reduce risks associated with climate change, the IPCC identifies a variety of adaptation options such as natural ecosystem management, sea level rise, risks in rural and urban areas using "green infrastructure,

sustainable land-use and planning, and sustainable water management" (Pirani et al., 2018, pp. 12, B.6.1).

Discourse on climate change has shown a growing recognition of multi-sector adaptation and mitigation actions at the local government level. Research about the state of municipal climate change adaptation in Canadian municipalities concluded that "smaller communities seem less likely to be planning for adaptation; but they may be the most vulnerable" (Hanna, 2014a). Municipalities (or local governments) are the level of government that is most effective in adaptation and mitigation not only because they are the first responders to natural disasters (FEMA, 2011; Lizarralde, Chmutina, Bosher, & Dainty, 2015), but also due to their ability and control over land-use, transportation and local resources (Stevens & Senbel, 2017; Stevens & Shoubridge, 2015; Wheeler, 2008). A 2014 IPCC report noted that "adaptation is rarely incorporated into planning, due to lack of resources, information, and expertise; and the prevalence of other issues considered a higher priority, suggesting the need for subnational and federal-level facilitation in the form of resources and enabling regulations" (2014, p. 1473). Still, local attention to adaptation may be overtaken by other competing local priorities such as upgrading roads or infrastructure. Cardona et al. (2012) surmise that "understanding of extreme events and disasters is a pre-requisite for the development of adaptation strategies in the context of climate change and risk reduction in the context of disaster risk management" (2012, p. 89). Therefore, the linkage between small local governments, climate change adaptation, disaster risk, and land-use planning is therefore critical in adopting any implementation strategy, particularly with escalating costs of disasters, economic loss and most importantly lives at risk.

Climate change and extreme weather events cause catastrophic disruptions and consequences such as loss of life, damage to property and economic losses. Globally, 95% of all extreme weather events resulted in losses of US $1.87 trillion (UNISDR, 2015b). In Canada, the average annual economic cost of disasters has been steadily increasing, from an average of $25 billion a year in the 1980s to a yearly average of $130 billion per year in the last decade (Insurance Bureau of Canada, 2017a). The cost of federal Disaster Financial Assistance Arrangement relief payments -which funds non-insurable losses and public infrastructure damages through cost-sharing agreements- has also been on the rise (Office of the Parliamentary Budget Officer, 2016). Federal spending increased from about $40 million annually in the seventies to approximately $100 million per year in the nineties (IBC, 2017, para. 3). Currently, Canada disburses about $600 million per year in disaster relief funding, with a peak record of $1.4 billion in 2013 due to the devastating flooding disasters in the Provinces of Quebec and Alberta (IBC, 2017, para. 3).

Canada's Office of the Parliamentary Budget Officer (PBO), estimated that the 2016 to 2020 average annual federal disaster payments for all extreme weather occurrences to be $902 million, of which $673 million is for flood-related incidents (2016, p. 17). The report concludes, "the Prairie Provinces face regulatory challenges of reduced enforcement and compliance when floodplain management is the responsibility of municipalities...Alberta does not take into account rising groundwater and debris floods on steep mountain creeks" (Office of the Parliamentary Budget Officer, 2016, pp. 3–4). Escalating disaster costs are not only attributable to significant disaster events alone. In 2018, small weather events that would not qualify as major disasters cost $1.9 billion according to data from the Catastrophe Indices and Quantification Inc. (IBC, 2019, para.

1). This research focused on single disaster events because of their impact to planning and development.

In a report titled *Estimate of the Average Annual Cost for Disaster Financial Assistance Arrangements due to Weather Events,* the PBO estimated that the federal government could expect spending $229 million annually for hurricanes, winter storms and convective storms; and $673 million per year for flood events (2016, p. 2). Floods have a disproportionately higher share of total economic losses which is estimated to be $2.4 billion for residential, commercial and public infrastructure damages (Public Safety Canada, 2017a, p. 11).

In May 2016, Canada experienced the worst wildfire disaster in the Regional Municipality of Wood Buffalo with a total economic loss of $1.4 billion (Government of Canada, 2015a). The final federal funding spending for the 2016 RMWB wildfires is currently unknown as it takes seven to eight years after a disaster for federal transfers to be made, and for reconstruction to be completed. (Government of Canada, 2015a). Estimates indicate that the federal disaster payments in June 2016 were $535 million, of which $307 million was for the Fort McMurray wildfires plus an additional $106 million transferred to the Canadian Red Cross to assist in relief efforts (Office of the Parliamentary Budget Officer, 2017, p. 13). Given that the 2016 wildfire was the worst natural disaster in Canada, it is estimated the future final costs of the wildfires will be much higher than the $1.4 billion 2013 southern Alberta floods. Municipalities must, therefore, consider how to reduce risks to their communities with increasing frequency and increased costs of extreme weather-related disasters as seen in the graph below (Source: Canadian Disaster Database, 2017).

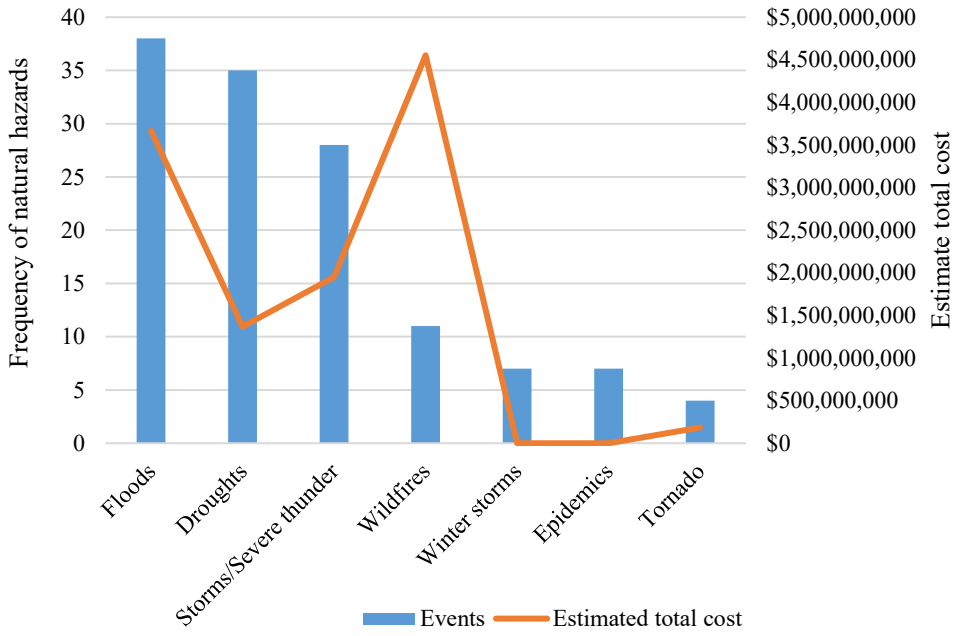

Figure 1-1 Frequency and cost of Alberta natural disasters, 1900-2016.

Source: Data from the Canadian Disaster Database, Government of Canada.

1.2 Research Problem

Compared to British Columbia municipal progress in climate change plans (Burch, 2010; Stevens & Senbel, 2017) or Ontario land-use plan quality studies (Guyadeen, 2018; Guyadeen, Thistlethwaite, & Henstra, 2018), there is no study on the discipline of land-use planning role in reducing multiple natural hazards (flood, wildfires, drought) in municipalities in the Province of Alberta as part of an overall climate change or disaster reduction strategy. Planners can influence what, where, and how municipalities adapt to natural disasters by leveraging land-use tools and plans to promote resiliency and mitigate future risks. It is therefore crucial for planners to consider how the impact of climate change, including a possible rise in global average temperatures and sea levels, will affect the ecosystems, coastlines, and local communities (Pachauri et al., 2014).

Intriguingly, Alberta was host to three of Canada's costliest disasters within a span of six years (2011 to 2016) namely: the 2011 Slave Lake wildfire, the 2013 Southern Alberta flood, and 2016 Horse River wildfire. Impacted communities included small and mid-sized northern, and rural municipalities and in the case of the 2013 floods, major cities such as Calgary were significantly impacted. Albertans are mostly concerned with blizzards, floods, droughts and wildfires. Excluding blizzards, the remaining three hazards have a direct impact on the planning of communities and were, therefore, the focus of the research study. Published studies following these disasters focussed on the lessons learned for emergency and recovery (KPMG, 2012a, 2017; MNP LLP, 2015; Northern Alberta Development Council, 2011; Ramsey, Ramsey, McWilliams, & Kristoff, 2012), or risk assessment approaches specific to the hazard (Harris, McGee, & McFarlane, 2011). No study focusses entirely on how the land-use planning functions in these municipalities adapted, or not, to incorporate natural hazard mitigation, for multiple hazards.

The graph below shows the disasters that are of most concern from a recent Statistic Canada's national survey regarding emergency preparedness and resiliency (Government of Canada, 2015b). Blizzards were excluded because one can mitigate extreme winter storms through building construction and heating/ventilation systems, rather than through land-use planning decisions.

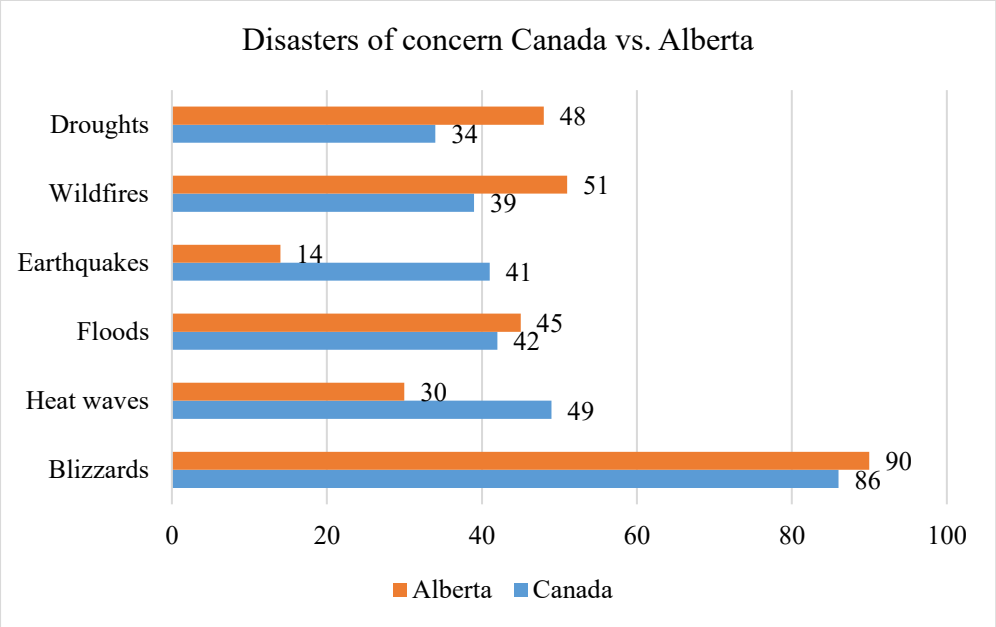

Figure 1-1 Disasters of concern to Canadians and Albertans

1.3 Purpose Statement

The purpose of this research was to investigate the role of land-use planning profession and practice in natural hazard mitigation in small/mid-sized municipalities in Alberta. The research expectations were to achieve a clear understanding of how small/mid-sized communities incorporate and adapt land-use plans and to document areas of improvement in the planning process, if any, required to better prepare municipalities with the increase of extreme weather events exacerbated by climate change. This dissertation establishes that planning practice that is adaptable to change, through a risk-based approach to hazard mitigation, is critical to preparing, responding, and recovering from future natural disasters, and therefore contributing towards building community resilience.

The objectives of the research were:

- To extract and assess data from existing publicly available municipal development plans, land-use bylaws and other technical studies, in order to produce and document the extent of hazard mitigation in the local planning process in a broader sample of small and mid/sized municipalities, specific to the three hazard types.
- To collect data from planning practitioners regarding changes to land-use practice following major natural disasters that occurred in four municipalities in the Province of Alberta, Canada, between 2011 and 2016. Specifically, the 2011 Slave Lake wildfire, the 2013 Southern Alberta flood, the 2015 agricultural drought in Brazeau County, and the 2016 Horse River wildfire in the RMWB.
- To collect data from research participants such as land-use planners, government and emergency officials, with the purpose of contributing to the definition of resilience in the context of disaster risk in Alberta.
- To develop policy recommendations to support small/mid-sized municipal land-use planning processes including legislative/regulatory and technical resources.

1.4 Research Questions

The following research questions were used to guide this dissertation:

1. What is the role of land-use planning in natural hazard mitigation in small and mid-sized Alberta municipalities, and why is land-use planning important in addressing natural hazards through disaster risk management?
    - What are the challenges facing small and mid-sized Alberta municipalities in utilizing land-use planning in natural hazard mitigation?

2. How can municipal statutory plans and policies address natural hazard risk reduction?
    - To what extent do federal, provincial and municipal legislation address the capacity of small/medium municipalities in hazard mitigation?
3. What is community resilience in the context of hazard mitigation?
    - What does resilience mean in small/mid-sized Alberta municipalities?
    - How do local plans influence pre-, and post-disaster community resilience?

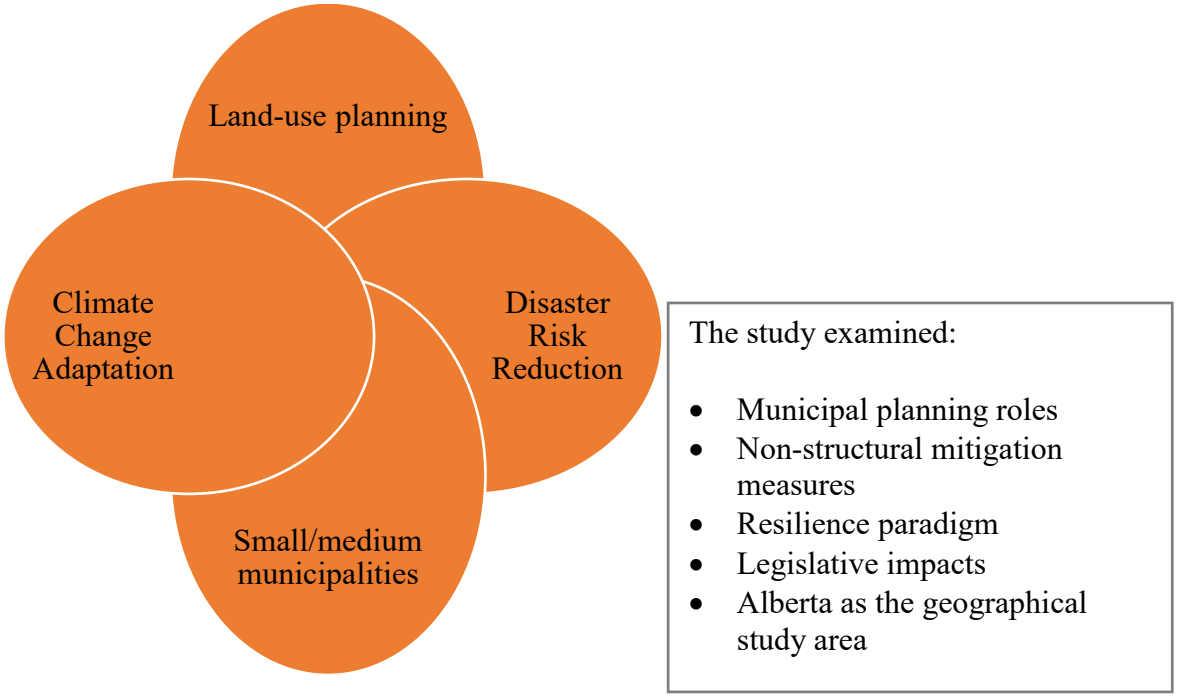

Figure 1-2 Study relationships

1.5 Overview of Methodology

The study used a qualitative perspective which holds that reality is a social construct and that it exists in multiple perceptions of people. The goal of this applied research study is “to improve the practice of a particular discipline” by understanding the meanings that

individuals have about a particular problem (Merriam & Tisdell, 2016, p. 16). The goal was to improve land-use planning practice and recommend changes to legislative policy, in the context of climate adaptation and disaster risk reduction. The research adopted a case study approach to understanding planners' experiences in "real-world" cases, or municipalities, with "important contextual conditions pertinent" to natural disasters (Yin, 2014, p. 16). The case study approach was an appropriate qualitative method of inquiry as it enables a researcher to conduct fieldwork in order to conduct

> "an in-depth analysis of a case, often a program, event, activity, process, or one or more individuals. Cases are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time" (Creswell & Creswell, 2018, p. 14).

In a qualitative study, the primary researcher is responsible for the collection and analysis of data and uses *reflexivity* as a means of connecting past experiences and being conscious of how existing biases shape a qualitative inquiry (Creswell and Creswell, 2018, page 183-184). It is important to note that a study regarding natural disasters and planning roles raises ethical sensitivities; therefore anonymity was necessary, to protect participant identities (Yin, 2014, p. 194).

The researcher was aware about how researcher bias may influence the research design and conclusions (Maxwell, 2013, p. 124). The initial bias of the researcher was that the land-use planning was not doing enough through land-use bylaws to protect development in hazard lands. To control for validity threats such as bias and reflexivity, the researcher was "open to contrary evidence" (Yin, 2014, p. 76) by using both triangulation in the selection of multiple methods, and by drawing on in-depth information gained from the interviews, focus group and content analysis, to better understand the

research problem (Maxwell, 2013, p. 126, 128). These biases were clarified after the research and were reported during data collection in Chapter 2 and 3 in the dissertation.

1.5.1 Purposive sampling

Purposeful sampling is a useful step in data collection, where a researcher sets the research boundaries by the sampling and recruitment of cases and individuals (Creswell & Creswell, 2018, p. 185). The study selected three types of hydro-meteorological disasters (fluvial/riverine flooding, wildfires and droughts) which occurred in four municipalities in the Province of Alberta. Research participants were land-use planners, emergency or government officials. It is essential to identify the case or unit of analysis and bound the case by a clear delineation of the specific group or phenomena being researched (Yin, 2014, pp. 14–15). The study used three criteria to determine an accessible sample of municipalities. First, the municipality declared a *State of Local Emergency* (SOLE) due to disaster between 2011 and 2016. Second, the natural hazard was listed as a major disaster in the Canadian Disaster Database (Government of Canada, 2013). Third, the municipality had land-use planners or development officers, a Municipal Development Plan (MDP), and a Land-use Bylaw. Using these procedures, the following municipalities were selected for the study as shown in Table 1.1 below.

Table 1-1 List of case study municipalities

Study location	Population (as of 2017)	Classification	# of Planners/ Development officers	Disaster-Meteorological-hydrological	State of Local Emergency
Town of Slave Lake	6,651	Small population centre	2	Wildfire	May 25, 2011
Brazeau County	7,771	Rural area	5	Drought	Nov. 1, 2016
Town of Canmore	13,992	Small population centre	5	Flood	June 20, 2013
Fort McMurray*	66,576	Medium population centre	20	Wildfire	May 1, 2016

Notes
1. The Urban Service Area of Fort McMurray is located in the Regional Municipality of Wood Buffalo, which is a specialized municipality. This number excludes a rural population count of 48,097 residents.
2. Statistics Canada categories are: small population centers have 1,000 to 29,999 residents; medium population centers have 30,000 to 99,999 residents; large centers have populations above 100,000 residents, while all locations outside urban centers are rural areas (Statistics Canada, 2011).
3. Alberta has a total of 112 small population centers; 8 medium and 2 large centers, i.e., the Cities of Calgary and Edmonton (Statistics Canada, 2016).
4. Source: 2017 Municipal Affairs Official Population List (Alberta Municipal Affairs, 2017).

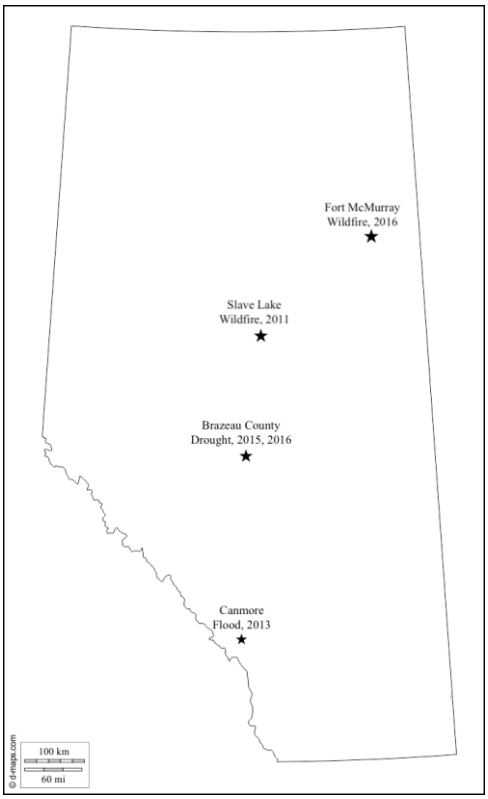

Figure 1-3 Study area map

The research study sites are described below as a rationale for why they were selected over other potential areas.

1.5.2 Research study sites

Canada's worst natural disaster occurred in Alberta in 2016 when the Horse River Wildfire, also called "The Beast," entered the wildland-urban interface (WUI) in the RMWB. The wildfire caused the evacuation of 94,000 persons; and reduced Canada's Gross Domestic Product (GDP) by 0.33% (Conference Board of Canada, 2016). The Beast destroyed 2,400 residential and commercial businesses; and beleaguered emergency and fire crews for a brutal 458 days before it was declared under control. Economists predict that the final cost of the wildfires will be in excess of $8.9 billion (KPMG, 2017, p. 3).

The RMWB wildfires were preceded by the 2011 Slave Lake "Flat Top Complex" WUI wildfires which destroyed one-third of the town, destroying 428 homes, seven apartment/multi-family, nine-teen businesses as well as the municipal and provincial government buildings (Alberta Government, 2012, pp. v–vi). The Slave Lake wildfires were unprecedented in that the town and adjacent small communities were threatened by three WUI wildfires, with unpredictable strong winds. At the time, the Flat Top Complex wildfires were the worst disaster, causing the evacuation of 15,000 residents, at the cost of $700 million in insurable damages (KPMG, 2012b).

Before the 2016 Horse River wildfire, the other most costly disasters in Alberta was the 2013 Southern Alberta floods, which cost $1.7 billion in insurable losses. The 2013 floods were caused by unprecedented above-average precipitation over snowpack as well as extensive atmospheric weather conditions (Pomeroy, Stewart, & Whitfield, 2016, p.

107). The floods caused over twenty-eight large, medium and small municipalities to declare a state of local emergency due to a natural disaster, and led to Alberta's largest evacuation of over 100,000 people; tragically, five Albertans lost their lives to the floods (MNP LLP, 2015, p. 1).

In addition to wildfires and floods, droughts are also of concerns to Albertans. In 2015, thirteen Alberta municipalities declared a state of agricultural disaster due to drought (Giovanetti, 2015). One of the municipalities that declared a state of emergency was Brazeau County. A year later, the same municipality declared a state of agricultural disaster again, but this time, it was due to extreme precipitation. In Alberta, the provincial drought policy is geared to the agricultural sector but does not explicitly guide municipal land-use planning on how to manage drought risk (Alberta Agriculture and Forestry, 2016a). Since studies show that droughts do not have a clear linkage to municipal land-use planning (Fu & Tang, 2013; Fu, Tang, Wu, & Mcmillan, 2013; Schwab, 2013), the study site was appropriate to begin to understand this connection. A detailed list of municipalities selected for the document content analysis, refer to Appendix C.

1.5.3 Data collection types and analysis

Data collection was over eight months, from February 2017 to September 2017, in the selected study sites where the natural disasters occurred. The researcher used multiple methods of data collection such as face-to-face interviews, a focus group and document analysis. The researcher used strategies such as the use of open-ended questions in the intervies and focus group settings in order to avoid influencing the participants or study areas during data collection (Maxwell, 2013, p. 124).

Face-to-face key informant interviews with lead planners in the four communites as well as experts such as emergency services and insurance staff, were conducted using semi-structured interviews to guide the conversations. The interview guide was structured based on the discipline of the interviewees, i.e. questions specifically for planners, elected officials or non-planners. The interviews were conducted in-person as well as by telephone for participants who were out-of-province.

A limitation of note was the number of lead professional planners that the resesarcher was able to interview (N=14). The number of lead or top planners in a small municipality are typically few, while mid-sized communities may have an array of development officers, junior planners, develoment permit clerks and planning technologists. In most small communities, there are no professional planners therefore knowledge about planning would be defered to other staff such as a development officer or planning technologist that has broader planning and policy knowledge.

Though the number of case study sites are few (N=4), the research findings with respect to disaster risk reduction, resilience and hazard mitigation, can be generalized to other small and mid-sized municipalities in North America and beyond, particularly if they are vulnerable to similar types of hazards (Yin, 2014, p. 40). A further cross-jurisdictional comparative study with small and mid-sized municipalities would be useful to explore the differences and similarities of that value od land planning and the various challenges for promoting resilience and hazard mitgation using non-structural measures at the local level.

A focus group with five individuals was conducted to understand the broader importance of hazard mitigation planning from government officials in disciplines in

drought, risk management and emergency planning. Focus groups are used "to elicit views and opinions from the participants" (Creswell & Creswell, 2018, p. 187).

The interviews and focus groups were electronically recorded on a hand-held digital recorder, then transcribed and analyzed using NVivo, a qualitative data analysis software. In NVivo, interview transcripts or field notes can be entered, searched and coded into summative themes. In this study, the researcher developed the codes based on the interview protocol questions. Refer to Appendices for samples of the interview protocols used for interviews and focus group.

Document analysis is the systematic review of public documents, records or reports that enable researchers to examine how individuals or cases address a particular issue (Creswell and Creswell, 2018, p. 187). As described in Chapter 3, the researcher analyzed Municipal Development Plans, land-use bylaws and other local policy documents, to examine how mitigation policies are reflected in documents specific to each hazard (see the list of municipalities in Appendix C). The municipalities were selected because they met several criteria. For example, municipalities that declared agricultural droughts in southern Alberta's drought-prone regions in the Palliser Triangle were more likely to have drought management requirements in the land-use bylaws. The study reviewed MDPs and land-use bylaws from twenty municipalities (N=20) specific to floods; fifteen municipalities (N=15) in the wildland-urban interface, and twenty (N=20) drought-prone municipalities.

The documents were accessible in the public domain through local websites. The researcher used key terms to search the hazard mitigation policies and used a spreadsheet

to organize the information. Creswell and Creswell (2018, p. 203) note that qualitative studies use descriptive terms to convey the research findings including direct quotes, the use of the first person, metaphors, tables and diagrams. These descriptive terms were reflected in drafting this report.

1.6 Planning for Natural Hazards

The Government of Canada's Ministry of Public Safety Canada has adopted a National Emergency Framework, which utilizes an "all-hazards" risk management approach to addressing natural disasters (Government of Canada, 2012, p. 74). The framework comprises four interdependent components: prevention and mitigation; preparedness; response and recovery. Under the prevention and mitigation components of the framework, land-use planning (as is building codes, education, and insurance) is identified as a non-structural mitigation measure that can minimize or eliminate hazard risks to Canadians. Despite the acknowledgment of the role of non-structural mitigation measures in disaster risk literature, the consideration of risk-based approaches at the local land-use planning level in Canada is limited. More robust examples of incorporating disaster risk reduction measures in land-use planning, such as state or local hazard mitigation plans, can be found in the United States, the European Union nations, Australia, New Zealand and Thailand (Berke, Cooper, Aminto, Grabich, & Horney, 2014; King, Gurtner, Firdaus, Harwood, & Cottrell, 2016; Mileti, 1999; Schmidt-Thome, 2007; Siembieda, 2014).

Gaps identified in the literature point to challenges facing planners in post-disaster reconstruction. In essence, although planners are visionary or perhaps utopic in their

visions of resilient communities, they do not always get their way, despite the cost-effectiveness of land-use planning in reducing hazard risk (Berke & Smith, 2009; Burby, 1998b; Glavovic & Smith, 2014; Moudrak & Feltmate, 2017; Olshansky & Johnson, 2014; Schwab, Topping, Eadie, Deyle, & Smith, 1998). Whereas post-disaster reconstruction efforts provide planners with a 'window of opportunity' to 'build better' by leveraging the resources and willingness of governments to rebuild quickly, the practical reality is that residents, the private sector and local councils' objectives and priorities may prevail over planning judgments (Desai & Sarmiento, 2015; Sudmeier-Rieux et al., 2015). The pressure to rebuild quickly is in part due to the 'time compression' phenomenon which drives recovery decisions and efforts to move forward at such a fast pace, with or without, fully understanding the repercussions of the resultant built environment post-disaster (Haas, Kates, & Bowden, 1977; Olshansky, Hopkins, & Johnson, 2012). This 'time compression' phenomenon is the view that it "is generally much faster to restore and rebuild what existed before the disaster than it is to make changes in land-uses and urban patterns and to reconstruct differently in the wake of disaster" (Johnson & Olshansky, 2016, p. 8). Time compression exists when the "processes of physical construction, financial transactions, social capital formation, and institution building compress unequally in time" (Olshansky et al., 2012, p. 173). This further results in shortcomings and underutilization of mitigation measures (Lyles, Berke, & Smith, 2014).

Nevertheless, this does not mean that communities do not learn from historical disaster events since they highlight the importance of spatial planning and improvement in building construction. In the early 19th century, several cities recovered and rebuilt successfully from significant hazards, namely, New York City, NY, after the great fire of

1835; Chicago, Ill., after the great fire of October 8, 1871, and San Francisco, CA following the great earthquake of 1906, which destroyed 80% of the city city (Goodspeed, 1871). Severity and recurrence of such high risk and low probability events (also called 'black-swan events') provide municipalities with a blank canvas in which the resulting pattern of development post-disaster can be envisioned.

Historians speculate that settlers in the ancient Mayan and Indus Valley civilizations abandoned those settlements due to climate change impacts such as famine, droughts, political instability, and wars (Newman, Beatley, & Boyer, 2009). Different communities that were unable to recover from disasters are the City of Pompeii, Italy after the earthquake of Mount Vesuvius in 79 AD; Managua, Nicaragua following the 1972 earthquake and Galveston, Texas, after the Great Hurricane of 1900 (Johnson & Olshansky, 2016). The concern for modern-day planning are the vulnerable populated coastal/delta cities like New Orleans, Lousiana, which rely on engineering structural solutions like sea-walls and levees for protection (Shields, 2008, p. 81), while islands like Tangier Island in Washington, D.C. are just one storm surge away from complete annihilation (Schulte, Dridge, & Hudgins, 2015). For every severe disaster, there is a chance that some communities may never fully rebuild.

1.7 Theoretical considerations

Two broad concepts underlie the research: the ontological view of the public interest and the role of the planner, and the nature of risk as a social construct.

1.7.1 Public interest

After disaster strikes, to what extent are decisions made in the public interest? Moreover, how is the public interest applied in the subsequent post-disaster reconstruction decision? Is it in the public interest to permit residential and commercial areas in a flood hazard area or a Wildland Urban Interphase without any mitigation requirements? Is it in the public interest to disregard water consumption or conservation policies in the wake of a long-strung drought? As will be examined in Chapter 2, the findings indicate that the answers to these questions are not simple.

Ubiquitous scholarship exists about the public interest in multiple fields and disciplines such as political science (Lewin & Lavery, 1991); public relations (J. Johnston, 2017); normative governance (Bozeman, 2007); and political science (Cochran, 1974). Public interest has a long history in land-use planning through classic utopian planners such as Lewis Mumford, Ebenezar Howard, Jane Jacobs, amidst more contemporary post-modernists with emancipatory social justice views like Judith Innes (1995), Leone Sandercock (1998), Susan Fainstein (Fainstein, 2005, 2014), John Friedmann (Friedmann, 1998, 2011) ; Heather Cambell and Robert Marshall (H. Campbell & Marshall, 2012).

Although earlier scholars questioned the public interest (Downs, 1962), the concept continues to be an "enduring centrality" that gives planning practice validity and usefulness in planning theory (Fainstein & Campbell, 2012, p. 102). This study, therefore, does not

abandon the concept of the public interest altogether but instead aligns with, and recognizes the legitimacy of the public interest in light of planning practice in climate adaptation and disaster risk reduction. The debate about the public interest has not dissuaded planners from the continued quest of the 'common good' because

> "In democratic polities, there has to be minimal agreement on the structure of the community and on the possibility of discovering a "common good" through political discourse. It seems to me that it makes a world of difference whether we seek to justify an action by grounding it in a conception of the "common good", a conception that always remains open to political challenge, or merely to assert it without voices of dissent, or omit any reference to it altogether" (Friedmann, 2012, p. 93).

As noted above, the choices that society and governing authorities, particularly high stakes policies around disasters and reconstruction, are subject to scrutiny and public challenge but should still be justifiable. Friedmann (2012) further outlines how the actions of all social actors in a democracy including governing authorities should espouse six criteria of "good governance": *inspired political leadership; public accountability; transparency and the right to information; inclusiveness; responsiveness and non-violent conflict management* (2012, pp. 99–100). Where governance does not meet the criteria Friendmann (2012) outlines, there is a breach in how the public responds to an uninspired, unaccountable, non-transparent system and so on.

In this study, the foundational legislative context that guides municipal planning embraces the concept of the public interest by enabling municipalities to prepare plans and actions, "*without infringing on the rights of individuals for any public interest except to the extent that is necessary for the overall greater public interest*" (Alberta Municipal Government Act, 2018). This dual dynamic between individual interest versus public

interest continues to be debated (Bozeman, 2007; Lewin & Lavery, 1991), and to pervade regulatory land-use planning at the regional and local level (Kaplinsky & Percy, 2014).

Public interest has multiple theoretical angles to pursue, but this dissertation first, aligns with the dual normative typology put forward by Campbell and Marshall (2012), i.e. consequentialist/utilitarianism; and second, the recent shift to Habermasian communicative rationality (Casteel, 2017; Fainstein, 2000; Gutmann & Thompson, 1996; Habermas, 1990). Deciphering the meaning of the public interest requires balancing the interests of individuals versus those of society as a whole. Public interest has, therefore, both objective and subjective meanings; it means "having something at stake" (citing (Pitkin, 1967) in (H. Campbell & Marshall, 2012, p. 112). As seen in the image below, there are often multiple interests at play given the various actors in land development at any given time.

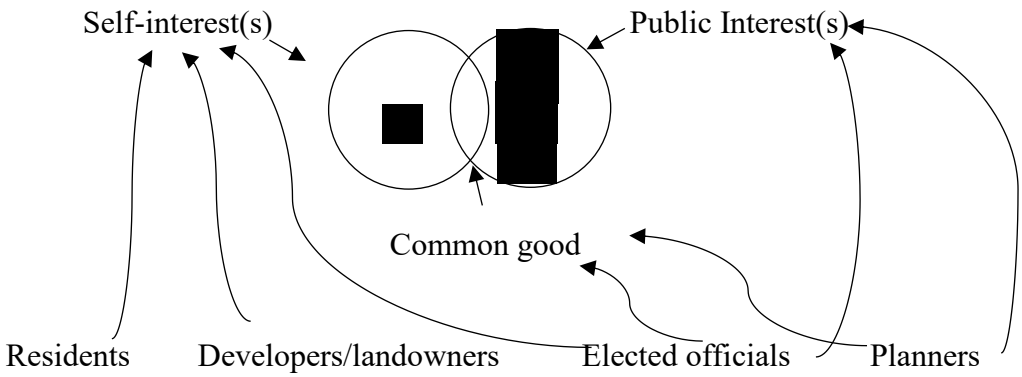

Figure 1-4 Self interest(s) versus public interest(s).

Note: Image adapted from (Lewin & Lavery, 1991, p. 105).

Campbell and Marshall (2012) typology of the public interest distinguishes "procedural (deontological) as well as outcome focussed (consequentialist) conceptualization of the public interest" (2012, p. 112). In other words, consequentialist "substantive interpretations [are] concerned with the content of actions and their consequences," while the deontological public interest focusses on "the quality of the decision-making or planning process" (E. R. Alexander, 2002, p. 228). As Friedmann (2012) concludes, the achievement of any results in planning cannot occur without both forms of public interest, i.e., "desirable outcomes" and "process of democratic procedures; one cannot do without the other (Friedmann, 2012, p. 94). In the context of hazard mitigation planning and adaptation, planners must continually navigate the public interest to determine how to respond through substantive actions after a disaster, as well as the procedural decision-making that often has a land-use planning component. Planning and risk management requires a mix of both consequentialist (Lilly, 2013) and deontological lens in order to reduce disaster risks.

A government that holds a *unitarian* view of the public interest elevates the collective views of society over the interests of individuals based on a "collective moral imperative that transcends particular or private interests" (E. R. Alexander, 2002, p. 230). In planning for disasters, this may include adopting mitigation policies to protect the collective public base as engrained in legislative and regulatory requirements. At a municipal level, the application of a *unitarian* view involves evaluating proposed developments against statutory plans such as municipal development plans or area structure plans to understand the conformity of the development to the policies or local bylaws. Although the major drawbacks of the concept of *unitarianism* "question the authenticity of societal consensus"

and “the legitimacy of the institutional frameworks” that implement it’s deontic rules, “this form of applying the public interest as a normative principle is universal, and is still its most common manifestation in planning today” (E. R. Alexander, 2002, p. 232). Unitarianism is therefore at the heart of navigating the land-use planning decisions and functions.

1.7.2 Temporal nature of risk

Municipalities can be more resilient by planning for disasters well in advance, in order to make land-use patterns that are adaptive, responsive and that minimize the risks in their communities. However, short timeframes hinder the consideration of alternative risk-based mitigative actions for long-term resilience. Planning theory is yet to incorporate the large body of literature about risk management fully. As explained in detail in Chapter 3, a risk management approach to disaster planning and the philosophical shift towards an “all-hazards” comprehensive approach, means planners have to balance the societal choices about lifestyles in hazard areas and more resilient, proactive, *build back better*, alternatives. Factors such as place attachment, memory, and performativity, as outlined in Chapter 5, may also slow down or redirect reconstruction in ways that are contrary to risk management goals of public safety and risk reduction.

A fundamental change in the 1990s set the stage to redefine disasters and the nature of disaster risk. The first was the declaration by the United Nations that the 1990s would be the International Decade for Natural Disaster Reduction. The UN encouraged member states to adopt an International Framework of Action of the IDNDR which later reframed into the *International Strategy for Disaster Reduction*, and the *Building the Resilience of*

Nations and Communities to Disasters. At the end of the 1990s, the UN established the United Nations Ofice for Disaster Risk Reduction (UNISDR) to implement the International Strategy. The gradual globalization of disaster risk reduction thus paved the way for the global response which culminated in 2005 with the signing of the *Hyogo Framework for Action 2005 to 2015*; and more recently, the *Sendai Framework for Disaster Risk Reduction 2015-2030* ('History - UNISDR,' n.d.). The UN has led world nations through these global positionings that focus on disaster risk prevention in the last decades and continues to be a priority in the 2015 Paris Agreement on Climate Change.

Second, it was in the 1990s that Ulrich Beck released his seminal book *Risk Society* (1992) whereby Beck provided a sociology lens regarding risk. The two important themes about risk were reflexive modernity (rooted in Habermas's communicative action) and a sociological view of modernity as 'risk society' (U. Beck, 1992). Beck argued that environmental risks are socially constructed so-called 'manufactured risks,' created by society and whose impacts society cannot fully compensate, and which must understand the sociological and political ramification of these risks (U. Beck, 1992). Other sociologists in the 1990's such as Anthony Giddens, sought to understand the multitude of explanations about why society makes certain decisions regarding all aspects of everyday life (where to live, work) for example. The work of Beck (1992) and Giddens (2013) indicates that the twentieth-century society may transition to the next post-modernist epoch which redefines the conceptualization of societal views about risk. Climate change, disaster risk and uncertainty, will continue to dominate the (world) risk society and society will, in turn, be in a recursive process of defining and redefining acceptable levels of risk and risk apportionment.

Resilience literature conceptualizes municipalities as *socio-ecological systems* (C. Wilkinson, 2012a); *spatial systems* (Cumming, 2011), or *complex adaptive systems* (Coetzee, Niekerk, & Raju, 2016; Marcus & Colding, 2014). Adaptive governance in socio-ecological systems is intended to tackle increasing risk and uncertainty by the implementation of adaptive climate change policies (Hurlbert & Gupta, 2016, p. 339). For the land-use planner, the juxtaposition and interruption of a disaster to a municipality's complex systems further enlarge the expectation, scope, and value of the profession in responding to hazards. This is because disasters often expose the vulnerability of the spaces and places that planners, developers, and councils work to create for their communities.

Consider how disheartening the challenge for reconstruction was (and still is) for land-use planners, community groups and governments in Houston, Texas after 2017 Hurricane Harvey or New Orleans, Louisiana after the 2005 Hurricane Katrina. In the latter, across the world, the images of poverty, crime, and the failure of government investment in dam/levee infrastructure exposed unsurprisingly deep pre-existing inequalities. In a matter of days, the "image of New Orleans as a cosmopolitan multicultural "gumbo" or as a heart of African American culture was overtaken by the image of the city as a "Third World" hell of poverty and violence" (Steinberg & Shields, 2008, p. 17). Even more disturbing, is the revelation of the politicization of Katrina that suggests planners should not only plan for rebuilding but be involved in the complex economic, equity and social justice/advocacy efforts (see details of "Disaster and Politics in (Flaherty, 2008, pp. 44–45)).

What Katrina and other disasters suggest is that while, long-range predictions, early warning systems, and mitigation strategies can reduce the impacts of hazards, not all risk can be mitigated or eliminated. However, risk can be reduced, and in the context of natural hazards and mitigation, land-use planning is a crucial component for post-disaster reconstruction (Johnson & Olshansky, 2016; Olshansky et al., 2012; Schwab, 2015). However, in the highly political arena in which land-use planning occurs, the role of the planner may be restricted to the provision of relevant advice for decision makers, via a plurality of interdisciplinary voices. Therefore, as Campbell (1999) concludes

> "planners will not always be able, on their own, to represent and balance social, economic and environmental interests simultaneously… [They] will have to decide whether they want to remain outside the conflict and act as mediators, or jump into the fray and promote their visions of ecological-economic development, sustainable or otherwise. Both planning behaviours are needed" (1999, p. 434).

Therefore, it is necessary for communities and their governance systems to adopt both deontological -rules-based approach- and consequentialist approach. This approach requires coordination, persuasion, and deliberation on the pressing problems at hand and the pursuit of workable solutions. Planners matter in the complex interconnectedness nature of disaster and climate mitigation.

1.8 Significance

This research contributes to the understanding about the value and role of land-use planning in the discourse on climate change adaptation and disaster risk reduction. This study will benefit policy- and decision-makers in smaller jurisdictions who experience recurring hazards by elevating the importance of land-use planning as a core municipal

function in mitigation and adaptation planning. Lessons learned will also apply to vulnerable communities where demographic, financial and regulatory capacities hinder adaptation and resiliency. The study is useful for planning practitioners to understand how they can facilitate, communicate and consider natural hazard risks in various land-use regulatory controls. The study will also contribute to the definition and application of the resilience concept, in contemporary planning practice and theory. It will also build on disaster risk reduction body of knowledge by highlighting the perspective and challenges faced when implementing non-structural mitigation measures, of which land-use planning is a crucial component.

1.9 Assumptions and delimitations

The study posits that land-use planning, as a function of municipal government, is fundamental, as part of a broader suite of epistemologies required for long-term climate adaptation and natural hazards mitigation. While mitigation strategies cannot eliminate hazard risks, they can reduce future losses to life and property damage. Also, mitigation planning varies between different sizes of municipalities, a gap that poses a serious concern, particularly for vulnerable small communities. Lastly, the study assumed that the extent of hazard mitigation is dependent upon regulatory and governance structures in place.

This study focussed on hydro-metrological natural hazards, i.e., floods, wildfires, and droughts, and avoided the causality argument of whether the disasters were natural or human-caused because the impact to the practice of land-use planning is inconsequential.

As well, the research did not evaluate the resulting outcomes of the hazard mitigation policies as the initial focus was understanding the baseline plan policies and bylaws.

Other human-made disasters such as economic, political, epidemic and chemical, biological, radiological, nuclear and explosive events were beyond the study. Populous urban municipalities are excluded due to their increased resource capacity for pre-and post-disaster planning, compared to smaller municipalities which experience more significant capacity challenges (FCM, 2015, p. 42). Lastly, First Nation Reserves and Métis settlements, although significantly impacted by these natural disasters, were not considered in the study due to constitutional powers and limitations of municipal land-use planning over Indigenous jurisdictions in Canada.

As addressed earlier, the other disaster areas in the recovery phase of the disaster and emergency management cycles such as evacuations, or early warning notifications, or incident command processes, were outside the scope of the study. This does not mean that the research did not consider the collective impacts of disasters, but rather, the research necessarily focused on the functional, applied aspects of land-use planning discipline. Further work is, therefore, necessary to understand Alberta's experiences about broader emergency planning, temporary housing recovery, and the social justice aspect of disaster vulnerability for vulnerable populations.

1.10 Organization of the Dissertation

Chapter 1 introduces the research problem of land-use in disaster risk, research assumptions, significance, a literature review on natural hazard mitigation, a discussion on

the conceptual framework from planning and disaster risk management, and lastly on the limitations of the study.

The main body of the dissertation comprises three independent research papers (i.e., Chapters 2, 3 and 4) which correspond to the three main research questions outlined earlier.

Chapter 2 is an independent study that draws on participant experiences in the four study locations in the context of natural hazards experienced by participants. The research first documents planners perceptions about hazard mitigation in the four study sites. Second, the paper reports on the challenges in long-term mitigation planning in four themes, i.e. blame and mistrust, community opposition, lack of education or risk unawareness and perceptions, and short memories that affecting resilient approaches.

Chapter 3 is an independent paper on how hazard risk assessment can inform land-use planning decisions through a variety of land-use planning tools and practices to reduce vulnerability to natural hazards. The study examines how land-use planning tools contribute to natural hazard mitigation using hazard specific actions or measures to address floods, wildfire and drought risks in the four Alberta municipalities. This study draws on three themes that emerged: local support on hazard mitigation; defining and understanding community resilience and collaboration with emergency planning and other disciplines.

Chapter 4 is a critique of the meaning of building community resilience in the context of natural hazard planning. This independent paper explores the various meanings of community resilience and their integration of hazard mitigation planning.

Chapter 5 is the overall dissertation conclusions that offer policy recommendations for local governments and suggestions for future research for planning and natural hazard mitigation. The proposed recommendations clarify the bounding nature of what can or cannot be achieved by land-use planners in addressing natural hazards. The intent is that these policy ideas be further explored to promote stronger resilient communities.

2 Planning Perspectives on Natural Hazards Mitigation in Small Communities

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2.1 Abstract

This paper focuses on the role of land-use planning in natural hazard mitigation in small and mid-sized municipalities in Alberta. It documents the perspectives and challenges of land-use planning when incorporating natural hazard mitigation in post-disaster reconstruction. Mitigation is a crucial component of Canada's four-phased emergency planning framework of prevention and mitigation; preparedness; response and recovery (Public Safety Canada, 2011). The mitigation phase, which occurs before and after disasters, specifically cites land-use planning as a critical component of protecting property damage and loss resulting from disasters. However, this research shows that the use of land-use planning tools to consider mitigation are limited and fraught with governance and regulatory gaps that may impact the long-term resilience of communities. The methods used to investigate this involved key-informant interview and focus groups based on four Alberta municipalities. Results found that there are significant challenges and gaps in land-use planning and municipal decision-making processes. They include the level of knowledge of hazard risks; understanding trade-offs that provide development opportunities versus risk reduction measures; the strengths, weaknesses and implementation of local plans and land-use bylaws; reactive versus proactive mitigation; and the reluctance of provincial governments on imposing legislative or regulatory mechanisms to local governments.

2.2 Purpose and Research Questions

In the wake of climate change and increasingly extreme weather, it is paramount to scrutinize the land-use planning role in disaster risk management and to understand how land-use planning contributes to building community resilience to natural disasters. More

specifically, it is critical to understand how natural hazard mitigation measures such as land-use planning occur in small, mid-sized communities, compared to larger urban centres where more capacity is available for mitigation and adaptation planning. The research purpose was to explore the value, role, and importance of the land-use planning function in mitigating the impacts of natural disasters in Alberta by exploring the challenges and extent of hazard mitigation in small and mid-sized communities. The research questions were (1) what is the role of land-use planning in natural hazard mitigation in small and mid-sized Alberta municipalities? (2) Why is land-use planning important in addressing natural hazards through disaster risk management? Also, (3) what are the challenges facing small and mid-sized Alberta municipalities in utilizing land-use planning in natural hazard mitigation?

2.3 Background

A 2014 survey conducted under the National Municipal Adaptation Project to assess municipal readiness to climate change, reveals the nascency of adaptation in Canada's municipalities: roughly 65% of small municipalities (less than 5,000 in population) did not have a climate adaptation plan and were not considering discussions about the matter (Hanna, 2014a, p. 8). Further, in the same study, the results for the Province of Alberta indicated that there were no municipalities with adaptation plans and 48.2% or 26 municipalities did not have adaptation plans and were not considering such plans even though they had experienced natural hazards (Hanna, 2014b, p. 4). The research concluded that small municipalities possibly are the most vulnerable to natural hazards (Hanna, 2014a, p. 13).

The Province of Alberta is Canada's most western Prairie Province bordered to the north by the Northwest Territories, British Columbia to the east, Saskatchewan to the west and the State of Montana (USA) to the south. The 2016 census for Alberta reported a total population of 4.2 million people, located over a vast landmass of 640,330 square kilometres (Statistics Canada, 2017a). Alberta's capital is the City of Edmonton, while the largest city is the City of Calgary, located east of the Rocky Mountains. In total, Alberta has 344 municipalities at the local government level. The province is geographically diverse and has the world's most extensive protected boreal forests to the northeast. The province has seven major watersheds with 80% of the population occupying the South Saskatchewan Watershed.

Since the 1900s, the Province of Alberta experienced 156 natural hazard events; mainly floods, wildfires, droughts, hail, tornadoes, and extreme cold weather (Government of Canada, 2013). Most notably, Alberta's recent major natural disasters occurred between 2011 and 2016, the largest being the 2016 Horse River wildfire in Fort McMurray, Alberta, which cost over $4.1 billion in insured costs. These wildfires were preceded by the 2013 Southern Alberta floods that cost $1.4 billion, and the 2011 Slave Lake wildfires which cost $700 million in insurable losses (Government of Canada, 2013). Canada's 2016 wildfires contributed US$ 4 billion in damages, which was three times higher than the previous period between 2006 and 2015 (Guha-Sapir, Hoyois, Wallemacq & Below, 2016). Ironically, in 2015 -two years after the worst floods- a widespread drought led thirteen communities to declare a state of local emergency due to agricultural disaster. Beyond initial property damages, these disasters also led to substantial capital investments for reconstruction in the recovery phases. In context, Canada's worst drought in 2001-2002

affected the Prairie Provinces at an economic cost of $5.8 billion (Wheaton et al., 2007; Wheaton, Kulshreshtha, Wittrock, & Koshida, 2008).

2.4 Literature Review on Hazard Mitigation in Planning

Studies on the integration of natural hazard mitigation in local planning are emergent and germane to understand how communities will adapt to the impacts of climate change and extreme weather. Canada's National Emergency Framework through the federal Ministry of Public Safety Canada has adopted a risk-based "all-hazards" approach to addressing natural disaster in its four phased frameworks of prevention and mitigation; preparedness; response and recovery (Public Safety Canada, 2011). Under the prevention and mitigation components of the framework of land-use planning, in addition to building code, education and insurance are identified as non-structural mitigation measures that can minimize or eliminate hazard risks to Canadians.

First, the literature on the role of land-use planning in natural hazard mitigation in Alberta is generally disaster-specific. For example, wildfire studies about the implementation of wildfire risk management by local governments found that few municipalities were adopting land-use planning in wildfire mitigation and that "none of the municipalities were restricting development in high wildfire risk areas" (Harris et al., 2011, p. 465). This underutilization of land-use planning is consistent with previous studies in Australia and the US (Burby et al., 1999; Prater & Lindell, 2000). Additional studies from British Columbia call for mandatory requirements to incorporate wildfire mitigation measures through a land-use bylaw, building code and regulatory standards. A recent study identified early successes by B.C. local governments in implementing wildfire mitigation

by having leaders champion mitigation, secure adequate resources and capitalize on the 'window of opportunity' often occurring after a disaster (Labossière & McGee, 2017).

Second, there is limited understanding of the extent of flood mitigation to avoid flood risks through land-use planning. Studies tend to focus on the structural mitigation feasibility studies of river basins (AECOM, 2014); on hydrological flood forecasting measures (Alberta Innovates, 2014); on causal assessments of the 2013 southern Alberta floods (Pomeroy, Stewart & Whitfield, 2016); or on the impacts and challenges of emergency management in Indigenous communities (Collier, 2015; Government of Canada, 2014). What is missing is an overall provincial floodplain management policy to guide local decisions in floodways. The *Municipal Government Act* (MGA) - the framework within which local governments operate- currently enables the controlling of floodway developments via a regulation. However, at the time of writing, Alberta had not used legislative power to adopt a floodway development regulation and lags behind other jurisdictions such as Manitoba, Saskatchewan and Ontario which have provincial flood management policies to which municipalities must comply. The absence of a regulatory mechanism means municipalities may or may not voluntarily restrict development in floodways through local community plans and bylaws, leading to an inconsistent approach. Even though provincial flood hazard maps are available through the Flood Hazard Identification Program, not all rivers have been mapped, and there is no mandatory requirement that municipalities reference such flood maps as a basis for restricting new development in flood hazard areas.

Third, drought mitigation focuses mainly on the agricultural sector, with minimal focus on how land-use planning could act as a hazard mitigation measure. Drought preparedness relates predominantly to the agricultural sector "due to the perception that drought affects agriculture most strongly, but also due to the fact that the best available impact data are associated with agriculture" (Schwab, 2013, p. 35). Losses are quantified in terms of crop losses, with much less impact on municipal losses. The research is unclear on the role if any, of land-use planning in drought mitigation at the local level (Fu & Tang, 2013; Fu et al., 2013; Schwab, 2013).

Alberta's provincial policy called the *Agricultural Drought, and Excess Moisture Risk Management Plan* asserts the principle that "risk is a shared responsibility" (Alberta Agriculture and Forestry, 2016b, p. i). The plan encourages municipalities and residents to improve water quantity and efficiencies by the development of water infrastructure (dams or reservoirs); and access to an alternate water supply. Critical infrastructures such as water pumps or lift-stations are considered appropriate in order to provide water supply to a community. Municipalities may also address water conservation, weed and pest control, through local Agricultural Service Boards. However, the plan has minimal drought mitigation measures for municipal-sector water usage for residential, or commercial land-uses. Water conservation measures appear to be driven by the activism of local voluntary, non-governmental organizations such as Watershed Planning and Advisory Councils (Beveridge et al., 2010).

In the City of Edmonton, for instance, water quantity or shortages are inconsequential because there is sufficient capacity in the North Saskatchewan River Basin for all industrial

and residential sectors. However, in Southern Alberta, the opposite is true due to the limitation and restrictions of water licenses by users drawing from the Bow River Basin. Communities in southern Alberta have more robust awareness and application of drought mitigation and water conservation measures, compared to their northern neighbours.

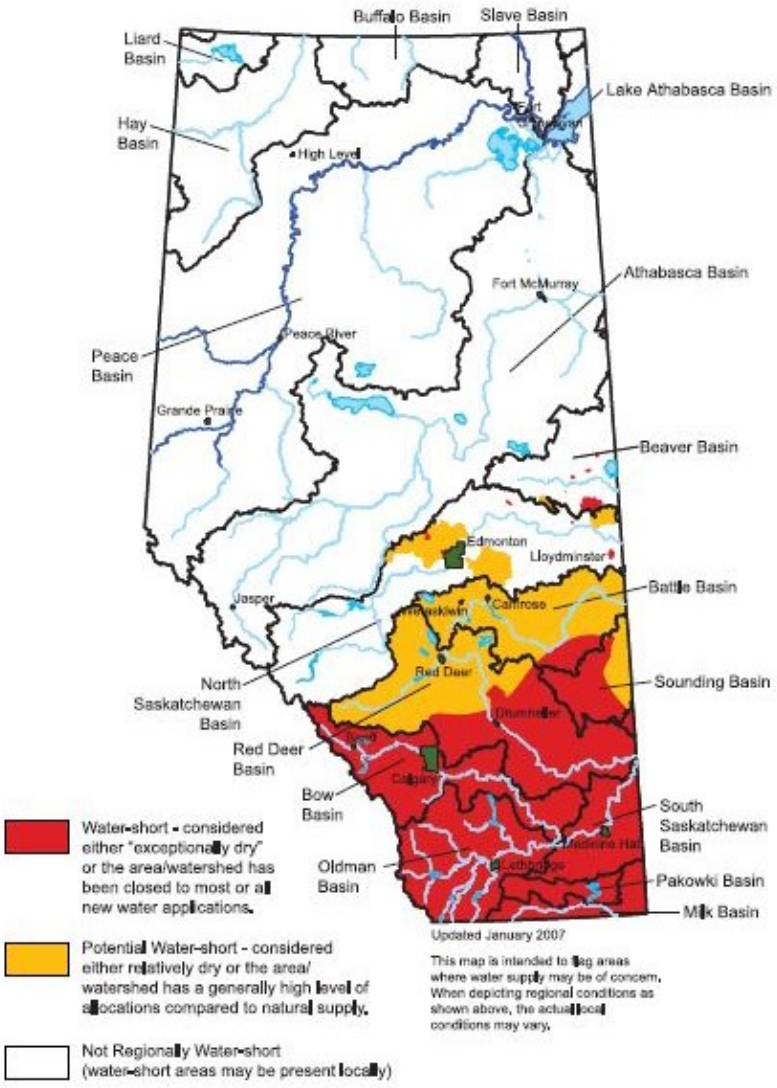

Figure 2-1 Water shortage map of Alberta

Map credit: The map is from *Understanding Land use in Alberta,* licensed under the Open Government Licence – Alberta (Government of Alberta, 2007, p. 34).

This research, therefore, focussed on land-use planning, within a broader multi-disciplinary context for hazard mitigation, to better understand how recent disasters shaped or challenged land-use decisions is communities, and to test whether the culture of continuous improvement -that is prevalent in emergency management- is evident in land-use planning. Did community land-use decisions change after the major disaster?

2.5 Study Areas and Methods

The study locations for the research were the Regional Municipality of Wood Buffalo (RMWB), Brazeau County, the Town of Canmore, and the Town of Slave Lake (see Table 2.1). All four study areas had experienced costly disasters between 2011 and 2016.

First, the town of Canmore, which was impacted by the significant 2013 flood, is located in the Bow Valley Corridor along the scenic Canadian Rockies, in the north-west province of Alberta. The town began in 1884 as a mining town and station for the Canadian Pacific Railway and proliferated between 1887 and 1979 when the last coal mine was decommissioned (Town of Canmore, n.d.). Over the years, economic stimulation such as the 1988 Olympic Winter Games and residential development have made the town a popular recreation and tourism destination. Presently, the town faces multiple environmental and natural hazard risks namely steep mountain creek flood risk (Holm, Jakob, & Scordo, 2016), wildfires (Walkinshaw, 2018) and underground mines (Predika, Dawson, & Stephenson, 1999), which require careful planning and risk management.

Second, the Regional Municipality of Wood Buffalo (RMWB), which experienced the devastating 2016 Horse River Wildfire, is 435 km northeast of Edmonton. The economy of the RMWB is historically associated with fur trading, but since the 1970s has

been better known for the Athabasca Tar Sands bitumen deposits. The 2016 wildfire compounded a struggling oil and gas economy following the 2008 recession. At the time, the wildfires caused the most massive evacuation of residents and damaged 2,400 structures. In addition to wildfire risk, the community is also vulnerable to ice-jam flood risks, flash floods and risks from adjacent bitumen operations (Regional Municipality of Wood Buffalo, 2011). According to the provincial maps produced through the Flood Hazard Information Program, more than half of downtown Fort McMurray is located in a mapped floodway. Growth in the floodplain areas is attributed to significant historical development patterns in the municipality that occurred over the history of resource development. Different risks facing the RMWB are groundwater, water quality, and transportation challenges in the remote community and ecological changes resulting from bitumen development (Regional Municipality of Wood Buffalo, 2011).

The third community is the Town of Slave Lake, located 248 km north-west of Edmonton. Slave Lake is vulnerable to floods, high water tables, unstable soils and low-lying lands subject to 1:100 flood events (Town of Slave Lake, 2007). In 2011, the Town of Slave Lake was the first community in Alberta to experience a major wildfire disaster resulting in the evacuation of residents and damage to structures and provincial/federal government buildings. “Wildfire 65” which entered the town was a ‘black swan’ anomaly that surpassed the town’s predominant risk factor: Slave Lake is most vulnerable to flood risk due to its adjacency to the Lesser Slave Lake. The major flood was the 1988 Sawridge Creek flood (Alberta Environment, 1993) and the town uses diversion canals to mitigate flood risk.

The fourth community selected is Brazeau County, located 142 km south-east of Edmonton. This unique community declared a state of agricultural disaster for two years in a row due to extreme drought conditions in 2015 followed by extreme precipitation in 2016 (the year of the RMWB wildfire). In addition to drought, the county is vulnerable to hazard risks such as wildfires, groundwater contamination, wetlands, steep slopes, and accidents from sour gas facilities (Brazeau County, 2017).

Methods

Key-informant interviews were held with lead planners in the four municipalities to determine the role of planning and on changes following the natural disasters experienced in the study areas. A focus group was held with experts such as emergency services, insurance staff, elected officials, or other government staff involved in the hazard events that occurred in the study areas. The researcher used semi-structured questions to inquire about the role of land-use planning following significant floods, droughts, and wildfires that affected municipalities between 2011 and 2016. The purpose of the key informant interviews with lead planners was to gather information on the role of land-use planning in hazard mitigation.

Focus group participants included government staff with interest in hazard mitigation and land-use planning. The method encouraged dialogue between different disciplines; tested the study's assumption on land-use planning in hazard mitigation and enabled discussion about the challenges facing local planning. The focus group was held with five participants over a half-day session (See Appendices). Open-ended questions were

discussed in a group setting. Focus group and interview transcripts were then analyzed and coded based on emerging themes using NVivo software.

One limitation that must be noted is that number of interviewees was limited to a small pool of lead planners in the four communities that experienced major natural disasters within a limited timeframe (2011-2016). In one study area, for instance, there are no professional planners however, a local development officer was able to participate in the research. The findings gained from this study are generalizable to other similar small and mid-sized municipalities that may be vulnerable to similar types of hazards. A further cross-jurisdictional comparative study with other similar sized municipalities may aid in advancing the overall perceptions about land planning roles, challenges and opportunities for advancing hazard mitigation at a local level.

2.6 Results and Discussion: Role of Land-use Planning in Natural Hazard Mitigation

The purpose of land-use planning is to determine the orderly development and use of land through settlements patterns that provide economic and social benefits to society. This section is a comparative representation of the role of land-use planning and challenges facing planning decisions, across three disasters -floods, wildfire, and drought- in four municipalities. The research set out to answer the questions: what is the role, and importance, if any, of land-use planning in natural hazard mitigation in disaster risk management? And, what are the challenges facing small and mid-sized Alberta municipalities in utilizing land-use planning in natural hazard mitigation? Results demonstrate that planners acknowledge the role of planning in hazard mitigation; however, the primary challenge is that municipalities are in various stages of the implementation.

2.6.1 Canmore: After the 2013 floods

Riverine floods are the most common natural hazard in Alberta, with major floods occurring in 1997, 2005, and most recently, the major southern Alberta flood in 2013. One of the municipalities impacted was the Town of Canmore. Located at the alluvial fan base of the Rocky Mountains, the 2013 floods caused steep mountain creek flooding, sending debris, boulders and sediments past homes along the Cougar Creek.

Following the floods, the Town of Canmore made significant progress in addressing flood hazard risk through local plans in addition to long-term structural engineering risk assessments (Holm et al., 2016). This research found that Canmore had comprehensive flood risk-based approaches incorporated in their land-use plans to guide development decisions in several hazards. After the floods, a research participant noted that most of the land-use planning changes in long-term plans were specific to greenfield or undeveloped areas where no development had occurred yet. In other words, the changes made to the planning documents were specific in undeveloped greenfield areas; leaving a critical gap in addressing flood mitigation requirements for existing residential developments located in flood hazard areas:

> So far in land-use planning, we haven't changed any of the existing areas. All of the changes are coming in new areas where development hasn't been approved...So in new areas, we have a new mapping. We have a new Municipal Development Plan—that was in the works anyway, so it wasn't directly as a result of the flooding. But there's a whole new section on flooding and so a whole requirement for studies to be conducted for new development in study areas (Interviewee F, personal communication, May 1, 2017).

What is essential in the participant's response is that changes to the municipal development plan had already contemplated flood reduction requirements and this plan update was not

necessarily triggered by the 2013 floods. In this regard, the regular updating on the MDP by this community pointed to a risk awareness about flood hazards and the vulnerability of the community.

Canmore faces another significant hazard risk related to flooding: it is one of the most developed alluvial fan in Canada with about 1,400 residential homes located at the base of the Cougar Creek (Jakob, Weatherly, Bale, Perkins & MacDonald, 2017). An alluvial fan poses a risk to adjacent residential uses due to the amount, force and speed of debris (boulders, trees) flow as witnessed in 2013 flows along nearby steep creek homes (Pomeroy et al., 2016, p. 3).

Figure 2-2 Cougar Creek debris flood infrastructure

Debris floods are triggered by intense precipitation and occur suddenly and without much warning. Debris floods can be catastrophic in an alluvial fan due to the intense impact

and force of debris impact on existing buildings/structures at the base (Jakob, 2014). To protect existing development along the fan and downstream Cougar Creek, the town of Canmore constructed a $48.6 million structural mitigation infrastructure called a *debris dam* that would hold 650,000 cubic metres of mountain debris upstream of the Cougar Creek (Government of Alberta, 2017).

> "Our greatest risk is called the "Debris Dam Outbreak," and what happens is a part of a bank of a river where it's quite steep will collapse and create a dam—a natural dam. And because it's natural the water backs up, but it doesn't hold. Eventually, it releases, and usually catastrophically.
>
> So Cougar Creek—if you go there today there's probably no water in the creek—it looks like nothing. And so, one of these happened about a month ago in Columbia where there was a creek upstream of a housing development, and there was some kind of flood that released quite dramatically in the middle of the night. And that's our worst concern. So, about 200 people were killed.
>
> And so, if you have one of these sudden releases in the middle of the night—especially when people are sleeping—that's probably our biggest risk" (Interviewee F, personal communication, May 1, 2017).

The risk of a catastrophic debris flood and the flows of large boulders and debris along an alluvial fan development is a serious risk to loss of life and is a major development constraint for planners. The participants' response, and recollection of a similar event in Colombia which resulted in fatalities raises significant gaps for both local land-use planning and the need for provincial guidance through interdisciplinary efforts (geology, engineering, steep mountain creek hydrology).

> So historically in a geological sense, there have been substantial events. And so it's changed how I drive the highway between here and Calgary. It's quite interesting—because if you go over a small rise on the road between here and the edge of the mountains—it's often an alluvial fan. Not always. But almost everything—small rises in the TransCanada Highway. A bunch of them are alluvial fans. So look at that when you drive out of the mountains towards Calgary. So we're trying to work on mitigation. We haven't changed the land-use in those areas. We've been very

> cautious. In some cases—well in one case—in two cases the town has bought land that had housed homes that were destroyed in 2013 (Interviewee F, personal communication, May 1, 2017).

From the response, it is clear that regulating existing development in the alluvial fan remains a critical challenge for Canmore. It appears the interviewees lived experiences were even altered such as driving options due to the recognition of risk. Also, the towns property acquisition of two properties is likely unscalable and unfeasible given the 181 parcels that are at risk of personal safety (Jakob, 2014, p. 36).

When asked whether there were changes to the planning documents to mitigate increased development in the alluvial fan, the participant noted that their land-use bylaw did not allow intensification or rezoning of land-uses in the alluvial fan. The participant also noted that further approvals and guidance were required by the provincial government to mitigate debris flood risks, and if no approvals were granted, the town may be contemplating conditions such as down-zoning -reducing a land-use to a less intense use- which would likely involve compensation to property owners.

> We're not entertaining any rezoning, or we're not allowing people to intensify their uses in risk areas. So that is the land-use. It's not so much a change at this point. We're still waiting for all of our approvals from the province. If we don't get them—then we will go in and we will down zone properties to make it so that properties can't be developed. But that would likely involve some compensation, so it's going to be tricky (Interviewee F, personal communication, May 1, 2017).

A final finding from the Canmore study area was the rationale behind the historical alluvial fan development. Given the consequences of debris flood occurrences, (fatalities, injury and property damage), the researchers' reflective inquiry was: why approve new development in an alluvial fan in the first place? The interviewee's response as noted below

was that the historical approval of alluvial fan developments occurred in the absence of understanding the risk and seemed to have been enabled by provincial decision.

> It was approved without an understanding of what the risks were. There was a real housing crunch in Canmore in the '80s and the province—I think it was one provincial department said, "no," another provincial department said, "yes," and they kind of won and that's what we're stuck with now (Interviewee F, personal communication, May 1, 2017).

This response was interesting because it highlighted the initial approval to build in the hazard area in the 1980s appeared to have been debated at the provincial government level, between two different departments, and in the end, development was allowed to occur. This response raises two issues: first, there was an inconsistency between provincial government departments approach to risk tolerance. Should councils ignore the risk and proceed with development because of economic pressures for residential and resort development? Alternatively, should councils concede that the risk of a debris flood (geologically evident) and its consequences (loss of life and damage to property) is intolerable, therefore, reject development? Clearly, in the case of Canmore's alluvial fan development, the provincial department with the high-risk tolerance won the argument. Second, the consequent difficulty for local government planners is that once such a policy decision is made, it triggers a permanence to development which "we are stuck with" long after approvals.

In summary, the research found that the town of Canmore had made significant effort to use existing authority for land-use decision making under the MGA to restrict floodway and steep mountain creek development through the land-use bylaw and local municipal development plans. As noted by the research participant, however, much work

remains on how to protect existing developments in high hazard areas such as alluvial fan development. Further, there remain detailed gaps in how to translate detailed engineering and risk management analysis (Jakob, 2014) into the towns land-use decision-making process.

2.6.2 Regional Municipality of Wood Buffalo: After the 2016 wildfires

The Regional Municipality of Wood Buffalo made several changes to flood risk requirements in the land-use bylaw before the 2013 floods and after the 2016 wildfire. The context around the rebuilding of the Waterways community, a historically significant floodway community, which lost 250 homes (~90% of the community) in the wildfire, is key to understanding the complexities of implementing flood policies in land-use planning.

Following the 2013 provincial announcement of the legislative changes to enable the development of floodway development policy, the RMWB adopted a land-use bylaw amendment which included stringent flood proofing requirements for new subdivision or developments applications for areas located in Flood Hazard Areas. These extensive flood proofing of developments in the flood hazard areas were considered commendable disaster risk management measures as they mitigate the risk of floods. They included: locating mechanical, heating equipment above the base flood elevation; or restricting basements below flood elevation. Interviewees explained that the 2013 flood-proofing bylaw was adopted at a time when there was no flood damage to existing homes or businesses in the neighbourhood and was never tested, i.e. no homes flooded and needed flood proofing under the requirements of that bylaw:

> So it was amended in 2013 after we had the flood and I would see more owner restrictions were implemented at that point in time. So it went from 248 to 250 metres. So habitable space below 250. And then there are requirements for geotechnical engineers to come in and sign off on things, floodproofing, and there's a whole series of requirements. Every property needed to be engineered. It had to be not just the geotec, but you also had to get an engineer also to design the property. So it was—like I said—it was never tested (Interviewee C, personal communication, March 31, 2017).

Following the 2016 wildfire, the rebuilding of the community of Waterways was called into question. Should Waterways be rebuilt to the 2013 flood-proofing bylaw, or should the risk of floods be avoided by naturalizing the community into parkland or other low-risk uses, and relocating residents to safer lands? In the end, and through sustained local pressure, the local government council decided to rescind the flood-proofing requirements in the land-use bylaw, and allow redevelopment of the Waterways community in the floodway. The timing of council's repeal of the floodproofing rules shortly after the 2016 wildfires, provided the opening for Waterways landowners to rebuild despite their awareness of the existing flood risk:

> "The bylaw wasn't put in place when 250 people needed to rebuild their home. The bylaw had flood-proofing requirements. By choosing to rebuild there, I am making the conscious choice to do this, in the floodplain (Interviewee A, personal communication, February 10, 2017).

Had there been flood damage to Waterways homes, the bylaw's floodproofing requirements would have been implemented when residents applied for a development permit to rebuild homes after the flood. However, planners noted that implementing the restrictive requirements such as seeking a professional geotechnical/engineer to ascertain preventative floodproofing, would have required significant investments. Such costs would have led to increased rebuilding costs to homeowners, who were already fiscally strained from the wildfire, and from the 2008 economic recession that hit the resource town. The

most stringent policy in the bylaw would not have allowed any development in the 1:100 floodway; it would have restricted Waterways residents from rebuilding at all.

> We—increased the flood-proof requirements of the flood hazard development requirements. And that was in consultation with our environmental services group and engineering group to come up with reasonable—what was deemed at the time to be reasonable--requirements and regulations. And what we found after the wildfire …is that because those [requirements] were never tested especially down in Ptarmigan or in Waterways—everybody that needed to rebuild after the wildfire would likely not be able to because of those restrictions. They were very, very prescriptive (Interviewee C, personal communication, March 31, 2017).

Planners interviewed had no concerns with the adoption of hazard mitigation standards, bylaws or policies to reduce natural hazard risks including stringent policies for floodway developments. However, they recognized the role of land-use planners as providing the best available information to decision makers and residents flood risk and mitigation options. They recognized that the decision makers are local elected officials, not planners. Therefore, the decision of the RMWB council to allow the rebuilding of communities in floodways was not necessarily a planning decision; instead, these decisions were based on a combination of elected officials' decisions and individual resident choices. Practical challenges, such as infeasibility of relocating large historical floodplain developments or entire downtown areas, as well as economic pressures to rebuild to stimulate growth and return to business-as-usual are vital factors. In the case of the RMWB, there was the recognition by planners that mitigation measures, however plausible, also come at increased fiscal costs to owners that may ultimately impede investments in hazard mitigation measures.

> "The flood you know, in my opinion as a professional planner maybe not so much as [municipal staff], is I would have preferred if nothing happened in Waterways. You know of anywhere that's really susceptible we should be looking at either a very

> different type of built form or no building at all. That's really the only way to protect the municipality from future losses…Our entire lower townsite is within the floodplain. And we can't certainly shut down the downtown and remove everything. Cause we just—how would we physically do that logistically? So, I think the only way to do it is identified which are your most hazardous areas and which pose the most risk and build through them parks (Interviewee C, personal communication, March 31, 2017)."

> "You know as planners we would obviously state that…obviously makes sense to include some policies and even incorporate some regulation if possible…but at the end of the day, you have to look at the cumulative impact and everything that's happening with this community…Philosophically—sure it makes sense, but if it adds to the cost of building a home, you're not going to get people coming here anyways. So, it's a fine line, and you have to strike a balance somewhere" (Interviewee B, personal communication, March 31, 2017).

Insurance was another aspect that participants noted that affected the way homes were rebuilt following the wildfires. In the Waterways example, the absence of a flood-proofing bylaw may have impacted residents' ability to access home insurance coverage. Participants noted they had encountered property owners in Waterways who were underinsured. Conversely, for residents with good insurance coverage, the existence of a flood-proofing bylaw would have allowed insurance payments to cover the cost of implementing flood-proofing requirements.

> Some policies have a statement in there that states they would allow a policy to rebuild or to construct something that's a requirement of a bylaw that's been prior to the disaster. So in that case—you know—I would think that insurance would certainly cover it—should it flood but at the same time, they only have a certain amount of money. Whatever they insured their house for—they would only have that much money. And there are so many different combinations and different pockets of insurance. Nobody is the same (Interviewee B, personal communication, March 31, 2017).

Insurance is another crucial non-structural mitigation measure that has an impact on development. At the time of the research, Alberta, Ontario and Quebec insurers provide overland flood insurance. However, if a high-risk property were known to be in a floodway

(such as through a provincial or local zoning map), overland flood insurance is not available, and if it is available, the premiums would be so high that obtaining insurance premiums would be unfeasible (Public Safety Canada, 2017a, p. 6).

> You know I would suggest that even through the wildfire —unless you had guaranteed replacement cost—you were under insured. Even if you think about old homes that renovated and didn't update their insurance policies—so they would have been only insured for whatever it was worth in 1989 or whenever it was built. And not the value of it in 2015 or 2016 (Interviewee B, personal communication, March 31, 2017).

Participants also mentioned how the 2008 downturn in the economy had a domino effect on who had or did not have insurance coverage after the wildfires. For some residents, the choices were down to the basics: spending income on food or home insurance.

> So the downturn in the economy forced these people to make a decision—am I going to have insurance or am I going to put food on my table. Or am I going to have gas so I can—I can get some work or whatever it is. Right? So it forced them to make these decisions (Interviewee C, personal communication, March 31, 2017).

Additionally, insurance coverage had an impact on the type and form of reconstruction after the wildfires. FireSmart development discipline emphasizes the need to ensure exterior walls and roofing materials have high fire-resistant ratings. However, rebuilding to a higher rating (such as hardy board siding, or metal roof) comes at an increased cost which insurance coverage, at the time, was unable to cover. The costs were so high that at the time of data collection, planners had not approved any development permits for such resilient building reconstruction.

> Most of them talk to us, but at the same time it comes down to preference. So their insurance company will only cover so much, they either get Hardy board siding or

> granite countertops. And they choose to go with the countertops (Interviewee B, personal communication, March 31, 2017).

Another finding was that there appeared to be significant funding to implement the FireSmart after the 2016 wildfires compared to previous years. The financial investments into wildfire management reduction programs are indicative of local government response and willingness to invest in such programs after a disaster.

> So prior to May 2016 the FireSmart program was active in the community but not as funded as probably for a community this size that was growing and developing so quickly that we needed to incorporate the FireSmart principles into the design and development of the communities and not just a—"build it and we'll catch up later" sort of perspective (Interviewee G, personal communication, July 17, 2017).

Increased funding for the FireSmart program meant that planners, residents as well as the development industry, were incorporating wildfire risk reduction measures in the development and design of subsequent rebuilds and subdivisions. Such measures include the creation of buffers zones on homes adjacent to the WUI, consideration of resistant species for landscaping trees and shrubs, and thinning the forest within and surrounding the municipality. However, interviewees were quick to point out that no amount of wildfire management can indeed eliminate wildfire risk, especially with the uncertainties and extremities in weather patterns.

> For the wildfire—people [have] been very critical why we didn't FireSmart our community. In fact, we did it in 2010. We had a FireSmart plan and then that was being maintained but keeping in mind; the fire jumped a river that's a kilometre wide. You could have FireSmarted anything, and it wouldn't have stopped (Interviewee C, personal communication, March 31, 2017).

Participants in the insurance industry offered useful insights into RWMB. Although the context was the 2016 wildfires, the interplay with flood insurance was brought up because the local government decided to build in the Waterways community. The first

finding participants noted was that although Alberta insurers were offering overland flood insurance coverage for certain areas in Canada, the coverage was not readily available for high-risk flood areas, or it came at very high premium costs:

> There's a handful of companies that are offering flood coverage for specific areas but in many of the areas that are specified in the designated flood hazard areas—overland flood coverage just may not be available or if it is the cost would be very, very high for the premiums for this and that's based on a known fact that—if it's in a flood hazard area,—that's a known risk and it's not a matter of "if it will flood," it's a matter of "when it will flood," based on what we're seeing.
>
> So where that makes things unique is even though there are some insurers are offering the coverage—there may not be coverage available in some of the most prone areas to that actual flood risk (Interviewee J, personal communication, September 21, 2017).

This finding is an essential consequence to the overall viability of redevelopment in hazard areas: planners (and councils) that approve development in the flood hazard areas, may inevitably be placing residents in areas where they would not have overland flood coverage. This begs the question: when the next disaster occurs, who will be responsible for the recovery costs if insurance is not available? Typically, taxpayers would need to pay for uninsurable costs either through the provincial programs such as the Disaster Recovery Program in Alberta or through the federal Disaster Financial Assistance Arrangements.

Participants noted the importance of educating homeowners to understand their risks and their home insurance policies in the event their property is flooded. Understanding risk (as discussed further in Chapter 3), requires thoughtful crisis risk communication delivered to homeowners as well as decision-making bodies similar to communicating public health crisis (Covello, 2003; Hyer & Covello, 2017).

> One of the things that insurance can do is send people a very direct signal on what their risk is. I think a recent survey surveyed people who were in flood risk zones and of those people, only 6% thought they had a risk. And so a good part of this I think—you know—is not just actions that the governments can take but until people start to realize what they're actual risk is, it's a very hard thing to get that sort of public support for actions directed around trying to reduce community-wide risk (Interviewee K, personal communication, September 21, 2017).

In conclusion, municipalities studied showed differing land-use-rules for addressing flood hazard risks, with either stringent land-use bylaws such as the Town of Canmore versus RMWB's which had relaxed its flood-proofing requirements. Also, both communities indicate a gap and need for provincial floodplain policies to guide floodplain development in a more consistent manner across municipalities.

2.6.3 Slave Lake: After the 2011 wildfire

Wildfires are a way of life for many northern boreal communities. Alberta's first significant wildfire was the Great Fire of 1919 in Lac La Biche; it displaced 300 residents and destroyed much of the town (Government of Alberta, 2011). Since then, five significant wildfires burned over 5 million hectares including the 1950 Chinchaga River Fire, the 1982 Keane Fire, the 2002 House River Fire, the 2011 Richardson Fire and the 2016 Horse River Wildfire both in the RMWB (Tymstra, 2015, p. 160).

In May 2011, the Town of Slave Lake experienced a significant wildfire disaster which destroyed 374 structures including 169 apartment units, ten businesses, three churches, and town, provincial and federal government buildings in the town (Northern Alberta Development Council, 2011). The irony in Slave Lake's disaster is that the community's greatest vulnerability is flood hazard risk given the town's adjacency to the Lesser Slave Lake; the flood of record was the Sawridge Creek flood in 1988 which led to

relocation and investment in flood mitigation structures (Alberta Environment, 1993). On May 15, 2011, within one hour, unprecedented 100 km/hr winds fanned three wildfires into the town boundaries, burning 22,000 hectares in the region and leading to the most massive single evacuation at the time of 10,000 residents (Kulig, 2012, p. 2).

> We went out to watch the fire - it was covering the treetops, and that's how fast it was going, and the wind was crazy. Absolutely crazy wind! Like you can hear it on all the video. The wind is like— "whooshing" (Interviewee E, personal communication, April 27, 2017).

Following the wildfires, Slave Lake decision-makers adopted changes to the towns' land-use bylaw, disaster recovery and emergency plans. The MDP already identified wildfire risks as a development constraint and thus did not require an amendment. Specifically, the MDP requires applicants of a proposed WUI development to seek a qualified professional to prepare a Wildfire Risk Assessment. Before issuing a subdivision approval or development permit, the development authority reviews the report and can attach conditions requiring the applicant to complete all the recommendations in the wildfire risk assessment (Town of Slave Lake, 2007). In terms of the municipal development plan, at the time of data collection, the participant noted that there had not been any changes (to address wildfire mitigation).

> I don't know that there was a whole lot of changes done to the MDP. In fact, I would say "there were no major changes" (Interviewee E, personal communication, April 27, 2017).

Lessons learned from participants is that wildfire mitigation measures implemented at the local or homeowner level may not necessarily deter wildfire damage to property due to extreme weather conditions. Severe wildfires, such as the unprecedented winds in Slave Lake can still impact communities that have implemented the seven FireSmart

disciplines/principles. The FireSmart program operates under the Ministry of Alberta Agriculture and Forestry; it aims to educate communities and homeowners on how to reduce wildfire risk on private and public Crown land. FireSmart refers to the "actions taken to minimize the unwanted effects of wildfire while recognizing the important role it has in maintaining healthy landscapes" (Government of Alberta, 2013b, p. 62). FireSmart disciplines can be implemented on a parcel specific level, as a neighbhourhood plan or part of a regional-wide strategy. A complete FireSmart implementation plan has two primary guiding documents: Wildfire Preparedness Guides and a Wildfire Mitigation Strategy. Slave Lake was unique in that although the town had existing FireSmart plans due to its historical location in the boreal forest, it was still not enough to protect the community from the 2011 disaster. While mitigation measures can reduce wildfire risk, they cannot eliminate the risk.

Specifically, one of the changes that the Slave Lake community made to their land-use bylaw was to re-designate the land-use districts where several apartment blocks were located. The 2011 wildfire damaged 169 apartment units, yet the locations of those apartments were zoned with broad language in the land-use bylaw that would not have enabled the rebuilding of apartments again following the wildfires. The research participant explained:

> We had a high-density district in which you could build anything from a duplex to an apartment in that section. Which is a really wide variety. And so an apartment district was created. The only issue that we had was that we didn't rezone those apartments at that time. We just did that this year—rezoned it—all of the apartments to the apartment district. So if something had happened to those apartments in between times, they wouldn't have been able to rebuild an apartment" (Interviewee E, personal communication, April 27, 2017).

Land-use bylaws, as was the case in Slave Lake, are living documents that can be amended at any time, subject to public hearing, except in the case of direct control districts, where councils make final decisions. As 'living documents' the land-use bylaw in Slave Lake was amended in order to 'correct' the former broad language. As noted above, residents were concerned about the rezoning, and the responsibility was on the town to explain why the parcels of land for apartments were being changed.

Lastly, a key finding is that there is a lack of collaboration between inter-governmental emergency management agencies and land-use planning. Planners must work more closely with emergency services as they develop emergency plans such as identifying evacuation routes, appropriate locations of reception centres for emergency operations. One emergency management participant noted that there was, at the time, a lack of collaboration between departments:

> So right now the—like the planning department— is not really engaged in emergency services when it comes to planning and development of our community. We do live in the Boreal Forest so pretty well we're surrounded with forest, it'd be rare. My opinion is [this is] one of the things that we need to do better, and we've unfortunately because of the incident last year, May of 2016 wildfires that we're able to now put more of an onus on those—those are more important with how we build our communities in the middle of the boreal forest, where we have so much fuel for fire around us and fire—wildfires being so natural and how—but they're occurring more often and more violent than ever before.
>
> People are saying—mostly associated with global warming and where warmer temperatures—warmer springs—dryer—that sort of stuff. So we need to pay more attention to how—when we are developing our communities around boreal forests—how FireSmart principles we have to bring in place (Interviewee G, personal communication, July 17, 2017).

Land-use planning that incorporates emergency management in their overall community or neighbourhood plans is vital to building community resiliency to wildfires. In many

boreal forest communities, there is often only one means of entering (egress) and leaving the community. Emergency evacuations at the time of a disaster event that may lead to traffic congestion and long waits to evacuate a community:

> "I think there are things you can do, but I don't think you'll ever really truly address the issue. Like having two egress routes out of a community or emergency access if you don't have that, e.g. Kamloops, BC is building secondary access out one of their communities, as a result of learning from the Fort McMurray wildfire. Make sure you have more than one way in and one way out (Interviewee A, personal communication, February 10, 2017)."

A research participant in Slave Lake also mentioned the issue of egress during the evacuation and how the evacuation had a personal impact on the town staff but also as individuals in the community:

> There were streams of traffic coming out, but you couldn't get back in. We parked our truck there and walked through to our house. Because we were like—our children are at home—we have to get to them. Yeah, it was a crazy walk home because there's a trail system that comes through here behind the school—yeah. Ran as fast as we could. But it was so smoky, and I have asthma so I could barely breathe, and because the wind was so bad there were large branches falling all around us, so a lot of those trees have now been cleared up of that area (Interviewee E, personal communication, April 27, 2017).

It was also noteworthy that the capacity for land-use planning between Slave Lake and RMWB was different. At the time of data collection, Slave Lake had no professional planners on local staff and relied on external planning consultants for significant re-writes of land-use bylaws or municipal development plans. On the other hand, the RMWB had a fully staffed planning department with twenty planners that supported the rebuilding efforts after the fires. This issue around capacity is echoed in the literature, in that the capacity of "in-house" planners is strained in small communities and may be contributing to slow adaptation or facilitation of disaster risk reduction conversations.

In summary, results from Slave Lake and RMWB wildfires show that land-use planning that incorporates wildfire mitigation prevention such as FireSmart can play an important role to minimize the impact of wildfires in Alberta communities. However, land-use planning is not the only solution to eliminating wildfire risks. As long as human settlements occur within or adjacent to Alberta's boreal forest in the wildland urban interface, the biological cycles of wildfires and forest regeneration will continue to pose a risk to municipalities (Flannigan, 2015).

2.6.4 Brazeau County: After the 2016 agricultural drought

While droughts are a common natural hazard in Alberta, their subsequent connection to land-use planning and further to land-use amendments was minimal. The community of Brazeau County which declared a state of agricultural disasters for two years in a row addresses drought mitigation via ecosystem goods and services policies in their proposed 2017 Municipal Development Plan. Natural resources such as air, water, land or biodiversity "yield ecological goods and services, such as carbon sequestration, flood and drought resilience, purification of air and water, and pollination of crops and other plants" (Brazeau County, 2017, p. 67). The research participant noted there were limited land-use policies to mitigate agricultural droughts due to the uncertainty and unpredictability of weather due to climate change.

> The problem with climate change when you make disaster comparisons, is that when you deal with things, especially in the agricultural sector, like we've been dealing with last year and this year, where you had a drought, and then you had a flood, the two polar opposites, back to back, is, it's hard to adapt.
>
> But when you look at something that is more subtle, like drought, or something that's a little more subtle, like unseasonably high levels of moisture, it has a big impact. People don't really see the long-term effects, though if you talk about them, people

> think they're obvious. When we had the drought, one of the issues was that you effectively cut your green hay harvest, things like that in half. As just one predictor there beyond less production for food, less production for exports (Interviewee D, personal communication, April 20, 2017).

It was evident in the research that drought hazard was different compared to the floods and wildfires experienced in the province. The fact that droughts in central Alberta impact mostly agricultural industry means that the average Albertan in a small (urban) town may not feel the impacts of agricultural droughts. However, municipalities in southern Alberta, where there is a frequency of water shortage, land-use planning had more drought mitigation requirements.

Unpredictability in climate patterns has an impact on how to prepare for drought mitigation. Land-use planners require data from other disciplines such as hydrology or climatology, to better understand their risk. Knowing the climatic variations over time is an essential precursor to climate adaptation and risk reduction.

> When it comes to agricultural disasters, or droughts, or soft floods, because it just keeps raining, the problem is no. There isn't [data to prepare for drought mitigation]. When you look at historical patterns, you can try to predict the future. The problem we are seeing is that historical patterns no longer becoming reliable predictors of the future. Although I have a hundred years or environmental data, I could probably look at; the other aspect is that that is not news to anybody (Interviewee D, personal communication, April 20, 2017).

In Brazeau County, planner's tools included natural preservation measures to maintain riparian areas or wetlands were much broader than drought mitigation. Planners, therefore, require a regulatory framework that calls for a standard (such as water conservation use per household) or through regulations (water conservation bylaws) to enforce any drought or water management approaches. For example, in a municipality that

wants to protect the value of watersheds or riparian areas, a planner or municipal staff need the appropriate authority to enforce drought mitigation measures:

> "I can't just go on someone's farm and say you need to move that skid-shack, and you need to move your cattle out of here, and you need to fence off this area for ecosystems services" (Interviewee D, personal communication, April 20, 2017).

Due to the uniqueness of agricultural droughts, participants spoke on the importance of source water protection, water quantity conservation measures to ensure aquifers meet demand or wetland preservation to retain water containment. The implications of successfully meeting the outcomes for ecosystem goods and services including drought mitigation mean that the broader economic function of a municipality would eventually impact development opportunities.

If municipalities are to expect increased water shortages and droughts as climatic patterns change, what would be the land-use planner's contribution given their expertise in the management of land as a natural resource? Although outside the scope of this study, what would have been the economic impact to municipalities if more Alberta communities declared states of agricultural disasters? What would have been the impact on residents? The responses from interviewees regarding drought risk raise a limitation of how planning in the Alberta context contributes to the broader drought risk reduction. The earlier question posed is further discussed in another study, which considers drought mitigation risks in land-use planning. One consideration as noted by the interviewee is to consider the economic impacts of a more widespread drought:

> "Ultimately speaking if it doesn't rain you will not be able to produce forage and if you cannot produce forage, you cannot feed animals unless you're willing to truck it in from different regions. The problem becomes -- although you have 12

> communities that declared a state of agricultural disasters for drought, if we had 70 rural communities declare that same thing, we wouldn't know what to do with the cattle we have in this province. You would destroy an entire industry in a season" (Interviewee D, personal communication, April 20, 2017).

Land is a limited and valued resource, and the planner's job is to ensure that it is developed in a way that maximizes social, economic and environmental objectives. According to Statistics Canada, Alberta has the second highest number of farms (40,638) in Canada while Alberta cattle accounts for 41.6% of the total Canadian herd (Statistics Canada, 2017b). If a slow onset drought were to occur, Alberta's entire agricultural or livestock sector would have immediate direct and indirect economic consequences such as farm loss, high commodity prices, implications for water conservation and consumption (Ding, Hayes & Widhalm, 2011). As noted by the interviewee, clear provincial policy statements regarding adaptation and mitigation are needed:

> We're reviewing our Municipal Development Plan right now currently we don't. The issue in Alberta and I know it's being worked on and I'm hopeful to see what might come out of the regional plans being prepared by the province, but right now, the only real direction a municipality has from the province is the land-use policies which are nebulous and non-enforceable (Interviewee D, personal communication, April 20, 2017)."

The respondent identified vital gaps in the Provincial Land-use Policies as well as the Land-use Framework Regional Plans, where high-level policies are given to municipalities. In terms of drought mitigation, the related policies for groundwater, and source water protection need further refinement in municipal sector water use. As such, municipalities (including land planners) should consider a stronger legislative framework for drought management in the overall land-use planning regimes to address future drought risks to the province (CBC, 2018). Such a framework may include imposing water conservation

standards for municipal residential uses or creating new statutory plans for drought hazard mitigation plans (such as in local government examples in the US).

2.7 Challenges of Planning for Hazard Mitigation

Participants discussion about challenges in hazard mitigation had four themes: blame and mistrust; community opposition; lack of education or risk unawareness; and short memories affecting resilience. These themes are discussed below and offer a useful analysis of challenges in land-use planning facing Alberta communities.

2.7.1 Blame and mistrust

Participants identified finger-pointing and blame as an ongoing challenge that surfaces following a natural hazard event. Blame is typically aimed at various levels of governments citing insufficient action or inaction in reducing natural hazard risks through policies, plans or funding. Conversely, residents may also be blamed for their decisions to invest in developments in vulnerable areas without sufficiently addressing the known natural hazard risks.

An excellent example of blame was evident following the 2013 southern Alberta floods. The object of blame at that time was the provincial government's inaction in implementing flood policies, and recommendations in a 2006 Provincial Flood Mitigation Report developed seven years due to another previous 2005 flood in Alberta, which cost $165 million in disaster recovery payments and three fatalities (Groeneveld, 2006, p. 1). The government only released the 2006 report several months after the 2013 floods. The circumstances surrounding the release of the report were subject to intense media scrutiny

and political speculation. As reported by policy think-tank organizations, opposition leaders at the time

> "Speculated that the government had delayed releasing the report because of the expense of implementing the recommended mitigation measures in Alberta's 60 flood-prone municipalities. Better the report go unreleased than risk having to act on it" (Lilly, 2013, p. 5).

Nevertheless, even if the actions recommended in the report had been implemented, and government invested in the $306 million investment to implement the recommendations, it may not have prevented the devastating consequences of the 2013 flood due to the sheer magnitude of the disaster and extreme weather conditions at that time.

> "I think one of the challenges I noticed in just hearing the media…is that there is a lot of blame, that's one of the challenges, and how do you deal with that? And there's a lot of mistrust and how do you build the trust? And how do you give somebody the responsibility? There's a lot of finger pointing: whose responsibility is this? And it's everybody's, I guess (Focus Group Participant A, March 24, 2017)."

Another concern raised is that of building trust between residents and their elected officials; trust between municipal staff and their local councils; trust between emergency management officials and law enforcement and trust between residents and non-governmental organizations. The presiding question that follows is, how do you build trust between land-use planners and decision-makers so that residents' exposure and vulnerability to natural hazard risk is minimized? Even more complicated is how to take both short-term and long-term disaster risk reduction measures to act on this trust? Building trust may be traced to social capital, which refers to the vertical and horizontal interactions between individuals, organizations and governing institutions, leading to collective action in response to natural disasters (National Research Council (U.S.), 2006).

Land-use planners who experienced these natural disasters directly, in several cases, indicated that their regular planning roles broadened to recovery and emergency efforts, such as supporting emergency management operations or housing evacuees. This collaboration led to a better understanding of planners' role by residents, and by emergency management, that was not evident before the disaster. Planners felt they had a social responsibility to support their community with long hours of work leading to physical and mental fatigue. These personal impacts are an area that is not addressed in planning as a discipline and warrants further research than this dissertation can provide.

2.7.2 Community opposition

A second theme that emerged and was cited frequently by research participants is the community opposition to disaster risk avoidance or reduction measures. Similar to NIMBYism, i.e., “Not In My Backyard,” participants noted examples of residents’ adamant opposition to mitigation measures. This pushback- or resistance tends to emerge when determining whether to rebuild areas where developments existed in known hazard areas. In the case of wildfires, for instance, planners noted how residents impacted by wildfires were eager to have trees replanted. FireSmart measures such as vegetation reduction around properties are received with little to no acceptance unless further imposed by local governments.

> FireSmart is a good example. Even when you provide the people with information…they don’t see how it applies to them, or they put the risk on someone else. You know, why would we want to chop down a single tree? “Remove the trees; we want the trees. Don’t FireSmart our community. But if something goes wrong, make sure we don’t have to pay for it; that’s the province’s fault!” (Focus Group Government Staff A, March 24, 2017).

Additionally, community opposition to resilient or risk reduction measures such as flood-proofing, or FireSmart implementation in communities, often influences political decisions that are contrary to advancing disaster risk reduction approaches. Push-back from residents was often raised when proposals were made that would impact existing redevelopment and the types of standards or bylaws for redevelopment.

> "It's just not something that makes people happy to have to do that. And I've seen where municipalities have buckled, based on the negative feedback. But there are some that have been very strong and have combined it with an extremely effective education program [with] both up-front implementation and continuous throughout, and creating what I say is the new norm of FireSmart within their community. There are several communities in Alberta where it has been extremely successful (Focus Group Government Staff B, March 24, 2017)."

Equally, community opposition concerning flood hazards was mostly on the type and extent of restrictions and regulatory approaches for developments in flood hazard areas. The challenge raised is that of understanding the differences, tensions, and authorities of municipal planning decisions versus those of higher orders of government. In one example, participants noted how resistance to long-term flood mitigation measures is often impacted by the political election cycle of local councils, which limits imposing controversial land-use decisions. In Alberta, municipalities have full legislative authority over land-use decisions through local land-use bylaws or other land-use plans. Unless and until provincial policies are imposed, the decision to build or not build in a flood-prone area is a local decision made by local councils.

> "No, you can't do this to municipalities." And I'd say, "Well then you're going to have another flood." And they'd say, "Well it's not, and if it were, we'll wear it, and we'll own it. We'll be the ones that are ceasing property and not allowing development and doing all sorts of stuff to try and fix this." And I said, "Well if you don't, we're going to have floods again." And for them, the next flood is 20 years away. "Another politician will deal with that." But they didn't want to be the bad

> guys to fix it now. And there's the big problem in all politics is the cycle doesn't allow long-term policy thinking because it's always about the next election (Interviewee F, Elected Official, June 20, 2017)."

Closely related to the link between risk perception and plans of actions, community opposition is inevitably linked to respecting the rights and investments made by property owners in areas that are perceived to be highly valuable such as waterfront or riverine areas. In the 2013 southern Alberta floods, participants noted how flood property buyouts through the Alberta Flood Relocation Program was only taken up by about ten percent of the 254 eligible homeowners located in six floodway communities (Alberta Government, 2013). The compensation was based on 100 percent of the 2012 property tax assessment value and not fair market value.

Planners need to understand what led to residents' opposition to the buyout program following the 2013 floods. First, planners need to understand the local and historical reasons that lead to floodway settlements and which in turn lead to the affective rationales that result in deep-rooted place attachments (Jive´n & Larkham, 2003). Lastly, planners must understand landowners concerns about the loss of property values including the impact on obtaining disaster recovery assistance and flood insurance. Participants also indicated how the voice of opposition from a few vocal or influential residents could tend to overcome the majority who support implementing hazard mitigation measures.

In the case of drought hazards, participants did not raise community opposition to drought mitigation measures in planning due to the uniqueness of droughts. The community of Brazeau County declared a state of agricultural drought two years in a row - one for dry conditions, and the next year due to unseasonably excess precipitation.

Participants explained how climate variability and extreme weather unpredictability cause long-range impacts not only to agricultural sectors but to other local or regional economic sectors. Since agricultural droughts are so different from floods or wildfires, the risk reduction measures are somewhat different, which is likely where the theme of community opposition is mute. When farmers contribute high capital investments into food production inputs such as grain seeding, their hopes every given year is that it rains when it is supposed to rain and that it dries at the right time in order to harvest. The recourse for farmers is to transfer the risk of agricultural drought by purchasing agricultural insurance provided by higher-level governments.

The declaration by a municipality of an agricultural state of disaster triggers the request for financial assistance for agricultural producers or agri-related businesses. In Alberta, the Agriculture Financial Services Corporation is the entity that assists farmers by providing loans, disaster financial assistance, crop insurance, and other programs in order to cope with drought or other perils (Agriculture Financial Services Corporation, 2017). Therefore, for communities dealing with the agricultural drought, the concerns are about access to these fiscal agricultural supports in order to address the range of hazards that affect agricultural production. Further analysis is required to determine whether other types of drought management reductions such as ecosystem goods and services policies, or water management approaches such as restrictions or storage, experience any community opposition similar to those experienced by communities where municipalities impose wildfire or flood mitigation measures.

2.7.3 Risk unawareness, perceptions, and lack of education

Another major challenge for land-use planning for natural hazard mitigation is lack of education on how risk unawareness, perceptions and aversions increase vulnerability to natural hazard risks. Research participants noted that the most daunting challenge for local governments is educating homeowners, land developers, and elected officials not only about the hazards to which their community is vulnerable but also how they might address those risks through concrete actions. Additionally, there was overwhelming support from all research participants for a more robust connection to natural hazard mitigation in the land-use planning process including policies for flood-prone areas, for enhancing FireSmart programming to address wildfire vulnerability near communities, and for elevating water management or conservation measures whether communities experienced droughts or not.

> "Educating homeowners and encouraging them to make changes in mitigating for natural disasters is not an easy task (Focus Group Government Staff B, March 24, 2017)."

Alberta's scenic natural parks and the boreal forest has drawn human settlements to be established in high-risk areas. The study found support for educating communities on disaster reduction measures when communities experienced natural hazards. However, participants noted that the problematic factors of non-structural measures such as education are that it can only go so far; more restrictive or conditional risk reduction approaches are necessary through stringent policies. An example includes clear rules about where development can occur in the wildland-urban interface area or what land-uses municipalities can approve in a flood hazard area.

The most interesting observation during this study is that for the communities that experienced floods, wildfires and droughts, participants noted the lack of general awareness around risks as being a hindrance to any actual development or redevelopment plans. A resident investing in a cottage or cabin along the edge of a boreal forest may not necessarily see this as a wildfire risk in the same way a fire chief or emergency personnel would. The boreal forest is a prime location for privacy, recreation and enjoyment, but to the trained eye, the forest is vegetation-fuel that has a high probability of ignition.

> "And for any place that doesn't have a disaster, my question is, why do you think you'll never have a disaster? You know, if you live [by] a river [valley] in Alberta, it's going to flood. Why do you think you are so special? You live in a boreal forest, why do you think you are so special? So, the planning is critical (Focus Group Government Staff A, March 24, 2017).

Research participants pointed out that to convince or persuade landowners about the prevalence and exposure to a hazard risk that could have adverse effects if nothing was done to mitigate it. The fact that a particular hazard is not prevalent in one community does not mean that that risk should not be understood, assessed and managed for that same community. The level of awareness of hazard mitigation measures and its importance in land-use planning requires further research for both planners and residents, regardless of whether they have experienced natural hazards.

> "Convincing people of that [hazard] is very difficult because it doesn't happen in my community. But it does happen somewhere, and we're going to have to deal with it somewhere. So, trying to incorporate that thinking is a challenge because it is not directly affecting me, because I don't directly see it until suddenly it does happen. I'm having difficulty convincing people…in our department. So how can I convince, then, a public who doesn't even have that experience? (Focus Group Government Staff C, March 24, 2017)."

It is important to note the struggle of risk perception and communication. If government staff are unable to convince educated staff about risks, how then, can staff convince residents of their risks? The research found that it is essential for planners to prioritize and communicate risks by drawing on inter-disciplinary resources such as climatology, hydrology, and geology.

A misconception raised by participants is the concept of the 'levee effect.' The levee effect occurs when new developments are located in flood-prone areas due to the perception that the risk has been mitigated as a result of the construction of a berm or dam (Plevel, 1997). As discussed earlier, the historical Waterways neighbourhood is a settlement in a floodway that is proposed to be mitigated through a series of berms and floodwalls built to the 1:100 design flood. If successful, and if insurance coverage is available, this may lead to additional new development in the historical community in the floodplain

> "One of the interesting pieces, talking about Waterways, is the municipality has proposed a flood mitigation wall to help protect that community to a 1/100 level. And I think there might be a misconception that if that wall is built, that would automatically open up the insurance industry to providing coverage at the very reasonable and affordable cost" (Interviewee J, September 21, 2017).

The research participant noted that the building of a berm such as the proposed flood wall in the RWMB does not mean that the risk of flooding behind the berm is eliminated because there is always a risk overtopping a berm. The fact that a berm is created does not mean that insurance premiums are automatically reduced. As discussed previously, overland flood insurance may not necessarily be available in high flood hazard areas.

Communities need to recognize the priority of and invest in, maintenance of structural mitigation infrastructure to continually address flood risks. Participants also noted that berms, dams or other measures do fail (as evident in Hurricane Katrina in New Orleans or Australia's Wivenhoe Dam spill) and that communities need to be aware of the unintended consequences and risks of those structures to downstream communities, should they fail, due to extreme weather. This means that communities must continually evaluate whether the structures that are built address both short-term and long-term hazard risks and then address any emerging deficiencies that arise.

> Well, it's an education piece. You know—there's I think always a risk that when you put those sort of physical protections in place that people think they will never break…You know in Alberta rising sea levels may not be a huge issue, but certainly, in other provinces, that's the case where they have to—you know—give some thought as to whether something they built ten years ago will do the job ten years from now. And that—you know that thing that they're building for Waterways well, maybe it will work, maybe it won't. And maybe it will only work for a short period of time and what they thought was a medium long-term solution ends up being a short-term solution (Focus Group Participant A, March 21, 2017).

Lastly, participants noted the importance of the implementation of hazard mitigation measures immediately following a disaster. In disaster risk planning literature, this is referred to as the 'window of opportunity' when governments are most willing to rebuild in order to demonstrate resilience and responsiveness, and when communities and residents leverage increased disaster financial resources (Desai & Sarmiento, 2015; Haas, Kates & Bowden, 1977; Sudmeier-Rieux et al., 2015).

> "Never underestimate opportunity…I mean, you try and have a discussion about flood mitigation now, and it will fall on deaf ears. You try and have a conference and educate people and no one will show up. But right after the floods that happened in those communities—oh the discussion was on every radio station and in every newspaper and when we would announce, "We're going to buy out the [neighbourhood] because it's in the floodplain," people—some people would say,

> "You shouldn't buy them out at all, [they] made their own choice." And other people would say, "Buy them out but don't ever pay for it again." It was the opportunity for the discussion, and so it's more to me, getting something done is about the opportunity (Interviewee F, June 20, 2017)."

The above response reflects the deep polarization of floodplain policies. While this is not new, what is different is the recognition of capitalizing on the flood event, as a means of introducing flood policies. Participants mentioned, for instance, that a provincial or state government has about two years after a major flood disaster to implement any regulatory or legislative change. For planners interested in proactive, resilient, disaster risk reduction and adaptation measures, the ability to know when to move forward with favourable flood policy decision is likely right after a disaster, and not when life is good, and floods are not a threat.

2.7.4 Short memories

The fourth major theme is how human beings' short memories impact disaster experiences faced by a community. Shortly after a disaster, residents who are most impacted tend to immediately attempt to retrieve belongings because the familiar

> "objects, personal belongings, houses, familiar buildings provide a scaffold for memory- the houses and other buildings…remind us that preserving, or restoring or reconstructing environments, buildings, and other artifacts may simultaneously be part of a project to restore a community's sense of its historical identity, or its wounded pride, or its tattered hope (Spelman, 2008, p. 149).

This research found that the concept of memory has temporal impacts in time: all participants noted that the longer the disaster event faded in time, the lower the likelihood to implement any mitigative measures with each passing year. Participants tend to remember only the most recent disasters, which, with time, leads to a tendency to become complacent regarding the hazard risk.

> "So, I get to ignore it for 10, 15, 20, 35 years and then all of a sudden it happens. So, I become complacent about it. After a typical lifespan of 10 years, I become complacent about that event occurring again. So how do you incorporate that idea into land-use planning? But the challenge again is that. We knew we had to act fast after 2013 because every year that goes by without an incident—people start to forget. And that's human nature. It's great. (chuckles) People would never have two children if they could remember the first one! (Focus Group Participant C, March 24, 2017)."

One participant with historical knowledge of past disasters in Alberta noted how Alberta's major disasters that residents remember more recently were not new at all. Major disasters preceded these events. For instance, Slave Lake had a wildfire in 1963 that came within one kilometre of the town, and there were significant prairie droughts in the 1980s. The lesson learned is that historical records of these natural hazards can inform long-term mitigation planning efforts. Knowing where to access this data, and what to do about it and with whom to collaborate, is particularly important for communities that have had near-misses simply because it is often not a question of 'when' and not 'if' a disaster will occur.

> "You know we had major flooding in 2005 -- does anyone remember that? Well people from Calgary maybe, but not in general. Looking at the Slave Lake map, how many times has fire approached Slave Lake in the last 100 years? We've actually got some pretty good records. The 1963 fire came within a mile of Slave Lake, travelled 45 miles overnight, paused 45 miles overnight, like a bullet for Slave Lake and the wind died a mile out of town. You know, how many times do you have to have near-misses before people start to go, "This is going to happen?" (Focus Group Participant A, March 24, 2017)."

During the research data collection, it was interesting to note how planners were noticing residents' memories regarding disasters were fading so quickly after the RMWB wildfires that some were requesting for trees to be replanted:

> You'd be surprised how much a trail system means to people. I've had people catch me at the grocery store, people at the gym [say], "When are you planting the trees behind my house?" (Interviewee C, personal communication, March 31, 2017).

Memories are discussed further in Chapter 5 in the discussion about place attachment and sense of place affectivity. Ponder this: a community that experienced Canada's worst natural disaster within a year had some residents asking staff to replant the trees (boreal forest fuel) back in their community. Considering the increased risk of wildland-urban interface fires, there is likely a balance to be struck between the aesthetics of living in the boreal versus the danger of wildfire risks.

To conclude, these four themes of blame and mistrust, community opposition, lack of education or risk unawareness, and short memories raised another question. What level of knowledge or information is available before development decisions in high hazard areas? Specifically, how much historical or local knowledge or technical studies does a land-use planner or development officer have to determine if a development is suitable for a particular area? Also, what information do locally elected council members require before deciding for new development in high-risk hazard areas? Further, how do they know whether risk has been mitigated and what is the acceptable risk any given municipality is willing to take? This line of inquiry will be explored in the next chapter of the dissertation which examines how a risk-based approach to land-use planning process leads to disaster risk reduction.

2.8 Conclusions, Implications, and Recommendation

The purpose of this paper was to assess the role of land-use planning in natural hazard mitigation in small and mid-sized municipalities in Alberta. Since land-use planning is cited in the national emergency planning framework as a component of the mitigation phase, it is essential to test the extent of the discipline in communities that recently

experienced significant disasters. Based on the research methods, the study highlighted the perspectives of planners on the role of land-use planning and -the challenges faced in planning for natural hazard mitigation. Three major themes presented focus on the: 1) role of land-use planning in natural hazard mitigation; 2) actions that prevent future losses and damage resulting from natural hazards; and 3) challenges in long-term mitigation planning.

In summary, the study found that municipalities play a significant yet varied role in land-use planning by adopting natural hazard mitigation. First, the Town of Canmore, for instance, had made significant efforts to incorporate all significant hazards such as floods, wildfires, or undermining development, in its Municipal Development Plan (MDP), and in an example of a municipality that incorporates risk-based approaches in their land-use planning documents. On the other hand, the Regional Municipality of Wood Buffalo (RMWB) also incorporated floods, wildfires and other risks in their MDP as well. Unfortunately, in 2017, the RMWB chose to repeal a flood mitigation bylaw to stimulate redevelopment and removed stringent flood proofing conditions as part of the subdivision and development process.

Second, concerning wildfires, both the Town of Slave Lake and the RMWB continued to heavily invest in FireSmart wildfire mitigation and education program as well as land-use bylaw amendments to recognize and regulate rebuilding following the wildfires. The research found that following the significant wildfires faced by these communities in 2011 and 2016, both the Town and RMWB had respectively addressed wildfire risk in their Municipal Development Plans (MDP) and land-use bylaws. For instance, the RMWB's land-use bylaw includes a Wildfire Recovery Overlay (BL16/020,

17/006) covering the five neighbourhoods that were ravaged by the 2016 major wildfire. The Town of Slave Lake MDP requires a wildfire risk assessment as part of a subdivision and development process and encourages homeowners to incorporate FireSmart principles in their landscape developments.

Nevertheless, there are significant challenges and gaps in the land-use planning and municipal decision-making processes that need to be overcome to implement disaster risk reduction measures. In making decisions, municipalities need to ensure they communicate and educate residents about the risks, in a proactive manner. During plan developments, municipalities must make an effort to balance policy trade-offs between the benefits of development versus risk reduction measures in hazard-prone areas. Regular revisions to MDPs and land-use bylaws are strategic opportunities to discuss natural hazards and resilience. Municipalities can advance the implementation of planning policies that address hazards either incrementally (such as one risk at a time, such as the RMWB) or radically (multiple hazards as addressed in Canmore). A municipality can also use other local policies such as ecosystem goods and services (Brazeau County) as an overall framework to inform land-use planning. Since planning is an organic, adaptable process, there are always opportunities to introduce risk awareness in the planning process.

Three recommendations are vital to this research. First, there is a need for higher order governments to adopt a proactive approach to disaster risk reduction through clear policies for local governments for wildfires, floods, and drought mitigation. Government direction on hazard mitigation in land-use planning can be most effectively achieved by amendments or revisions to the relevant sections of Part 17 and 17.1 of the *Municipal*

Government Act and updated or more stringent Provincial Land-use Policies. Examples such as Ontario's efforts to integrate wildfire mitigation in local land-use can serve as useful models that can be adapted to Alberta's unique governance structure.

Second, the findings from this paper highlighted the vital role of inter-disciplinary collaboration in disaster risk reduction. In Canmore, for example, disciplines outside of planning gave specific risk-management and geotechnical analysis for the alluvial fan development, that was used to develop land-use bylaw restrictions. Further work is needed to determine the extent of the alluvial fan development problem in Alberta. Research that includes planners, hydrologists and geotechnical engineering expertise would be vital in reducing hydro-meteorological risks such as floods, wildfires and droughts.

The third recommendation is to cultivate a culture of risk reduction by using all opportunities in land development to discuss disaster resilient actions at the local government level. Communities located in high hazard areas, or where there are water shortages, must seek ways to educate land and homeowners about shared responsibilities to reduce impacts of disasters. As found in the research, risk awareness is likely the most important strategy to build resiliency in communities.

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3 Risk Management Approaches in Land-Use Planning and Natural Hazard Mitigation

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3.1 Abstract

Land-use planning practice at local level lacks the regulatory guidance in the application of risk management approaches to natural hazard risks. Presently, municipalities can regulate environmental and anthropogenic threats such as the proximity of land-uses to oil and gas wells, or wastewater facilities. However, there is an apparent gap in planning rules on how municipalities are to address natural hazards risks in the subdivision and development approval process. This research addresses this gap by examining how a planner's hazard assessment methodology and regulatory amendments, can reduce vulnerability and exposure to natural hazards by using appropriate risk assessment methods and making necessary amendments to regulations.

This study compared risk mitigation measures in local bylaws to determine how, and to what extent, municipalities mitigate against floods, wildfires, and drought. The research found that building community resilience requires an enhancement of risk-based approaches in land-use planning practices, an interdisciplinary approach, and stronger legislative and regulatory guidance. Planners can advance risk reduction objectives by balancing the competing interests of residents, elected officials and developers, through a culture of risk-reduction in all land-use decisions. Given the complexities of reducing risk while meeting a community's aspirations after a disaster, municipalities where risk-based approaches are lacking, require further research and community engagement.

3.2 The Importance of Risk Management in Planning for Natural Hazards

Despite the acknowledgment of the role of non-structural mitigation measures in disaster risk management literature, the consideration of risk-based approaches at the local

land-use planning level in Canada is limited. More robust examples of incorporating disaster risk reduction measures in land-use planning can be found in the United States, the European Union nations, Australia, New Zealand and Thailand (Berke, Cooper, et al., 2014; King et al., 2016; Mileti, 1999; Schmidt-Thome, 2007; Siembieda, 2014).

As Alberta municipalities recover from recent major disasters (2011 Slave Lake wildfires, 2013 southern Alberta floods, 2016 Fort McMurray wildfire), there have been no studies specific to the role of land-use planning as a tool for managing multiple hazard risks to reduce impacts of future events. Several studies outline the importance of integrating hazard mitigation and land-use planning (Burby, 1998a; Burby, Deyle, Godschalk, & Olshansky, 2000; G. Smith & Glavovic, 2014). However, in practice, there remains a disconnect "between the obvious need to reduce risk and 'business as usual' practices that continue to expose people and property to escalating levels of risk" (Glavovic & Smith, 2014, p. 6).

A 2014 survey conducted under the National Municipal Adaptation Project to assess municipal readiness to climate change, reveals the nascency of adaptation in Canada's municipalities: roughly 65% of small municipalities (less than 5,000 in population) did not have a climate adaptation plan and were not considering discussions about the matter (Hanna, 2014a, p. 8). Further, in the same study, the results for the Province of Alberta indicated that there were no municipalities with adaptation plans and 48.2% or 26 municipalities did not have adaptation plans and were not considering such plans even though they had experienced natural hazards (Hanna, 2014b, p. 4). The research concluded

that small municipalities possibly are the most vulnerable to natural hazards (Hanna, 2014a, p. 13).

This research contributes to disaster risk reduction literature by an examination of the state of risk-based land-use planning practice in small and medium-sized municipalities to highlight the critical role of land-use planning discipline in adaptation and to identify the limitations and opportunities for reducing disaster risk. This study is significant because disaster risk reduction and emergency management are shifting towards non-structural measures such as land-use planning to manage natural hazards.

First, the study presents a literature review on hazard mitigation planning. The next section outlines the methodology and summarizes the land-use planning framework in Alberta. It then frames how risk management approach intersects with land-use planning processes in hazard mitigation. Results showcase how municipalities use risk-based approaches to achieve flood, wildfire, and drought-resilience, and concludes with recommendations to fill research gaps.

3.3 Literature Review on Risk and Linkage to Planning

Land-use planning is an effective means of natural hazard mitigation (Burby et al., 1999; Mileti, 1999). Multiple studies focus on its importance in hazard mitigation (Burby, 1998; Burby et al., 2000; G. P. Smith & Glavovic, 2014). A significant gap is that municipalities underutilize risk-analysis to guide land-use planning (Berke, Lyles, & Smith, 2014; Olshansky & Johnson, 2014; G. Smith, Lyles, & Berke, 2013; T. Smith, 2015). In Canada, the federal government provides municipalities with risk-based implementation guides, tools, and resources to guide local decisions (Black, Bruce, &

Egener, 2010), while the professional organizations offer resources for land-use planning tools for climate adaptation specific to small Canadian municipalities of less than 25,000 population (Bowron & Davidson, 2011).

Provincially, although the emergency management system promotes municipalities to conduct community hazard identification and risk assessments and to prepare emergency management plans (Alberta Emergency Management Agency, 2018), the linkage of hazard risk assessments methodology to land-use planning discipline is weak or absent (Comfort et al., 1999; Galderisi & Menoni, 2015). As pointed out in the European example,

> The new role of urban and spatial planning is neither mirrored by most current practices nor translated into effective risk mitigation measures (Wamsler, 2006). The former are still struggling to correctly embed risk assessments into zoning and design decisions, the latter are too fragmented and uncoordinated (Galderisi & Menoni, 2015, p. 2).

In another study, authors recognized that "there is a widespread failure to recognize and address connections between changes in land-use, settlement policies, population distributions and the accompanying degradation of habitats on the one hand and dramatically increased levels of hazard exposure and vulnerability on the other" (Comfort et al., 1999, p. 39). Further, Feltmate and Moudrak (2016) made several recommendations to support Canadian provincial and territorial jurisdictions flood preparedness including establishing Chief Adaptation Officers to report on flood preparedness; restrict new development in flood hazard areas or ensure that developments are constructed in a flood-resilient manner and reduce federal disaster funding and insurance for high-risk floodway properties (p. 84-85). The authors conclude "it is unconscionable that developments are

continuing in recognized flood zones, with limited flood mitigation controls in cities across Canada" (2016, p. 84).

Studies in western nations (Hanna, 2014a) as well as in developing countries (Humanitarian Practice Network, 2015) suggest small municipalities lack the technical, financial or planning capacity to address disaster risk adequately both. However, few studies such as E. Wilkinson (2012); found that smaller municipalities have a capacity for managing hazard risks although local disaster risk reduction initiatives "may be facilitated by training, capacity building and resource transfers" (Comfort et al., 1999, p. 43). The literature on climate change defines *adaptive capacity* as follows:

> "Adaptations are manifestations of adaptive capacity, and they represent ways of reducing vulnerability…At the local level, the ability to undertake adaptations can be influenced by such factors as managerial ability, access to financial, technological and information resources, infrastructure, the institutional environment within which adaptations occur, political influence, kinship networks" (Smit & Wandel, 2006, pp. 286–287).

Although disaster risk literature point to the role of land-use planning in the prevention/mitigation phase -regardless of municipal size or capacity- current practice does not reflect this when landowners continue to build new developments in hazard-prone areas (Birkland, 2009; Glavovic & Smith, 2014; McMahon, 2018; Radeloff et al., 2018a). For example, a recent US-based study on wildfires found that 12.7 million new homes were approved and built in wildfire-prone areas between 1990 and 2010 (McMahon, 2018; Radeloff et al., 2018a, p. 3). The characterization of land-use planning as "bad planning" (McMahon, 2018) or "poorly planned," "inadequate planning," and "weak," points to critical deficiencies in managing hazard risks in the planning process (UNISDR, 2015a). Barriers that hinder the transformation of local polices into adaptive outcomes reflect the

ongoing challenges municipalities have in breaking out of their path dependencies (Burch, 2010, p. 288).

3.3.1 Defining Risk

While risk does not have a universal definition, its early definitions can be traced to economist Frank Knight who stated that risk is both "a quantity susceptible of measurement" or risk is a "measurable uncertainty" (Knight, 1921, pp. 19–20). Other studies suggest that various types of 'uncertainty' can be calculated but that the vital task is on how to communicate those risks (Oberkampf, DeLand, Rutherford, Diegert, & Alvin, 2002). According to Yoe (2012, p. 1), risk as "a measure of the probability [chance] and consequence of uncertain future events. It is the chance of an undesirable outcome." Risk is "the potential damage that may result from a given hazard and from the probability that it will occur. Risk is a function of hazard, exposure, and vulnerability" (Herwig & Simoncini, 2016, p. 25). Another way to understand risk is the negative outcomes that occur as a result of decisions made by decision-makers or individual residents (Cardona et al., 2012, p. 90). A risk could be subjective and socially constructed (Douglas & Wildavsky, 1982; Savage, 2009; Slovic, 1992); or solely objective (Philipson, 1983; Royal Society (Great Britain), 1983). Hansson (2010) proposes that risk may be both "fact-laden" or objective, and "value-laden" or subjective while Campbell (2006) cautions this distinction should be avoided pending further analysis. Risk attitudes influence the choices people make.

Social scientists such as Ulrich Beck, provides a sociological theory about risk whereby Beck argues ecological or environmental risks are a reflection of social problems

created by industrial societies and that risks are ‘manufactured realities’ and that risk is an anticipation of a catastrophe often with global implications (M. Beck & Kewell, 2013, p. 182). Beck argues that existing institutions such as political, law, or industry, in modern society, cannot manage the environmental risks which modern societies face and instead advance the principle of ‘precaution by prevention’:

> Modern societies and their foundations are shaken by the global anticipation of global catastrophes (climate change, financial crises, terrorism). Such perceptions of globalized manufactured risks and uncertainties are characterized by three features: De-localization: Their causes and consequences are not limited to one geographical location or space, they are in principle omnipresent; Incalculableness: Their consequences are in principle incalculable; at bottom it is a matter of ‘hypothetical’ or ‘virtual’ risks which, not least, are based on scientifically induced not-knowing and normative dissent. Given the new quality of threats to humanity, the logic of compensation breaks down and is replaced by the principle ‘precaution by prevention’ (U. Beck, 2014, p. 82).

According to Beck’s (2014) typology of delocalization; incalculableness and the ‘precaution by prevention’ is reflective of the types of disasters that humanity is experiencing in the neo-liberal framework of the present day. Douglas and Wildavsky (1982) suggest that the way to manage involuntary risks -such as those imposed by society- is by providing information and that the more that is known, the more an individual is likely to ‘make the right choice’ (Douglas & Wildavsky, 1982, p. 75). Dougals and Wildavsky (1982) go on to argue that:

> It is obvious that people may and do endanger themselves (and, possibly, others around them) without realizing that what they are doing or what is being done near them is dangerous. The remedy, equally obvious, is better information. People will either refuse a known risk or seek additional compensation for assuming it. Thus an involuntary risk due to ignorance is by knowledge converted into one that is averted into a voluntary risk (1982, pp. 17–18).

As outlined earlier in Chapter 2, the problem with this argument is that 'better information' does not deter councils from approving developments in high-risk areas, and the subsequent individuals who purchase and build homes. As society progresses with more advancement and knowledge about climatic changes one would hope that better decisions will be made to reduce exposure by curtailing development in hazard-prone areas. Therefore, institutions such as local governments and their component functions in land-use, transportation or emergency services, have a distinct role in providing accurate information during the decision-making and planning process, and in reducing future impacts of hazards, should they occur.

3.3.2 The utility of risk analysis in land-use planning

Risk analysis comprises three components: risk management, risk assessment, and risk evaluation. First, risk management is a process used to identify, quantify and estimate risks; determine strategies to manage risk impact; and monitor/evaluate progress on risk strategies (Etkin, 2009). Strategies include *risk acceptance, risk avoidance, risk reduction* and *risk transference* (Etkin, 2009). Since a community cannot eradicate hazard risks, municipalities must anticipate unintended consequences and assess if the risk is acceptable.

Second, risk assessment has shifted from a single-risk to an "all-hazards-at-a-place approach" (Hewitt, 1971; Kappes, Keiler, Elverfeldt, & Glade, 2012). Canada's federal and provincial emergency management agencies adopt an 'all-hazards' approach to disaster risk management (Public Safety Canada, 2015). All-hazards is a holistic way of thinking about what causes of action are needed should a disaster occur and recognizes the interdisciplinary nature of responding to hazards (Bouchon & Dimauro, 2016, p. 38). It

does not mean that a municipality should address all hazard risks that may occur. The approach allows decision makers to identify the environmental risks of concern and the *object* that is vulnerable once exposure has occurred.

Last, risk evaluation involves the monitoring and evaluation of risk approaches. Decision-makers must regularly reflect on whether the risk objective has been achieved to measure the efficacy of a selected risk management strategy. Risk strategies often culminate into risk-oriented legislation and regulations to enhance public safety and reduce damage and loss to life and property (Herwig & Simoncini, 2016). Currently, Alberta municipalities apply risk-based bylaws for a variety of environmental and anthropogenic risk (see Appendix I). Risk management strategy, therefore, is dependent on the quality of risk information and value proposition. Thus, the risk management process itself is a means of availing data to the decision-maker to make an informed decision.

3.3.3 Planning dilemma and normative theories

The following section describes theoretical underpinnings when considering a risk-based land-use planning approach. Three aspects are discussed: the *deontological* – rules-based – versus the *utilitarian* -outcomes based- the role of a planner; the dilemma of planning in a politicized democracy, and the problems of normative planning theories.

With the backdrop of natural disasters and planning, what is the fundamental role of a planner? Howe and Kaufman's (1979) study on planners ethical choices characterized planners into three roles: *technical (or* value-neutral advisor)*, political* (advocating for a policy or value) or a *hybrid* of both technical and political roles. A follow-up study by Lauria and Long (2017) found several differences. Contemporary planners are more likely

to be *technical* with a dependence on objective information, and less political and "today's planners tend to make virtuous choices, aspirational decisions based on their own moral codes" (Howe & Kaufman, 1979, p. 203). Planners make decisions based on deontological views (rules-based modes), or they make utilitarian ethics (focus on the outcomes or impact) of a particular choice.

The first dilemma in planning practice is differentiating between the 'expert legitimacy' of planners armed with technical knowledge versus the 'democratic legitimacy' of decision-makers who stipulate the rules on behalf of the electorate (Lauria & Long, 2017, p. 204). Thus, to achieve a prescribed outcome, the implementation of a specific cause of action depends on the *subject* (landowner, planner or government) that is leading the direction, the *object* (structure, building) that is subjected to the rules, and the deontological basis (policy or building requirements) that the subjects rely on.

A second and contradicting dilemma is the use, misuse, or rejection of planning information by decision-makers. Consider this statement:

> "Much planning research is merely a form of symbolic gesture, a justification for a priori determined action or inaction…All too frequently…the data…may fail to provide definitive insight. Numbers are or should be, the prelude to policy. In a number of areas, however, we are flooded with data—and yet, we lack its ultimate distillate-information for action. However, the assemblage of numbers is our unique area of responsibility" (Sternlieb & Burchell, 2013, pp. 300–301).

As seen in Table 1 below, the subject's justification for supporting a priori outcomes is dependent on common arguments. Planners must effectively balance the need to convey data while acknowledging a posteriori argument that residents, developers or decision-makers provide. Although non-technical residents/councils' decisions may contradict a

priori justifications -which planners consider as a reasonable rationale or cause of action- planners must ultimately be able to live with decisions made.

Table 3-1. Examples of *a priori* and *a posteriori* flood propositions.

	A priori – knowledge independent of experiences	A posteriori – knowledge that is experiential
Proposition	Floodways are unsafe	Floodways are not dangerous
Justification	because they are where the fastest, deepest, most destructive flood waters convey.	because buildings can be designed or floodproofed to withstand floods.
Outcome	Therefore, a local government should not build or allow new structures in the floodway.	Therefore, landowners can be allowed to rebuild if they floodproof structures in the floodway.
Problems of the argument	The proposition does not address existing developments in floodways, particularly landowner rights.	Even with floodproofing, or engineering designs, flood risks cannot be eliminated entirely.
Subject – who is likely to say this?	Hydraulic engineers, climate scientists, provincial/state agencies, local government bylaws, policies or regulations	Residents, experienced developers, or local governments that want to 'rebuild, and get back to normal.'

A third dilemma is framing normative planning theories in the context of natural hazards. What is good planning? Planners epistemological views are influenced by their contexts and cultural settings of the day and tend to be non-static. Planning theory has come a long way from the public health responses of the early 19th century to various forms of procedural (how planners plan) or to normative theories (what planners should be doing). Change can come from: non-planners such as the public (consider Jane Jacob's activism); economic policies such as post-war or neoliberal policies in western nations; or from planning practitioners with visions on the built form (such as Ian McHarg's *Designing with Nature*).

In contemporary planning, climate change discourse is the next epistemological shift to influence planning theory and practice with priorities in transportation, greenhouse gas reductions or disaster risk reduction (Grunt, 2012, fig. 10; Tozer, 2018). John Friedmann's mantra of linking *knowledge to action* remains particularly refreshing (Friedmann, 2011). How can planners, with technical or political leanings, generate knowledge with the public and influence decision-makers to reach a desired outcome or action? The struggle in theorizing natural hazards in planning and its component complexities is the reliance on multiple theoretical constructs, yet focussing on the central supposition that managing natural hazard risks retains an essential element for land-use planning. The horizon appears to be shifting regarding how planning theories can relate to the broader conceptualizations about risk, climate change adaptation and disaster risk reduction. It is the researcher's view that planning theory and practice needs to aggressively engage in future deliberations and contribute to advancing adaptation and mitigation within the uncertainty that characterizes the 21st century.

3.4 Methodology

Data was collected using document content analysis by reviewing land-use bylaws and municipal development plans (MDPs), or other policies on floods, wildfires, and droughts. The study used three criteria to select the study area municipalities. The municipality must be a location of a major natural disaster (flood, wildfire or drought) as documented by the Canadian National Disaster Database, and declared a state of local emergency. The municipality's population size is small (less than 29,999), or medium (30,000 to 99,999) (Government of Canada, 2016b) and has publicly accessible MDPs and LUBs. The sample areas included the towns of Slave Lake and Canmore, the Regional

Municipality of Wood Buffalo and Brazeau County, which experienced significant floods, wildfires, and droughts, between 2011 and 2016. The study reviewed plans from similar municipalities in Alberta that are vulnerable to the same hazard to determine the extent local governments were utilizing risk-management approaches in land-use planning. A list of sampled Alberta municipalities is provided in Appendix C. Concerning flood hazards; the study reviewed planning documents (MDP's and land-use bylaws) from twenty municipalities (N=20); fifteen municipalities (N=15) in the wildland-urban interface, and twenty (N=20) drought-prone municipalities.

The study tested evaluation protocols from hazard plan content studies (Brody, 2003; Lyles, Berke, & Smith, 2012; Lyles et al., 2014; Srivastava & Laurian, 2006; Stevens & Shoubridge, 2015). Many of these evaluation protocols are US-based and occur in a legislative context that requires mandatory state and local hazard mitigation plans which is absent in Canada. Similarly, Canadian plan content studies focus on local climate change action plans particularly Ontario and British Columbia which do not exist to the same extent in Alberta at the time of the study (Guyadeen et al., 2018). This study developed a unique coding instrument that narrows to the natural hazard indicator, specific to land-use planning, to determine the depth of hazard mitigation policies specific to floods, wildfires or droughts based on over-arching policies in an MDP; implementation controls in land-use bylaws; and other bylaws or technical studies related to each hazard. An example of sample coding sheets developed for each hazard type is provided in Appendix D to F.

3.5 Analysis and Findings: How Risk-based Planning Approaches Addresses Natural Hazards

This section describes the findings on the extent of implementation of risk-based approaches in municipal land-use plans and policies to mitigate natural hazards. It is organized based on three hazards: planning for floods, wildfires, and droughts.

3.5.1 Planning for Flood Risk

Riverine or fluvial flooding - which is when intense rainfall causes a major river to overflow its banks (Alberta Water Portal Society, 2018; Bosher & Chmutina, 2017)- is the most prevalent and historically the most recognized natural hazard affecting Alberta municipalities. A 2014 national study on Canadian municipal-readiness to tackle climate change found that 18 municipalities experienced major floods; with -16 municipalities concerned about future flood occurrences (Hanna, 2014b, p. 3). Although avoidance is the most effective risk management strategy -by locating people and property away from a flood-prone area- this approach is unfeasible in areas where historical developments have occurred. In Alberta, for instance, early settlers built along rivers and lakes because of the ease of water transportation for the fur trade and trapping economies and high-quality agricultural soils. These areas burgeoned into larger agricultural towns and settlements despite knowledge of flood risks.

Land-use planning decisions in flood-prone areas require access to accurate flood hazard information to inform development decision. Between 1975 and 1998, the federal government invested in a non-structural land-use program through the Canada-Alberta Flood Damage Reduction Program with the aim of discouraging new development in flood hazard areas through mapping and designating areas based on the one percent chance (1-

in-100) design flood (Government of Canada, 2009). A total of 16 Alberta communities were designated, and the federal and provincial government agreed not to build new structures in the floodway. Municipalities were encouraged to reference the maps as the basis for restricting new development in the floodway through land-use planning and zoning. In 1999, the federal government ceased funding, leaving the responsibility for flood hazard mapping to the provinces.

Presently, Alberta's Flood Hazard Information Program (FHIP) publishes flood hazard maps to delineate the floodway and flood-fringe zones, conducts flood hazard studies, and provides flood river forecasting information (Alberta Environment and Parks, 2014). To date, 90 municipalities have flood maps, and work continues to map other rivers in the province. The flood maps are an essential resource for both large and small municipalities useful in municipal emergency management, insurances, and land-use planning. The FHIP maps provide baseline flood risk maps which are critical to identification of flood hazard risks from a parcel, neighbhourhood- or river basin scale. One caution, however, is that "sharply delineated flood zones on a hazard map do not reflect the true level of uncertainty" (Kryspin-Watson, Dharmavaram, Stanton-Geddes, & Chia, 2017, p. 18). Therefore, planners who use FHIP flood hazard maps in zoning or subdivision application reviews must account for the risk of more massive more severe floods, that may occur outside the flood-zones, thus putting more people and property in danger of flood damage.

The following flood hazard maps show the two-zones for Canmore and Fort McMurray, to depict the level of granularity that is essential for municipal planning.

Insurance companies use the provincial flood maps, where available, to produce their risk maps, which incorporate risk exposure among other factors. Such accurate flood hazard maps are useful for municipalities, provincial government (where the province develops its infrastructure or buildings); professional engineers as well as the private sector (landowners or developers) and insurance industry.

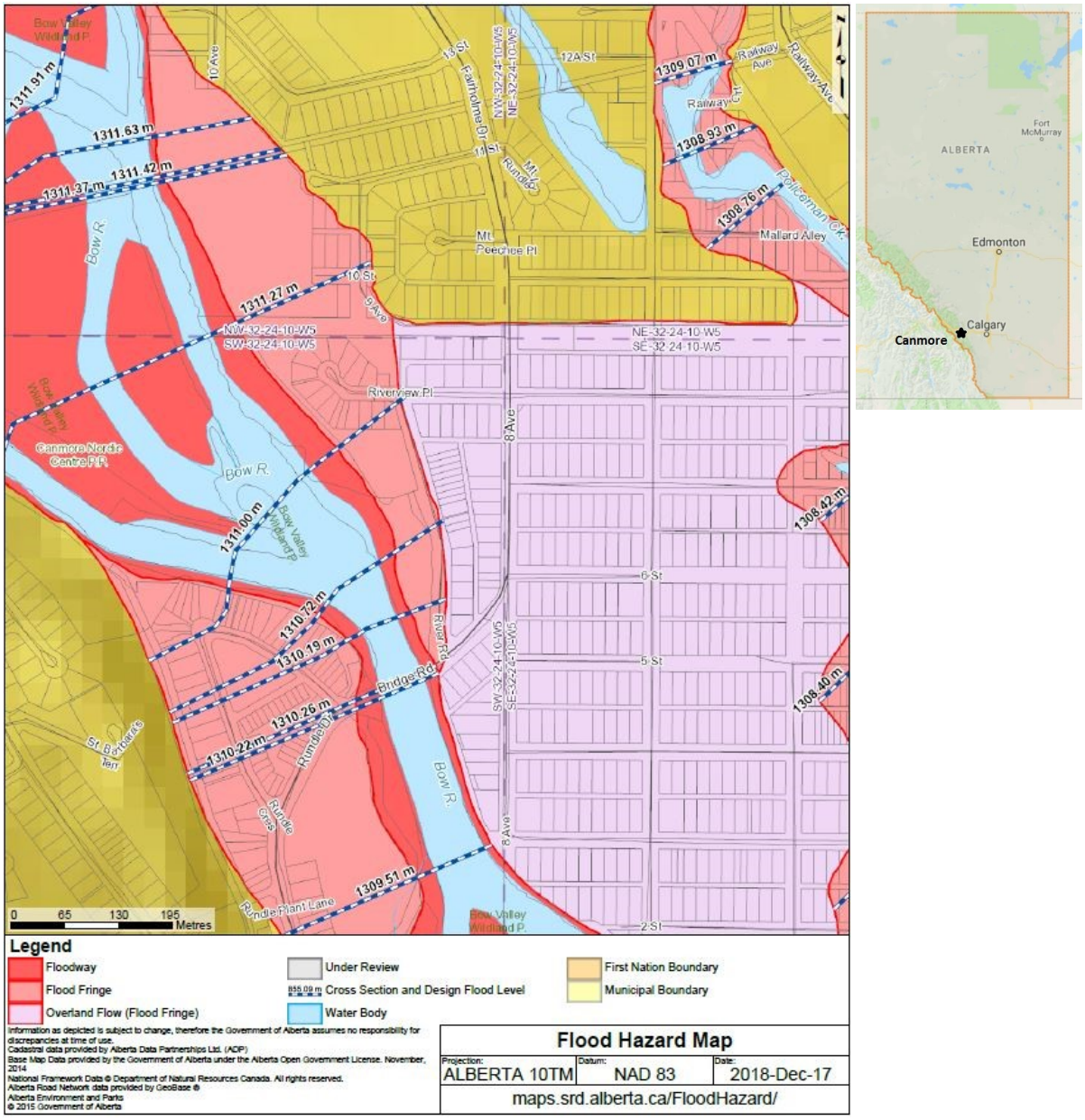

Figure 3-1 Town of Canmore flood hazard map excerpt.

Map credit: Government of Alberta and Google Maps for inset.

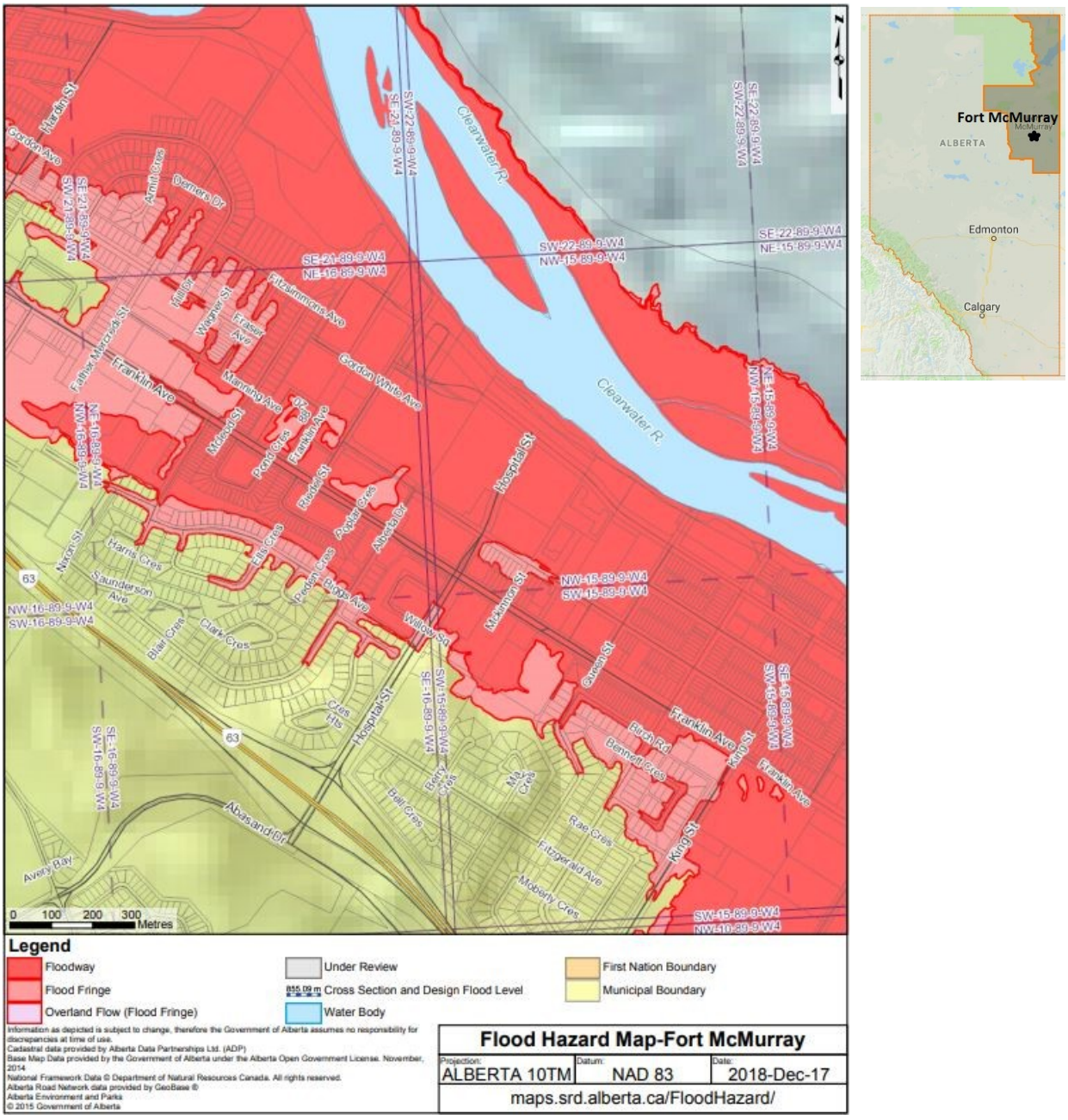

Figure 3-2 Fort McMurray flood hazard map.

Map credit: Government of Alberta and Google Maps for inset.

Results from this research show that municipalities in Alberta use a variety of flood risk management approaches to mitigate flood risk (Table 3). The province invests heavily in structural mitigation such as dry dam reservoirs and floodgates to protect municipalities (Figure 3.3).

Figure 3-3 New Cougar Creek culvert in Canmore, AB

Where developments in floodways cannot be physically (re)moved, communities such as RMWB and Drumheller, use non-structural measures to address risk. The outcome of avoidance strategies such as flood relocation or managed retreat is to naturalize lands, yet these strategies require public support to be effective. Alberta's contentious Flood Relocation Program had low uptake with about 60% of residents rejecting the

government offer to move out of the floodway zone (Henton, 2015; Komarnicki & Henton, 2013).

Table 3-2. Alberta's Flood risk management approaches for municipalities

Risk management approach	Mitigation examples	Municipality	Cost
Protection	Springbank Off-stream Reservoir Dam	City of Calgary	$432M
	Floodwall	Regional Municipality of Wood Buffalo	$153M
	Culvert and backwater valve	Town of Peace River	$4.85M
	Centre Street Floodgate	Town of High River	$3.5M
Accommodation	Waterways and Lower Townsite	Regional Municipality of Wood Buffalo	-
	Downtown	Town of Drumheller	-
Avoidance	Flood Relocation Program voluntary buyouts (254 homes) (26 out of 94 acquired properties were auctioned off in 2017).	High River (102), Calgary (50), Medicine Hat (57), Bragg Creek (36), Black Diamond and Turner Valley (9).	$81M
Managed retreat/ realignment	Wallaceville buyout and naturalization (107), Beachwood sale (9) and auctioned (17)	Town of High River	Unknown

Sources: Flood mitigation projects - Alberta Environment and Parks; Alberta Infrastructure (2017); and individual municipal websites and media reports.

3.5.1.1 Discussion and themes

This study analyzed twenty municipal land-use bylaws, and municipal development plans to determine how municipalities vulnerable to flood hazard risks use risk-based approaches to land-use planning. Results are in five broad categories: general versus detailed land-use flood policies; mandatory versus voluntary requirements for flood-

proofing measures; inconsistency of the types of uses that are allowed in a floodway; conflicting flood policies or *'flip-flop'* flood policies and protracted, or unenforceable legislative context to restrict development in floodways in a more consistent manner.

3.5.1.2 General versus detailed land-use flood policies

The first finding is that small/mid-sized communities (N=20) have some capacity to address flood hazard risk in their local plans. This does not mean the municipalities have the capacity for all aspects of municipal governance, but there is evidence, that both small and mid-sized communities use the same legislative provisions for land-use planning as other larger centers. In this regard, the research distinguishes between planning resource capacity (i.e., human capacity through planners) versus planning legislative capacity (i.e. through plans and land-use bylaws).

In the towns of Canmore, Slave Lake, Turner Valley, Black Diamond, and Whitecourt, document analysis reported detailed flood hazard policies to guide development. The towns reference the technical flood hazard studies produced by the former Canada-Alberta FDRP program for identification of the two flood zones (floodway and flood fringe). Few municipalities such as the towns of Black Diamond and Camrose have broad flood policies in their municipal development plans, while others such as the towns of Canmore and Cardston have extensive policies for how subdivision and development authorities are to regulate developments in the floodway, flood fringe, and overland flood areas. The more details included in a land-use bylaw, the more prescriptive the rules.

Small and medium municipalities are, and can, promote flood resiliency through zoning regulations, storm-water management, erosion controls, local mitigation infrastructure projects, and water management policies such as source water protection or wetland preservation. The concern of note is that when small municipalities do not have strong, clear policies for flood plains, landowners can push the limits of what would otherwise be unacceptable development. Municipalities that therefore have stronger policy direction at the MDP and through the land-use bylaw will have better support for planners and land developers because of clarity. Whereas, having some form of a flood policy is better than none, generic or vague generalized statements will have difficulty in translating into subdivision or development rules. Such requirements may also be subject to local appeals through local appeal boards which can overturn, reject or approve development applications.

3.5.1.3 Mandatory versus voluntary floodproofing requirements

The second learning is that there appears to be no strict guideline on requiring floodproofing in the floodway, flood fringe or overland flooding areas in local documents. Floodproofing measures are the physical building alterations implemented to protect a building from flood damage, e.g., raising electrical, plumbing or heating equipment above the flood elevation; or requiring habitable floors to be at or above the flood elevation. Twelve municipalities (N=12) have floodproofing requirements for developments in both the floodway and flood fringe. There were also other nuances such as in municipalities where additions to a building, for example, a deck, in the flood fringe, require floodproofing, but repairs or renovations to the building itself do not need floodproofing.

There are two critical gaps in land-use bylaw floodproofing requirements: first, is the local position on whether to allow development or not in the floodway and flood fringe and second, whether and when to require floodproofing. To reduce risk, the study posits that if a building is renovated in the flood fringe, then the building should be floodproofed to avoid future damage. New residential homes in a provincially mapped floodway should be prohibited. Where buildings exist in the floodway, minor renovations that do not add structural changes could be floodproofed. Major renovations that increase building footprint or intensification (such as replacing one home with a duplex or fourplex) in the floodway should not be contemplated in land-use bylaws.

3.5.1.4 The inconsistency of the types of uses allowed in a floodway and alterations to existing buildings

A third outcome found is that the list of land-uses allowed or prohibited, and definitions, vary from municipality to municipality. Seventeen municipalities (N=17) stipulate the types of land-use permitted in the floodway or flood fringe areas, e.g., extensive agricultural uses, outdoor recreation areas, parks and playgrounds, public utilities, and natural areas. In 13 municipalities (N=13), no new development was allowed in the floodway, and in one case, the municipality (Whitecourt) prohibits buildings for vulnerable populations such as hospitals or seniors' facilities in the floodway which was unique in a land use bylaw. Recognition of demographic factors was not prevalent in the documents reviewed yet uses such as schools, daycares or medical facilities, yet the safety and vulnerability of the young and elderly, are critical for emergency management.

In nine out of 20 municipalities, current developments in the floodway were allowed to repair, rebuild or replace to the same footprint if the applicants provided engineering

studies as a basis for mitigation. Out of these nine municipalities, only four had flood-proofing mitigation measures, and three municipalities did not allow an increase or expansion of the building size of an existing building. In two municipalities, roads and bridges were prohibited in the floodway (High River), while in another (Ponoka) road and bridges were being allowed.

Another inconsistency is the minimum setback for environmental reserve lands for flood-prone lands. They range from the legislated minimum of six metres to 30 metres in six municipalities; to a maximum of 60-metre setback from major rivers (Bow River) in Calgary and Canmore. From the land-use bylaw and plan review, Cochrane's inclusion of wetland policies in the land-use bylaw was unique. The town of Cochrane has a Wetlands Conservation Policy which provides riparian policies at the local level; these local requirements align with the Alberta Wetlands Policy (Government of Alberta, 2013a, p. 18) which seeks to maintain natural wetlands in the province. Cochrane's policy restricts development in riparian and wetland areas (avoidance), and where development must occur, the town requires a developer to replace the riparian or wetland feature with another wetland area (restorative replacement). Since many municipalities must meet various provincial regulations and policies, land-use bylaws can be powerful tools for minimizing hazard risks by incorporating applicable policy at the local level such as the wetlands policy.

To summarize, there appears to be a need to consider the standardization of consistent types of land-uses allowed or prohibited in the floodway across municipalities that would reflect the acceptable risk to both residents and governments. When the

Province of Alberta, moves forward with a floodway development regulation, it will be useful for developers and municipalities to have clarity on the types of uses allowed, flood proofing requirements and a mandatory linkage to the use of provincial flood hazard maps. Additionally, municipalities and landowners (including infrastructure or facilities on public land) should protect vulnerable populations and institutions by avoiding flood hazard-prone areas.

3.5.1.5 Conflicting flood policies /"flip-flop-notwithstanding" flood policies

The fourth finding is that there are unusual cases where a municipality provides a stringent land-use requirement then subsequently overturns the policy. For instance, several municipalities require new developments to be setback from a range of 11m to a maximum of 38m from a flood risk area. However, the same municipalities still allow development within the minimum 11m or 38m setback if an applicant can provide flood protection measures. Consider this excerpt from the Town of Drumheller (2018, p. 140) land-use bylaw section 61 outlines the following floodway requirements in the 1 in 100 area:

> (a) Development shall be *discouraged* on land within the flood risk area as determined by Alberta Environmental Protection;
>
> (b) Development activities in the flood risk area shall be *carefully controlled*. Low intensive uses such as open space, recreation, and agricultural activities shall be *preferred*.
>
> (c) Subdivision and development of *permanent structures shall not be permitted* within the floodway;
>
> (d) *Notwithstanding the above* and at the *discretion* of the Development Authority, development defined as infill development *may* be allowed on land within the flood risk area. In all cases, as a *condition* of development approval, the Developer shall hold the Municipality harmless from any damage to or loss of the development

> caused by flooding by way of an agreement registered as a caveat or restrictive covenant against the titles of the property being developed; and

From the excerpt above, section 61 (a) *discourages* new development in a *flood risk area*, while section 61(c) does not permit subdivision or development in the *floodway*. Terminology means everything in a land use bylaw: in this case, section (a) references the flood risk area, therefore taken together with section (d), infill projects – i.e., developments on vacant parcels of land within an existing area- may be permitted in the flood risk area.

Further, section (d) conditions these infill flood risk area developments by requiring a developer entering into a 'save harmless agreement' with the town and flood-proofing the structure. A save harmless agreement is a legal mechanism that releases the town from any liability for property loss or damage resulting from a flood. Six municipalities (Canmore, Fort Macleod, Slave Lake, MD of Lesser Slave River, Drumheller and RMWB) register these indemnities as caveats or restrictive covenants on the land titles of the properties that are being developed.

> The development authority may require an applicant to enter into a development agreement or save harmless agreement with the Town, relieving the Town of responsibility for any damage to loss or loss of the development caused by flooding, subsidence or erosion (Town of Whitecourt, 2018, sec. 6.9.5).

A more in-depth study is required in planning law and legislation about the success of save harmless agreements in the protection of municipalities where flood damage has occurred. At the time of this research, there was no knowledge about whether these agreements have been challenged through judicial reviews. Much is unknown about the Canadian legal professional liability to engineers, planners or municipal governments when flood damage occurs although there is scholarship about the topic in the U.S. (Kusler, 2007).

Caution should be given that although the design flood level in Alberta is the one percent chance of flood occurrence every year, with increasing climate change, communities should anticipate and prepare for more significant events which would inundate -flood- the presently identified flood fringe lands. Municipalities that require applicants to raise buildings above the flood elevation through fill or other stilts should be aware that these are not absolute protections from severe events. Using the example from the Town of Drumheller, section 61(e) states:

> *At the discretion of the Development Authority* and where development does not constitute an infill situation as defined in this bylaw, *development may be allowed* on land within the flood fringe area *if* sufficient landfill can be provided to raise the building or development site above the elevation of the 1:100-year flood probability contour or *other suitable flood proofing techniques* can be employed. The Town *may require* professional certification to ensure this requirement (2018, p. 140) (italics added).

Elevating buildings above the design flood elevation elicits varying viewpoints: there is a school of thought that buildings can be raised, and an opposing view that raising a building above a flood level is not a mitigation measure (Alberta Municipal Affairs, 2014, p. 8). Focussed stakeholder discussions, together with input from technical experts, can assist governments in determining the best way forward for flood fringe developments. As noted in the excerpt (e) above, the *discretion* of a development authority is key to mitigation. What should the motivator of the development authority be: to promote safe development in the long-term by discouraging increased floodway and flood fringe development, or to promote short-term economic development at the expense of future flood damage costs in the future? The study concludes that much work remains to build a culture of risk reduction from the council chambers to the planners front counters in our local governments.

3.5.1.6 Protracted or missing federal and provincial flood policy regime

Lastly, it is necessary that Alberta strengthens its flood policies, similar to other provincial jurisdictions, to reduce damage from future flood hazard risks. At the time of writing, Alberta (and to a large extent British Columbia) does not have mandatory regulations to restrict new development in floodways, while Manitoba, New Brunswick, Nova Scotia (especially its Municipal Climate Change Adaptation Plans), Ontario, Quebec and Saskatchewan, have varying floodplain management policies to discourage development in the floodway through land use planning (Feltmate & Moudrak, 2016, pp. 16–17). In accordance with the Provincial Land-use Policy, Alberta municipalities are *encouraged* but not expected, to minimize land-use conflicts for lands adjacent to floods (Alberta Municipal Affairs, 1996), and municipalities retain broad authority to restrict floodway development locally if their locally elected councils choose to do so.

There is no mandatory requirement that a municipality must use the provincial flood hazard maps to restrict new development in floodways through land-use bylaws and plans. There is no restriction suggesting the crown is prohibited from the construction of a publicly-owned infrastructure or facilities in floodways, and there is no prohibition of the sale of crown lands in flood hazard areas (Groeneveld, 2006, p. 10). The 2013 southern Alberta flood disaster was not the most massive flood of the century and as Pomeroy et al. (2016) soberly indicated, municipalities should prepare for a more massive flood event through "enforced floodplain development restrictions [which] could reduce infrastructure and property damage and even save lives in future floods" (2016, p. 116). What is promising is that the municipalities in this study continue to reference provincial flood hazard maps as a basis for informing local decisions. Also, the municipalities use the 1:100

(one percent chance of occurring flood) flood standard in local plans and bylaws. The implications of referencing provincial flood hazard maps are that municipalities can rely on the hydrological basis to determine appropriate mitigation requirements from landowners proposing developing structures and buildings in the flood-prone areas.

3.5.2 Planning for Wildfire Risk

Wildfires are naturally occurring disturbances that contribute to forest health and rejuvenation (Natural Resources Canada, 2015, sec. 5). Globally, approximately 3.7 million persons live in remote rural communities in the boreal zone, and in Canada, 70% of Indigenous communities live and practice traditional uses in the boreal regions (Natural Resources Canada, 2015). While agencies suppress and manage wildfires well in Canada (Stocks & Flannigan, 2013), wildfires can still lead to catastrophic losses. Human settlements at risk of wildfires are those that encroach the wildland-urban interphase (WUI), which is the area where human developments intersect or intermingle with forest vegetation. In Alberta, the Forest and Prairie Protection Act is the legislative framework for wildfire management in ten Forest Protection Areas (FPAs) and all municipal districts (See Figure 3-4). The province can enter into agreements with these parties for fire control (Forest and Prairie Protection Act, 2016, sec. 2 and 6). A municipal district cannot pass a fire protection bylaw on land located in the FPA as this is a provincial jurisdiction (Alberta Municipal Government Act, 2018, sec. 75(2)). When wildfires threaten lives or lead to property damage outside the FPAs, the ‘urban’ municipality is responsible for fire suppression. If a wildfire exceeds local resources or capacity, a municipality may request mutual aid assistance from adjoining municipalities, the provincial government or through industry (Alberta Emergency Management Agency, 2011).

In a 2014 national study on climate change adaptation, nine Alberta municipalities had experienced wildfires in the -10 years preceding the study; and six were concerned about the threat of wildfires increasing in future (Hanna, 2014b, p. 3). The major 2011 Slave Lake Wildfire and 2016 Fort McMurray wildland-urban interphase wildfires highlighted the vulnerability of both northern and urban areas to wildfires, and the need to adopt mitigation. Research on wildfire behaviour modelling exists in the US, mainly how wildfires create their weather systems (Coen, Stavros, & Fites-Kaufman, 2018), and how fire embers ignite homes in the WUI (Maranghides & Mell, 2013).

Planners can acquire information about the extent of the wildland-urban interphase from forest behaviour modelling (L. M. Johnston, Wotton, & de Groot, 2018) or remote-sense mapping in their wildfire risk assessments (Ahmed, Rahaman, & Hassan, 2018). A US-based study by Radeloff et al. (2018b) reported that, between 1990 and 2010, new residential development in the WUI increased from 30.8 million to 43.4 million homes and the total land mass of the WUI increased rapidly from 581,000 km2 to 770,000 km2. This increase is attributed to new residential developments encroaching the WUI area rather than to vegetation growing towards built-up areas (Radeloff et al., 2018b).

Similarly, in Canada, Johnston and Flannigan (2018) were the first to quantify and map Canada's wildland-urban interface, including mapping WUI critical infrastructure and WUI industrial areas. The report found that Alberta has a WUI of 3,165,144 hectares (31,651.44 sq. km), WUI-Infrastructure of 18,027,267 hectares (180,272.67 sq. km) and the highest WUI-Industrial in the country at 3,409,839 hectares (34,098.39 sq. km). As more knowledge on the WUI occurs at a more precise scale (e.g., neighbourhood or parcel

of land), planners can utilize this information to determine where to focus mitigation or education efforts. Although the number of buildings or infrastructure in Alberta's WUI is unknown, small-scale studies such as Beverly, Bothwell, Conner and Herd (2010) have determined critical infrastructure and structures at risk of wildfires in four Alberta towns (Fox Creek, Slave Lake, Whitecourt, and Swan Hills).

One way to counter risk perception is to educate residents on wildfire risk. Since 2003, FireSmart Canada program has been encouraging municipalities, industry, and homeowners to reduce the risk of wildfires through seven 'disciplines.' The program is voluntary, inter-disciplinary, and when implemented or well-funded, can reduce property damage or economic losses resulting from wildfires (Partners in Protection, 2003).

Table 3-3 Overview of the seven FireSmart disciplines.

FireSmart Disciplines	Examples	Implementors
1. Education	Educate homeowners in the wildland-urban interface on how to manage risk.	Governments, residents
2. Vegetation management	Remove surface fuels, thin forests, use fire-resistant landscaping	Homeowners, local government
3. Legislation and planning	Create hazard mitigation plans, require wildfire risk assessments and adopt land-use bylaws to incorporate FireSmart.	Local and provincial governments
4. Development considerations	Design and build using fire-resistant materials for roofs and exterior siding.	Developers, planners, homeowners
5. Interagency collaboration	Gather the right mix of stakeholders; mutual aid agreements,	Residents, all levels of government
6. Emergency planning	Emergency plans and procedures are in place; host mock wildfire emergencies to test preparedness	Emergency agencies, homeowners,
7. Cross training	Regular training opportunities and of innovative fire suppression equipment	Provincial and local fire/emergency agencies

Source: (Partners in Protection, 2003)

The most effective mitigation measures are to ensure buildings are built with FireSmart considerations; to locate development away from forested areas (Kornakova & March, 2017; Partners in Protection, 2003, p. 15), and to reduce the WUI area by promoting in-fill residential or high density development (Moritz & Stephens, 2008, p. 269).

3.5.2.1 Discussion and results from study sites

This study explored current practice in municipal land-use planning to address wildfire risk, with the aim of identifying opportunities to strengthen wildfire mitigation measures through land-use planning further. The key research question is: how are Alberta municipalities reducing wildfire risk through land-use planning? Land-use planners have a wide range of wildfire mitigation strategies and planning tools that can be used to mitigate wildfire risks. These risk-based approaches are summarized in Table 3-4.

This study reviewed land-use bylaws, municipal development plans, and wildfire mitigation strategies, in municipalities outside Forest Protection Areas (FPAs). These municipalities are at risk of wildfires and lack access to funding since they are private lands within municipal jurisdiction (Alberta Government, 2012, p. 28). Planners can access wildfire information from sources such as Wildfire Mitigation Strategies. The 2012 *Flat Top Complex* report indicated that 82 Alberta municipalities had prepared Wildfire Mitigation Strategies while 154 had a Wildfire Preparedness Guide in place (Alberta Government, 2012, p. 28). What is unclear is whether these mitigation plans are implemented in local plans and bylaws to protect areas at risk of wildfire.

The following sections elaborate on the critical learnings for the RMWB, Canmore and Slave Lake wildfire mitigation program and their connection to planning.

Table 3-4 Wildfire risk management approaches and tools

Policy approach	**Public Education**	**Wildfire hazard or risk assessments**	**Homeowner incentives or assistance**	**Wildfire regulatory or statutory plans**	**Building or development considerations**
FireSmart disciplines*	Education	Planning	Vegetation management	Legislation	Development
Description	Public education or awareness programs on wildfire risks.	Identification and mapping of high-risk WUI areas prepared by wildfire specialists.	Direct assistance is provided to homeowners to implement wildfire mitigation.	Development of plans or laws for wildfire mitigation to restrict development in the WUI.	The construction of buildings or structures incorporate wildfire mitigation measures
Tools	Publications on wildfire risks/multi-media (websites, print).	Wildfire Hazard/Risk Assessments (at the site level).	Support residents in wildfire fuel management.	Municipal development plan/ subdivision plan	Building permits align with building codes or WUI codes (U.S.)
	Vegetation management projects K-12 schools/teacher resources.	WUI mapping to determine at-risk infrastructure or properties.	Free/cost-shared mitigation actions, e.g., debris removal, fuel breaks.	Land-use bylaws, caveats, or restrictive covenants.**	Land-use bylaw conditions, e.g., water supply, road access or forest setbacks.
	Fire/emergency management meetings/demonstration projects with residents.	Multicriteria WUI severity ratings, e.g. building construction.	Insurance or financial incentives, e.g. roof replacement.	Comprehensive Community Wildfire Protection Plans (US).	Relocation or land acquisition for high-risk properties *(overlaps with legislation)*

Source: Adapted from Haines et al. (2005).

* The FireSmart disciplines of Emergency Planning, Cross-training, and Interagency Cooperation, focus on emergency management. This research finds that there is value in including municipal planning in these disciplines as well.
** A restrictive covenant is a legal, contractual agreement between landowners that states what can or cannot be done on a particular parcel within a subdivision.

3.5.2.2 The RMWB wildfire mitigation program

The RMWB has a Wildfire Mitigation Strategy that documents the vegetation management approach based on wildfire hazard and risk assessments for 10 communities within the municipality (Walkinshaw, 2017). The strategy adopts the seven FireSmart disciplines to outline practical wildfire mitigation measures, including an analysis of wildfire behaviour potential by community and landscape type, which can be useful to prioritize wildfire mitigation actions. It provides recommendations for post-fuel reduction maintenance (Walkinshaw, 2017, p. 3). The strategy identifies specific neighbourhoods in Fort McMurray that have unrated roof materials (wood-shakes), and exterior wall sidings (vinyl or wood) which makes structures in these homes potentially vulnerable to potential fires. Other development considerations are the prioritization of a secondary egress route in the small and development standards for driveway access in communities with steep slopes (Walkinshaw, 2017, p. 4).

Concerning land-use planning, the RMWB Wildfire Mitigation Strategy makes two outstanding issues. The 2017 strategy found conflicting policies in the *Engineering Services Standards* which encouraged the use of evergreen trees and bark mulch or wood chips which are highly combustible (Walkinshaw, 2017, p. 5). It also reported that many planning documents referenced FireSmart, but did not necessarily have stringent development rules such as vegetation clearance or non-combustible exterior buildings. The RMWB wildfire mitigation strategy also recommended the "revision of the current RMWB statutory planning documents and provide input to Building Code revisions to meet FireSmart recommended guidelines" (Walkinshaw, 2017, p. 5).

At the time of writing, the RMWB had revised the *Engineering Services Standard* to incorporate FireSmart principles (Regional Municipality of Wood Buffalo, 2016, pp. 10–12 to 10–13). This includes a requirement that a 'qualified professional' prepare a wildfire risk assessment for any proposed developments located or adjacent to the high hazard areas and that a developer implements recommendations resulting from such an assessment as a condition of the development permit (Regional Municipality of Wood Buffalo, 2016, pp. 2–8). After the 2016 Fort McMurray wildfires, the RMWB adopted a Wildfire Recovery Overlay (BL 16/020, BL 17/006). The overlay provides landowners whose properties were destroyed by wildfire options for re-development. RMWB's municipal development plan identifies WUI policies by encouraging developments to adopt FireSmart best practices. The land-use bylaw has only one policy that campgrounds designs must comply with the

Figure 3-4 Vinyl siding damage, Fort McMurray, AB

provincial wildland-urban interface recommendations of the FireSmart manual (Regional Municipality of Wood Buffalo, 2017, p. 87).

3.5.2.3 Wildfire mitigation in Canmore

The study found that there are municipalities outside the Forest Protection Area such as Canmore which identify wildfire risk and provide mitigation measures in all their planning documents. The threat of wildfires is a hazard of concern for the town of Canmore as reflected in various plans and wildfire management policy documents. Most recently the 2017 Verdant Fire near Kootenay National Park, B.C., which was east of the town, came close to Canmore but did not affect the municipality.

The town uses FireSmart mitigation and has a revised Wildfire Mitigation Strategy to guide the community in reducing the threat to wildfires to 2023 (Walkinshaw, 2018). Canmore's strategy acknowledged that residents were not conducting vegetation management around their properties in Priority Zone 1 (within zero to ten metres of a structure); fuel reduction completed (about 138 hectares) on both private and Crown/public lands and identified new areas for vegetation management in Priority Zones 2 and 3 (between 10 and 100 metres) (Walkinshaw, 2018, p. iii). The strategy discusses how land-use planning changes were underway to incorporate FireSmart policies into the town's land-use bylaw/zoning ordinance. The strategy recommends that the town replace all wood-shake roofs (highly combustible) with Class "B" fire-resistant roofs on critical infrastructure; and that inconsistencies in the towns construction and landscaping standards be revised to ensure combustible trees, shrubs or groundcovers are replaced with fire-resistant species to reduce the risk of spreading to structures (Walkinshaw, 2018, p. 13).

While the town has made efforts to address wildfire mitigation through plans, guidelines, and policies, a research participant cited possible reluctance about implementing wildfire mitigation measures that may be construed as too extreme.

> "But I think in some cases it's trying to understand the risk and what the appropriate risk tolerance is? And so, this is my concern about wildfire risk: Canmore is extremely vulnerable to wildfire risk by virtue of living in a narrow valley with an old forest where wildfires have been suppressed for 100 years—but there's been active fire suppression until about 10 or 15 years ago. So now for wildfire mitigation, the challenge is the mitigations required would be so extreme to make us safe—I'm not sure if we're prepared to undertake those interventions" (Interviewee F, personal communication, May 1, 2017).

It appears that the participant was concerned about the practical implementation of wildfire mitigation strategies, particularly on the willingness of both local government and residents to carry out risk management measures as guided through the FireSmart program. For instance, the location of the town in the heart of the boreal forest surrounded by national parks in the Rockies means that wildfires are a real and continued threat to residents and developments. How do you manage 'extreme' measures in a way that reduces such concerns? What these results indicate is that wildfire mitigation strategies consistently provide implementation recommendations for land-use planning. At the time of writing, the town is in the process of developing a Wildfire Hazard and Risk Assessment, and had a successful roof replacement rebate program, as recommended by the towns' wildfire mitigation strategy.

3.5.2.4 Slave Lake post 2011

Prior to the 2011 wildfire, the town of Slave Lake lacked a FireSmart Community Wildfire Protection Plan which is part of a wildfire prevention plan. After the wildland urban interface wildfires, it was surprising to find out that "the public and many of the

stakeholders, were not aware of the potential wildfire risk to their community, nor were many aware of the proactive measures they could take to reduce the risk of wildfire" (Alberta Government, 2012, p. 32). The lack of awareness about the risk of wildfires (as well as other risks in the areas) points to a severe deficiency about the state of knowledge about risk and indicates a need for more educational awareness plus clear policies regarding wildfire management on private land.

While the MDP has policies on wildfire risk, and minimal requirements in the land-use bylaw, a review of the town's regional wildfire mitigation strategy outlines specific wildfire mitigation priorities that link to land-use planning activities. These priorities include amending land-use bylaws to incorporate FireSmart principles -thinning trees or prohibiting combustible roof materials such as wooden shakes- and requiring all new developments to use fire-resistant roofing or exterior siding materials. At the time of writing the dissertation, most of the damaged homes were rebuilt although there were pockets of existing lots where residents had not returned.

3.5.2.5 Wildfire risk results from MDP land-use bylaw and review.

A detailed review of 15 municipalities (N=15) in the wildland-urban interphase in Alberta shows that municipalities in the province are utilizing various wildfire mitigation approaches in land-use planning, but there are inconsistencies in implementation policies. These results align with findings on wildfire mitigation (Haines et al., 2005; Partners in Protection, 2003). Three inconsistencies are wildfire risk implementation in local plans and bylaws; wildfire risk recognition as a development constraint; and the connection to building codes.

Majority of the municipalities (N=12) recognize the FireSmart program in the MDP and land-use bylaws; while 11 had Wildfire Mitigation Strategies. Seven municipalities recognize wildfire as a hazard risk in the municipal development plan; however, their corresponding land-use bylaws did not have wildfire mitigation requirements. This inconsistency is problematic because the land-use bylaw requirements are the best tool to implement the principles of FireSmart, specifically vegetation management around a home, landscaping, and setbacks from forested areas. Eight municipalities, including small communities, require a wildfire risk assessment as part of development applications. Planners rely on the recommendations in wildfire risk assessments when considering municipal approvals. Other municipalities (e.g., Lac La Biche) utilize municipal reserve land for parks or playgrounds on an adjacent property to separate buildings from the forested area; these areas act as a natural fire break to protect homes from wildfires.

Although the province recognizes wildfire risks in the Provincial Land-use Policies, and the South Saskatchewan Regional Plan, the *Municipal Government Act (MGA)* does not identify wildfire risk as a development constraint. One could argue that properties located in WUI zones are undevelopable similar to flood, erosion or subsidence areas and could be taken as environment reserve lands unless mitigation measures are incorporated. Although provincial legislation is silent on how land-use planning can mitigate wildfire risk, municipalities can incorporate wildfire mitigation measures using the existing authority. Lastly, there is an opportunity to strengthen further wildfire risk in the planning system, similar to other Canadian provinces such as Quebec, Ontario and British Columbia as explained below.

Quebec, which has the highest WUI in Canada, recognizes disaster risks in the *Civil Protection Act*, by requiring municipalities through their regional planning structure, to identify hazard risks and resources (Ministère de la Sécurité Publique du Québec, 2018, secs 17–18). The *Act Respecting Land-use Planning and Development* enables municipalities to prohibit or regulate land-uses where natural hazards such as floods, landslides, and 'other hazards' exist, without specifying wildfire risks (Gouvernement du Québec, 2018, secs 5(4); 113(16); and 115(4)).

In 2014, Ontario with the second highest WUI in Canada adopted a Provincial Policy Statement on wildland fire risk. The policy recognizes wildland areas as unsuitable in 'unsafe' areas, thus directs development away from the WUI, and permits development in the WUI only with the implementation of wildfire mitigation measures (Ontario Ministry of Natural Resources and Forestry, 2017, p. 11). The province has a detailed guide, and a municipal decision must comply with the policy.

Lastly, British Columbia, with the third highest WUI, has a B. C. Wildland Fire Management Strategy with two strategic priorities. The strategy identifies the need to develop resources for WUI and support for FireSmart, and second, it encourages municipalities to use local plans and 'enforcement mechanisms' on wildfire risk mitigation and the FireSmart Program (British Columbia Government, 2010, p. 13). In the *Local Government Act*, municipalities can identify hazard areas in the Official Community Plan (section 488(1)(b). The municipality can further require a development application located in these areas to specify wildfire mitigation measures such as landscaping or setback provisions (section 491(2) (a), (c) and (d)).

While land-use bylaws regulate land, the *Safety Codes Act* and associated building code regulations, control the building structure and construction. The study found that the current building safety codes legislation does not recognize any local bylaw that regulates the types of building construction materials such as fire-resistant roofs or exterior wall siding. In other words, any bylaws that attempt to regulate matters contained in the Safety Codes Act, are deemed invalid; local building codes cannot exceed the legislation. Unless the legislation is amended, municipalities such as the RMWB have used other planning tools such as architectural guidelines to implement wildfire mitigation measures in subdivision or homes adjacent to the wildland-urban interface. There is a need for better alignment of building codes and land-use regulations to ensure wildfire mitigation measures are implemented in the actual building construction of homes to reduce wildfire ignition risk. land-use. Several counties in Colorado, U.S. have successfully adopted WUI codes into land-use planning (State of Colorado & University of Denver, n.d.).

In summary, there is evidence of local implementation of wildfire mitigation despite the legislative gaps in the land-use planning. Nevertheless, there are inconsistencies in ensuring the provincial land-use policy is implemented in a more systematic, and mandatory manner, to ensure wildfire risk is addressed in all municipal plans and land-use bylaws, especially in areas vulnerable to wildfire risk. WUI mapping information should be accessible and affordable, at a neighbourhood or parcel specific scale, so that municipalities and citizens (property owners) understand wildfire behaviour potential and specific structures or infrastructure at risk, in order to make sound decisions.

3.5.3 Planning for Drought-resilience

Drought is a naturally occurring slow-onset disaster compared to floods, earthquakes or wildfires that have a definitive start and end, and a form of an early warning system. The term drought has varied definitions, but in general, can be defined as a "*deficiency of moisture when compared to some normal or expected amount over an extended period*" (Alberta Agriculture and Forestry, 2016a, p. 3). Droughts are of concern because they not only reduce agricultural productivity, but they increase the risk of wildfires, reduce water supply and affect tree mortality (Agriculture and Agri-Food Canada, 2016; Michaelian, Hogg, Hall, & Arsenault, 2011). Globally, droughts have implications on water and food security, the environment, increasing poverty and transboundary water conflicts (Solh & van Ginkel, 2014; *Troubled Waters: Climate Change, Hydropolitics, and Transboundary Resources*, 2009).

Canada's worst drought occurred in 2001-2002 affecting the Prairie Provinces at an economic impact of $5.8 billion (Wheaton et al., 2007, 2008). Further, Schindler and Donahue (2006) anticipate that the prairie provinces will experience water quantity and water quality crisis in the future. Given that Alberta has the second highest number of farms in Canada (Statistics Canada, 2017), drought poses significant impacts to farming populations in small and rural municipalities. The government response following the 2001/2 and 2009/2010 droughts, was the Agriculture Drought and Excess Moisture Risk Management Plan (ADEMRMP); a proactive mitigation measures aimed at increasing drought resilience in Alberta's agricultural sectors. The challenge for drought resilience is that drought does not have a clear linkage to municipal land-use planning (Fu & Tang, 2013; Fu et al., 2013; Schwab, 2013). Even the ADEMRMP does not have specific policies

on how the municipal sector is to manage drought risk. Severe droughts in major cities such as São Paulo, Brazil's 2014-15 drought (Millington, 2018), Cape Town, South Africa's 2018 "Day Zero" water crisis (Muller, 2018) and California's extensive 2012-2017 drought (Mann & Gleick, 2015), highlight the importance of managing drought risk beyond agricultural sectors, and to our cities and towns.

Drought is of concern to Alberta municipalities: Hanna (2014b) found that drought was the risk of most concern to twenty municipalities; and that 13 had imposed extensive water use restrictions (Hanna, 2014b, p. 3). Another six used land-use zoning and bylaws for drought mitigation (Hanna, 2014b, p. 3). These findings were echoed in the resulting findings of the research. Alberta's water licence system and linkage to drought risk are essential to outline. In southern Alberta, where 80% of the province's population lives, residents only have access to 20% of water supply. In 2006, the government issued a moratorium on new water licences from the Bow River Basin which created a private market for water licence transfers and trading between municipalities and irrigation users (Agrawal, 2016, p. 43). Calgary holds a considerable water licence that can accommodate the city's growth, as well as surrounding areas (Agrawal, 2016, p. 43). Calgary supplies treated water to the cities of Airdrie and Chestermere and town of Strathmore while other municipalities rely on surface and groundwater, regional or private systems, or individual wells (Pernitsky & Guy, 2010, p. 83). Since water availability can impact the ability for growth, aggressive drought management measures such as water reduction for municipal, agricultural or commercial sectors, are needed to meet water capacity goals (Pernitsky & Guy, 2010, p. 88).

To assess drought risks and conditions, land-use planners can access provincial drought indices such as the Palmer Drought Severity Index, and the Standardized Precipitation Index (Masud, Khaliq, & Wheater, 2015). A drought index measures drought categories, based on frequency, intensity and time intervals (McKee, Doesken, & Kleist, 1993). Planners can then contribute their planning expertise in developing drought mitigation policies at the local level, with such indices, while recognizing the cross-jurisdictional water-management responsibilities between the federal, provincial and municipal governments. Planners should rely on scientific climatology or hydrology experts to interpret what the drought index maps mean for municipal sector uses in order to respond with water conservation or drought mitigation measures.

Planners can begin to address drought risk by recognizing the importance of water and land-use planning to sustain future growth demands for their municipalities. First, planners must garner political support to allow them to conduct a climate and drought risk assessments. Climate change modelling can be sought to understand how future climate variability may affect their region, water basin or municipality such as climatic maps in recent studies (Rahaman & Hassan, 2017). This technical modelling can inform future preparation of planning documents including climate adaptation plans or municipal development plans. This data can inform the preparation of area structure plans (ASP), where land-uses are spatially and sequentially developed to accommodate future population projections. At the ASP stage, and with various population projections, calculations on water supply can be used to determine whether there is enough water to accommodate increased growth. Water management staff can assist planners in forecasting when water licence capacity exceeds population size, and explore future mitigation

responses. At the subdivision or development phases, soil surveys can determine the suitability for certain types of development depending on the soils and drainage. Drought mitigation requires input from various stakeholders, ongoing monitoring and risk assessments (Fontaine, Steinemann, & Hayes, 2014). Planners can facilitate innovative public engagement processes such as role-play tournaments (Hill et al., 2014) with climate change scientists, water management scientist, water management groups and citizens to share knowledge, in a simplified non-technical manner, about vulnerability, and collaboratively develop drought mitigation options. Figure 3-6 below was adapted from Manitoba's *Climate Change Adaptation through Land-use Planning* (Government of Manitoba, 2011).

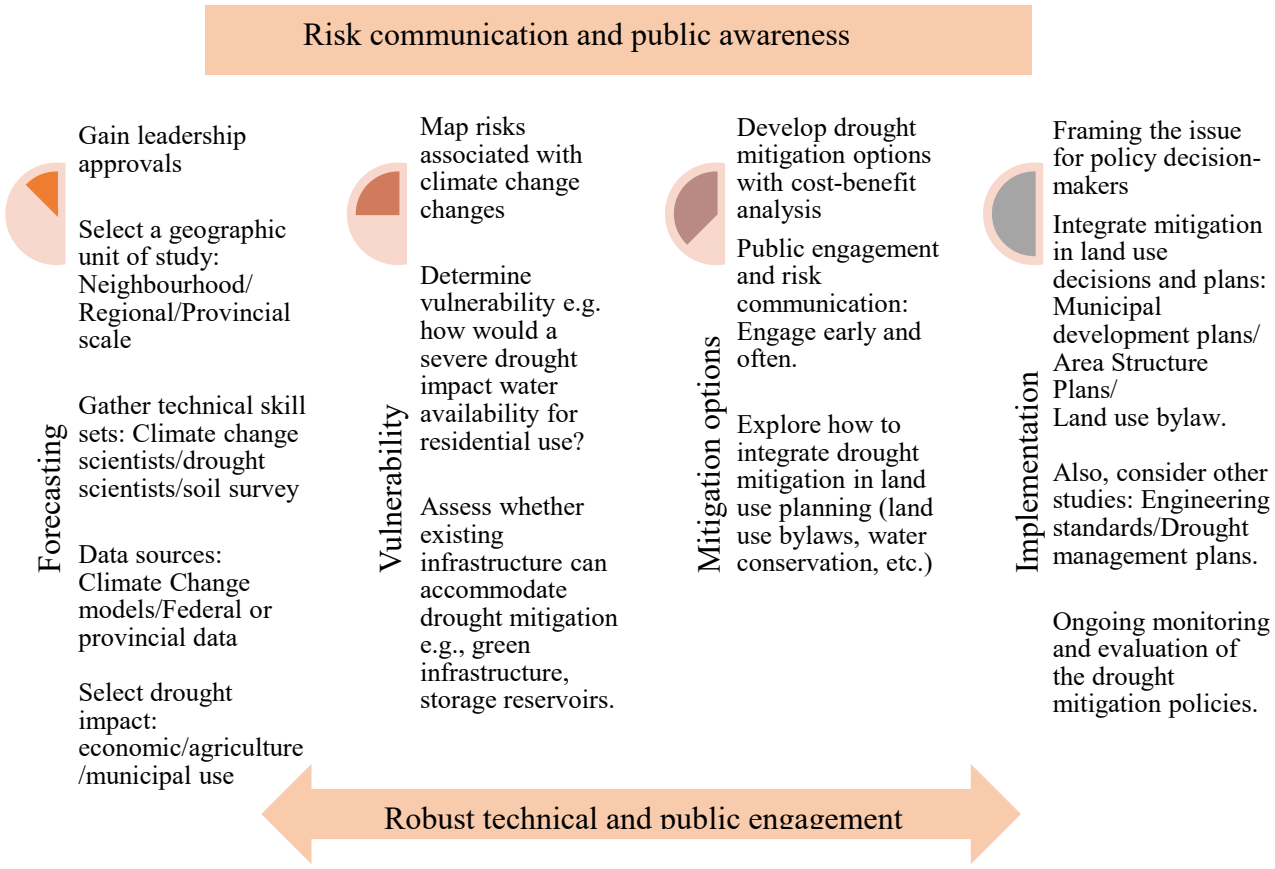

Figure 3-5 Drought risk assessment and vulnerability process for planners

3.5.4 Drought risk results from MDP and LUB review

This study conducted a content analysis of statutory plans and bylaws from a total of 20 Alberta municipalities(N=20). Ten municipalities had experienced agricultural drought-related disasters between 2011 and 2016, and another ten were located in southern Alberta's *Palliser Triangle,* a region where drought risks and water shortages are prevalent. The next section presents the results in three themes: integrated drought and water policies in local plans; implementation of drought-resilience measures at the subdivision and development stages; and water conservation bylaws and incentives.

3.5.4.1 Integrated drought and water policies in local plans

The provincial Subdivision and Development Regulation (SDR) provides municipalities general requirements of subdivision and development applications which are subsequently embedded in land-use bylaws. All applicants must provide a subsurface assessment of land to be subdivided including a description of the water table depth, water, and site sewage. Municipalities use these mandatory provisions in addition to other considerations such as site topography, soil features, stormwater and water quantity adequacy and availability (Alberta Government, 2017, sec. 7(f)). The results indicate that municipalities are addressing various forms of drought resilience measures in local bylaws using existing enabling legislation.

Municipal recognition of surface water quantity and quality in local plans signals their awareness and integration of water management in local planning. Municipalities integrate drought mitigation measures in the MDPs through several policies. First, municipalities reduce potable water use for irrigation through water efficiency policies

(N=3; St. Albert, Lethbridge, Fort McCleod); drought tolerant landscaping (N=16); water conservation strategies (N=5; Red Deer, MacKenzie, Parkland, Cochrane and Okotoks) and water quantity and quality policies (N=5; Black Diamond, Sedgewick, Lethbridge, MacKenzie, Yellowhead). Other alternative water conservation measures such a rainwater harvesting, or the use of rain barrels, was noted in three municipalities (N=3; St. Albert, Parkland and MacKenzie).

The study noted that municipalities in water-short areas in southern Alberta, tend to have more drought management requirements compared to those in the north; 16 out of 20 municipalities had drought-tolerant landscaping in local plans and bylaws.

Water management and drought mitigation tend to occur beyond borders; therefore a broad perspective is needed. Five municipalities recognize the larger watershed basin and adjacent municipal water sources and how their actions contribute to water usage (N=5; Red Deer, Lethbridge, Cochrane, Nanton, and Cardston). Seven municipalities protect and conserve the natural environment through biophysical assessments to determine environmentally significant areas, i.e., areas with species at risk, wildlife habitats, and watersheds such as wetlands, riparian areas, and floodplains. (N=7; Brazeau, Red Deer, Leduc, Sturgeon, Cardston, Cochrane and Wetaskiwin County).

Municipalities use various tools including environmental reserves, easements, or restrictive covenants, to protect the natural environment. Four municipalities (N=4; Brazeau, Lethbridge, Leduc, Parkland) include storm-water management and ‘green infrastructure’ such as low impact bioswales, or wetland areas, as a water storage measure. Two municipalities (Thorhild and Cochrane) prohibit development in areas with reduced

potable water, and on riparian land; this is consistent with other provincial legislation concerning the Wetlands Policy. Another municipality *discourages* development in natural areas (Yellowhead County).

Another finding is 17 (N=17) municipalities implemented their MDP policies on drought-hazards into the land-use bylaw (LUB) (Red Deer, Slave Lake, Okotoks, Brazeau, Leduc, Thorhild, MacKenzie, Parkland, Yellowhead, Cardston, Lethbridge, Sturgeon, Black Diamond, Cochrane, Sedgewick, Fort McLeod, Nanton). One municipality had MDP policies but no corresponding or unclear LUB drought requirements (St. Albert). Lastly, two municipalities did not have clear MDP policies but had some general requirements for water supply in the LUB (Wetaskiwin, Longview).

What these findings indicate, is that there are opportunities to explore drought mitigation requirements in local bylaws, which means that Alberta municipalities - particularly those in the water-short areas can pass bylaws to meet the broader goals around water security and drought mitigation.

3.5.4.2 Drought resilience in subdivision and development land-use bylaws

All municipalities in the study require an applicant of a proposed development or subdivision to identify their surface and groundwater supply, stormwater requirements as well as landscaping requirements. Remarkably, the majority of municipalities (N=16) identified the types of drought-tolerant species specific to their climatic areas for *xeriscaping* which is landscaping that requires minimal irrigation or watering. In one example (City of Red Deer), a minimum of 15% of all landscaping in proposed developments must use drought-tolerant plants. In another municipality (Town of

Cochrane), non-residential uses xeriscape to 100%; other residential uses 25%; and multi-residential areas must have sod coverage between 50% to 70%, and the remaining area xeriscaped. Four municipalities referred applicants to the horticultural standards of the Canadian Nursery Trade Association for the selection of suitable plants (Sturgeon, Parkland, Yellowhead and Cochrane). Lastly, four municipalities had general landscape requirements with no direct policies on xeriscaping or the use of drought-tolerant species in development proposals (St. Albert, Brazeau, Wetaskiwin, and Sedgewick).

Considering how much land is allocated for front and backyard lawns, and the fact that a land-use bylaw can granularize specificities down to species type, communities must further strengthen these requirements in order to achieve collective advances in water conservation in the province.

3.5.4.3 Water conservation bylaws and incentives

The study found that 13 municipalities had water conservation or water restriction bylaws. The water restrictions have three classes of restrictions ranging from Class 1 (voluntary reductions of potable water) to mandatory Class III water use prohibition for non-essential usage such as washing vehicles. Financial incentives are essential risk management approaches. The study found two municipalities (Cochrane and Okotoks) that have water conservation and xeriscaping rebate programs. At the time of writing, residents who plant drought tolerant groundcover or install irrigation systems in the town of Okotoks can receive up to 50% rebate and up to $200 per household. Residents that xeriscape up to 500 square feet and plant 50% drought tolerant plants receive a 50% rebate up to a maximum of $1,000. In Cochrane, residents receive $50 rebate for installing a low flush

(4.8 litres) toilets; and if households install rain barrels, they receive up to 50% rebate, to a maximum of $50. As a result, Cochrane has reduced its average water consumption from 243 to 189 litres since the water conservation bylaw was adopted.

Generally, awareness about drought and water supply in southern Alberta is higher due to the drought vulnerability of the region and water licencing moratorium, which results in the broader application of drought mitigation and water conservation measures, compared to other areas in the province. Recent research about 'wet growth' suggests that the next challenge for the Province is on water management and that regional approaches through regional or growth plans can provide municipalities with this direction (Agrawal, 2016). As more is known about drought vulnerability, municipalities should prepare stand-alone drought mitigation plans as does the US and use existing resources to promote drought readiness in Canadian jurisdictions (National Drought Mitigation Center et al., 2010).

3.6 Conclusions and Implications

The driving research question was whether local plans and land-use bylaws address natural hazard risk reduction. Moreover, to what extent do provincial and municipal legislation address the capacity of small/medium municipalities in hazard mitigation?

Contrary to literature about the underutilization of land-use planning, the study found that in the three hazards studied, municipalities are using risk assessment methodology- such as requiring flood or wildfire risk assessments or imposing water restrictions- in local plans and bylaws, but to varying degrees of sophistication. Some municipalities adopt a more rigorous risk-based approach to inform development while other municipalities have

broad rules or manage risk through ‘save harmless agreements.’ Save harmless agreements are a type of waiver or indemnifying agreements used to manage risks through “clauses in contracts or agreements where one party agrees to protect the other party from legal action arising out of the contract or agreement. Waivers and hold harmless agreements may deflect and transfer liability if they are properly worded” (Insurance Bureau of Canada, 2017b, pt. 3(2) and 3(3)). It is unclear whether judicial reviews honour such agreements and if they, therefore, protect municipalities from flood or wildfire damage claims.

Small and mid-sized communities can address natural hazards locally, but their capacity is dependent upon the level of guidance from higher orders of government. Hanna (2014a) found that the degree of municipal adaptation planning is a reflection of the “strength of provincial policies” and that the “support and leadership from planners and other municipal staff and local politicians can be important factors in advancing adaptation planning.” The study affirms these findings by recommending that the provincial government provide leadership in natural hazard mitigation by adopting legislative or regulatory policies aimed are reducing risks. The province can also support local planners by developing risk assessment guides (such as those provided by federal government agencies) tailored to local contexts. The province can also provide funding support to local governments that are keen on developing risk assessments or hazard mitigation plans. There is a lack of clear ‘top-down' regulatory direction for hazard mitigation planning at the local level by way of clear legislation, regulation specific to floods or droughts. The study also found inconsistent ‘bottom-up approaches' in municipal plans and bylaws (especially for flood and wildfire risks). For example, the types of land-use allowable in a floodway varied from agricultural uses to residential development and a mélange of

variations of floodproofing requirements. Lastly, there is an absence of political will and enforceable mechanisms at the local level to discourage development in hazard-prone areas. In other words, there is no enforcement mechanism that the research was aware of that enables a municipality to impose mitigation or risk reduction strategies.

It is also clear that prevailing societal values tend to supersede the risk-based rationale of avoiding hazardous lands. Both societal conceptions of risk and lifestyles, as well as "*human dimensions"* of natural hazards affect policy options and require consideration as humanity moves toward a warmer climate (Goodrich, 2015; Government of Canada, 2018; Wilhite, Sivakumar, & Pulwarty, 2014, p. 12). This study argues that municipalities, with the advice of professional planners, engineers, and hydrologists, can and must continue to consider natural hazard risks before determining the suitability of proposed land-uses in high-risk areas. Examples of such interdisciplinary approaches can assist land-use planners in determining property damage and risk vulnerability.

Implications

There are three policy implications and future research questions for advancing this work in planning practice. Future research for planning practice includes an exploration of what and how far municipalities should regulate natural hazards; the types of new planning documents such as hazard mitigation plans or climate adaptation plans required, and approaches to communicating hazard risk to residents and elected officials in municipalities.

First, how far should decision-makers at all levels of government regulate natural hazards? Under the current planning framework in Alberta, local governments have autonomy for all land-use decisions. The study reaffirms the need for participation from all levels of government in regulating natural hazards. However, there is a breaking point – the increased number of fatalities or escalating economic costs of future disasters-which will drive higher orders of governments to provide leadership for the sake of public safety. California's deadliest Camp Fire of 2018 damaged 18, 804 structures and 85 fatalities, prompted the California State Legislature "with a new drive to address wildfire as a serious land management and public safety concern" (Young, 2018, p. 302). Should Canadian provinces wait until fatalities escalate before prioritizing hazard mitigation policies?

Second, the study shows there is a need to develop a new class of statutory plans that focus on reducing natural hazards. This includes the creation of climate adaptation plans, or hazard-specific resilient plans, that would complement or guide local development decisions. The Province of Alberta has acknowledged the importance of climate adaptation by enabling the cities of Edmonton and Calgary to create climate mitigation and climate adaptation plan by the year 2020, as part of the city charters regulations. In the City of Calgary Charter, for example, the city must prepare a climate change adaptation plan "*based on an assessment of the exposure, risk, and vulnerability of systems within the City to effects of climate change over the short, medium and long term; set out or summarize the assessment and identify actions that will be taken to address the effects*" (Government of Alberta, 2018, secs 615.5(3)(a)-(c)). This study recommends that the provincial government extend the requirements for the preparation of climate mitigation and

adaptation plans to other small or mid-sized municipalities (including smaller cities) since climate change and extreme weather events impact smaller communities.

Third, there is a need to pursue innovative participatory approaches such as *citizen-science* -where the public participate in data collection together with the scientific community- (Hendricks et al., 2018), or crowdsourcing/visualization for hazard damage assessments (Lue, Wilson, & Curtis, 2014) to help communicate hazard vulnerability and risk. To cap the number of new developments in flood-prone areas, a convincing, persuasive and compelling approach is needed. Technical studies such as geotechnical reports, wildfire mitigation strategies and drought-plans, are critical to inform municipal planners about hazard vulnerability. Planners must collaborate with other disciplines to ensure that residents and decision makers understand the scientific knowledge about flood, drought or wildfire behaviour and vulnerability and that this knowledge translates into actions that inform a built environment that reduces natural hazard risks. For instance, Gharaibeh et al., (2019) describe an interdisciplinary team of engineers, social scientists, and residents (youth, families) who collect data about stormwater infrastructure to reduce flood risk. Other participatory approaches such as public participatory geographic information systems may be useful in engaging residents to collect and communicate data about disaster risk and vulnerability (Hendricks et al., 2018, p. 267).

Lastly, planners (both long-range and development officers) must be trained in risk management processes earlier in their planning education. A risk-based approach will be useful in the preparation of long-term statutory plans, such as the MDP's reviewed in this study, as well as in processing development or subdivision applications, as guided by local

land-use bylaws. This will not only question the suitability of a proposed development, but it will help in identifying the mitigative actions needed, to either reduce or eliminate the risk, if possible. In other words, planners must engage with, and incorporate, a culture of risk management, in the day to day planning practice, to promote resilient communities.

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4 A Commentary On Building Community Resilience: Perspectives From Planners In Recent Natural Disasters In Alberta, Canada

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4.1 Abstract

This article explores the meaning of community resilience in the context of natural hazard mitigation, in small to mid-sized municipalities that experience natural disasters. Enhancement of resilience is a result of shared responsibility by all societal systems; it strives to minimize the hazard vulnerabilities by the pursuit of proactive practices that absorb, resist or accommodate future hazards. The key research question was what community resilience is in the context of hazard mitigation and what resilience means in small/mid-sized Alberta municipalities. This inquiry is essential for planning practice because the way planners work with municipalities, before and after a significant natural disaster, must reconcile the meanings of resilience in their communities. This study adds to the knowledge of an ongoing narrative on resiliency in the context of natural hazards. Individualistic or community-based understanding of resilience may either align with or contradict with the formal institutionalization of resilience in emergency management planning or planning discipline. Moreover, despite the theoretical concerns on resilience, the study asserts that the concept retains validity in land-use planning for natural hazards.

The purpose of the research was to understand the meaning(s) of resilience from planners and other research participants in small and mid-sized municipalities in Alberta, following the significant disasters between 2011 and 2016. This study holds a conviction that when it comes to disasters and land-use planning, present-day human settlements - while they can abandon hazard areas when feasible- have the ability and capacity to adapt, (re)learn and implement decisions to minimize the impacts of future disasters with sustainable practices and therefore, become resilient.

This paper first explores definitions of resilience and literature review, followed by the theoretical perspectives on performativity in social resilience. The paper then describes the methodology, the research findings, and discussion, followed by concluding remarks vis-à-vis the inclusion of resilience narrative in land-use planning praxis.

4.2 Problematics of defining resilience

Scholars are divided about the concept of resilience with those who support the concept (L. J. Brown & Dixon, 2014; Pickett, Cadenasso, & Grove, 2004); those critiquing the concept (Davoudi, 2012; Keil, 2014); and those that reject resilience due to the underlying social inequities and vulnerabilities of marginalized populations (Slater, 2014; Vale, 2014). Other scholars take issue with the equilibrium/non-equilibrium aspect of the engineering definition of resilience, particularly in flood hazards where rebuilding in flood areas often contradicts the anticipated resilient outcomes (Liao, 2012, p. 50). However, scholarship on resilience continues to grow in disaster risk reduction, ecology, engineering, psychology, and public health sectors.

Resilience in land-use planning is relatively nascent in disaster and emergency management literature but has essential aspects for this study (Jagannath, 2018; Sharifi & Yamagata, 2018; G. Smith et al., 2013). Given global-to-local nature of disaster risk, the United Nations International Strategy for Disaster Reduction (UNISDR), which coordinates disaster risk globally, defines resilience as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner.” Canada’s Emergency Management Framework defines resilience as “the capacity of a system, community or society to adapt

to disturbances resulting from hazards by persevering, recuperating or changing to reach and maintain an acceptable level of functioning" (Public Safety Canada, 2011, p. 12). From these definitions, resilience is systems-based, has an ability or capacity, that can be used to respond and change when disasters occur; resilience is temporal or progressive in time and requires efficiency. Despite the variation of defining resilience, the concept serves as a central organizing theme for addressing the complexities of long-term communities in a world of increasing uncertainty and vulnerability (Berkes, 2007). Therefore, stakeholders involved in disaster mitigation must continually clarify the intent and meaning of resilience (Lizarralde et al., 2015).

There are also other definitions of resilience that have utility in planning practice. For example in engineering, resilience is "the ability of a system to return to equilibrium or steady-state after a disturbance resilience (Davoudi et al., 2012, p. 300)." Evolutionary resilience challenges the notion of equilibrium as systems can, and do change over time, without a disturbance. Accordingly, "resilience is not conceived of as a return to normality, but rather as the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains" (Davoudi et al., 2012, p. 302). Evolutionary resilience was further developed in the "panarchy of adaptive cycle" of a system: growth or exploitation, conservation, release or creative destruction, and reorganization (Gunderson & Holling, 2002). Hence, evolutionary resilience touches on the fragility of a system that may not necessarily return to what once was, but that accommodates renewal and regeneration.

In this study, community resilience is defined as the capacity to anticipate and prepare for natural hazards through a collaborative, adaptive land-use planning and an emergency management system that considers hazard risk to enable a community to learn, change and adapt. In this sense, resilience is necessarily a process, not an outcome or endpoint (Innes & Booher, 2013); therefore what is needed is a transformational resilience which progressively adapts with each disaster.

The following section is a brief review of disaster risk reduction literature to uncover the complexities, fluidities and unresolved questions about resilience.

4.3 Literature review: Resilience in the wake of disasters

Resilience research in the built environment is categorized into four broad areas: socio-ecological resilience (C. Wilkinson, 2012b, 2012a); transformative resilience paradigm (Newman & Beatley, 2011; Pelling, 2010); community and neighbourhood-scale resilience (D. L. Brown & Schafft, 2011; Hopkins, 2011; Social Planning Council of Greater Victoria & Transition Victoria, 2014, 2017; Wheatley & Frieze, 2011); built environment and national security (Coaffee, 2008, 2013), and resilience in land-use planning (Eraydin & Taşan-Kok, 2013; Fleischhauer, 2008; Lu & Stead, 2013). The characterization of resilience is thus a confluence of various dichotomies (Figure 4.1). Studies regarding the integration of resiliency paradigms in planning consider how resilience fits in various aspects of the planning cycle. Sharifi and Yamagata (2018) suggest that land-use "blueprint" planning (such as visioning plans) do not support the resilience-equilibrium concept because of the long timeframes required to revise or implement plans, which is contrary to resilience (Sharifi & Yamagata, 2018, p. 8). The notion that land-use

planning is static is disputable because increased or decreased development continually changes human settlement patterns and the planning involved. When a disaster occurs, the land-use planning function of a local government tends to be dynamic, to either rebuild to a previous state or to adapt or change to a desired future state; this is the transformational resilience to which communities must strive to achieve in land use decision.

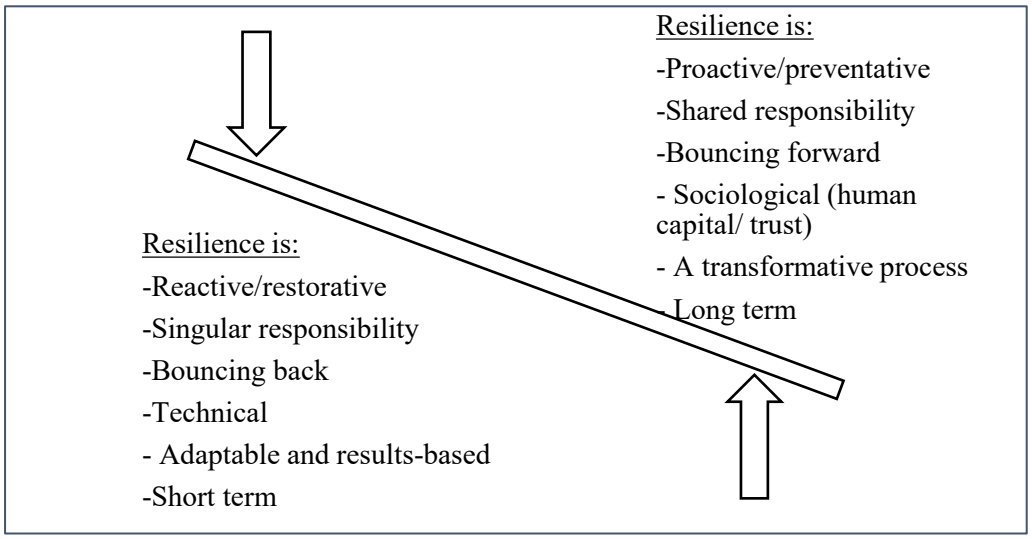

Figure 4-1 Dichotomies of resilience

4.4 Theoretical aspects of disasters resilience in planning

Discourse about socio-ecological resilience paradigm and its influence on spatial/land-use planning is of specific interest. The resilience paradigm has permeated public governance discourse at national levels such the United Kingdom's *National Adaptation Program for 2018 to 2023* with clear objectives of land-use planning as well as naturalization programs to reduce risks (Government of the United Kingdom, 2018). Other thinkers conceptualize how resilience theories can have an impact on disaster risk policies (Wenger, 2017). An additional aspect of understanding resilience is to explore how

resilience theory differs in objective reality despite physical, evidence-based, constructions of a normative future state. To deconstruct this, the influence of socio-ecological resilience and the concept of performativity are outlined as a foundation.

Scholars explore the dynamism or malleability of resilience through the performativity lens (Hillier, 2015; Kulynych, 1997; Wagenaar & Wilkinson, 2015). The performativity concept seeks to fill the gap between the socio-ecological definition of resilience and the implementation of resiliency in practice (Beilin & Wilkinson, 2015; C. Wilkinson, 2012a, 2012b). The performative concept is useful to "explain why realities seem to persistently confound governance efforts" (Wagenaar & Wilkinson, 2015, p. 1267). Performativity acknowledges that the way institutions or society defines resilience is different from the action's governance structures makes in day-to-day praxis.

Wagenaar and Wilkinson (2015, p. 1267) summarize performativity as *primacy interventionism, temporal emergency* and *the interpenetration of the human and the material on the world*. Primacy interventionism is the notion that the physical environment in which we live in is a result of our interaction with the world. This echoes the phenomenological aspect of place attachment -affective connectedness to the environment (Devine-Wright & Manzo, 2013, p. 11). Next, performativity has to do with time and space/experience, or *temporal emergency*; it is the awareness that the "constraints and affordances of the outer world only come to us through our experience of them in emergent time" (Wagenaar & Wilkinson, 2015, p. 1267). The last concept is an interaction between the physical and the human, and how practitioners or humans relate to the physical world. Performativity has its roots in Deweyan pragmatism, yet in planning praxis, notions about

power and its influence on the purposive selection of the knowledge are understudied, as Flyvbjerg (2012) concludes:

> Knowledge about the phenomena that decide whether economic, social, geographic, or other knowledge gets to count as important is at least as important as that knowledge itself. If you are not knowledgeable about the former, you cannot be effective with the latter...In reality, however, power often ignores or designs knowledge at its convenience (2012, p. 294).

In the book, *What is a Disaster?* (Quarantelli, 1998), social scientists extensively argue about a standard definition of a disaster: is a disaster mainly physical, or a socially constructed phenomenon? Other scholars question whether other global or capitalists forces are the causes of a disaster, based on those that are benefiting post-disaster, mainly higher income groups or individuals (Mutter, 2015; Riederer, 2015). From a purely land-use planning perspective, this study focusses on the physical aspects of a disaster, i.e., a disaster only occurs when a hazard poses a risk to human aspects. The study relies on the current and broad definition in Canadian emergency strategy. A disaster is

> "a social phenomenon that results when a hazard intersects with a vulnerable community in a way that exceeds or overwhelms the community's ability to cope and may cause serious harm to the safety, health, welfare, property or environment of people; may be triggered by a naturally occurring phenomenon which has its origins within the geophysical or biological environment or by human action or error, whether malicious or unintentional, including technological failures, accidents and terrorist acts (Public Safety Canada, 2017b, p. 21)."

Theorizing resilience can also be understood by the nature of research studies in the disaster risk field. Tierney, Lindell, and Perry (2000) classify disaster resilience scholarship into three theoretical approaches: the functionalist/systems approach, vulnerability approach or a social constructivist approach (Tierney et al., 2000, pp. 28–29).

A functionalist theoretical approach focuses on a disaster's disruption of the 'normal' functioning of a community such as damaged critical infrastructure, employment, school or business closures, or social disruptions. A vulnerability approach seeks to uncover the underlying social inequalities from a disaster, based on race, gender, or cultural factors. Finally, the social constructivism approach questions whether a disaster stems from internal social imbalances or external forces such as global capitalism or systems theories (Tierney et al., 2000, pp. 16–23). Both functionalist and social constructivist approaches to disasters occur in the realm of uncertainty as studied in crisis theory (Rosenthal, Boin, & Comfort, 2001).

This research aligns with and focusses on the functionalist perspective, but acknowledges further work is required to understand the vulnerability and socio-constructivist perspectives in the Canadian context. Additionally, crisis management, as epitomized in a disaster, appears more pronounced in complex city systems (Jacobs, 2005) compared to rural or smaller communities (Brinklow & Gibson, 2017; Cutter, Ash, & Emrich, 2016; Keogh, Apan, Mushtaq, King, & Thomas, 2011; McManus et al., 2012). Based on these theoretical approaches, small communities or marginalized groups equally have a form of capacity for transformational resilience and disaster recovery, such as social capital, although extreme natural disasters can exceed their capacities for disaster response and recovery, thus impact their ability to respond and prepare for significant disasters.

An unanswered question is this: is it possible to develop an integrated singular planning and disaster recovery theory to guide planning practitioners? Smith and Wenger (2006) argue that although a holistic, unified, theoretical approach to sustainable disaster

recovery is necessary for planning and emergency management, the concept of a comprehensive theory on disaster recovery *does not exist* (2006, p. 246). If a holistic disaster recovery approach is attainable, Smith and Wenger (2006) suggest that theorizing disaster recovery is best analyzed at a local community level because

> "that arrangement of social units and systems whose activities, be they consensual or conflictive, form the social, economic, political, built and natural environmental contexts for daily existence. It is also that social arrangement, because of a legal mandate and issues of shared governance, that most directly impact the achievement of sustainable, community disaster recovery" (2006, p. 246).

Recalling Flybjerg's (1998) concern about the chasm between rationality and power, other scholars (Kendra, Clay, & Gill, 2018) suspect that a government's reluctance to make resilient decisions is a way to withdraw from making hard decisions, and thus transfer the burden to achieve resilience to residents or other stakeholders. In other words, "a focus on resilience forms a justification for government retreat from risk management in favour of seemingly more beneficial personal or market-oriented solutions" (Kendra et al., 2018, p. 1). This study argues for the need for shared responsibility of broader governance systems as well as local/community system in disaster risk management, in a western (Canadian) context where the institutional capacity for adaptation exists.

Despite the intellectual diversity on disaster resilience, a lack of unified disaster recovery and gaps in the integration of resilience in planning theory, this study's quest was modest: to outline common constructs about resilience. By focusing on the local government level, the study set out to understand how planners and participants understand resilience in four small/mid-sized municipalities that suffered significant disasters in the Province of Alberta, Canada. This research will add to the Canadian literature on land-use

planning within the context of disaster risk reduction as well as the emerging literature on the resilience paradigm.

4.5 Methodology and study areas

The research methodology included key-informant interviews with lead planners and other experts (N=13) from four municipalities namely: Canmore, Regional Municipality of Wood Buffalo (RMWB), Slave Lake and Brazeau County. These municipalities were selected for three reasons. Each community had experienced a major natural disaster between 2011 and 2016 as evidenced by a declaration of a State of Local Emergency due to floods (Canmore), wildfires (RMWB and Slave Lake), or drought (Brazeau). The municipalities had land-use planners or development officers, and other research participants who were knowledgeable about the disaster, and had a vision or perception about community resilience. The research participants included land-use planners or development officers, the insurance industry, emergency management staff, and elected officials. Key informant interviews were held between February and September 2017 and recorded using a hand-held electronic recorder. Next, the interview scripts were transcribed and transferred to the NVivo 12 software package, which helps in coding and analyzing qualitative data.

One limitation is that the sample of key informants interviewed (the number of lead planners) was drawn from a small list of participants from municipalities that experienced significant natural disasters within a limited timeframe (2011-2016). The findings gained from the planners, emergency management staff, or government officials, and generalizable to other similar small and mid-sized municipalities. A detailed study may be

required to understand practicing planners' overall perceptions of resilience, by pooling a larger sample of registered professional land-use planners and development officers in other small/mid-sized municipalities either in Alberta or other comparable jurisdictions, that experienced both major and smaller types of disasters. This paper is complementary to two separate research studies by the author described in Chapter 2 and Chapter 3 of this dissertation.

4.6 Results and discussion on the meaning of building community resilience

As stated previously, the purpose of this research is to understand the meaning of building community resilience from planners and research participants in small to mid-sized municipalities in Alberta that experienced major natural disasters (floods, wildfires, droughts) between 2011 and 2016. The following section documents the findings and analysis of the perception, definitions, and criticisms on the concept of building community resilience. The four themes are leadership and decision-making; the ability to learn and adapt/change and grow/education; and lastly, factors that do not constitute resilience.

4.6.1 Resilience requires leadership and decision-making

Participants identified leadership and decision-making as drivers for building resiliency in all phases of the disaster management cycle. One daunting, yet recurring message participants cited was '*don't waste a good disaster*.' Building back better requires leveraging the resources that flow post-disaster during the 'window of opportunity' and utilizing government readiness to make costly investments and political decisions. Although disasters accrue significant property damage and loss, disasters are simultaneously opportunistic. Thus, the making of decisive, resilient actions and outcomes

must occur when the 'appetite' for change is prominent on the public agenda and in the public eye. The thought that a natural disaster can be 'wasted' points to the need for preparatory, proactive, presupposition on the part of planners, residents and local governments, long before the disaster occurs.

> "And one thing that I've heard is don't waste a good disaster. But really the community resilience is how do you make it better? How do you build back better? Or do you make it better and leverage the disaster? You've had it, so leverage it. Not a nice thing to say, but it's the truth. Never waste a good disaster. That's community resiliency" (Interviewee A, personal communication, February 10, 2017).

Governments exemplify leadership by the actions taken to ensure communities not only return to 'normal' functionality but that the rebuilt infrastructure and housing, are not susceptible to further damage when the next natural disaster occurs. For many elected officials, the difficulty is in standing tall on a resilience-based decision that will outlive their mandates. Planners need to understand and accept how to leverage these opportunities and be prepared to give sound advice to decision-makers who have the difficult task of making disaster recovery decisions. Participants also noted that a governing system that fails to decide on a mitigation measure or policy, inevitably by its inaction, perpetuates risk vulnerability in hazard areas. This finding is supported by other studies about being cognizant of the consequences of not making decisions:

> "No action or no decision 'is a decision' because the resources we manage are not static, they are not frozen in time and procrastination or delay only allows the present to continue, often with unintended consequences. In addition, the longer an activity that is incompatible…is allowed to continue, the harder it will be to eliminate or restrict.
>
> 'No action' over a long period allows incompatible activities to become standard practice and acceptable—and almost impossible to alter. There are times when no action is appropriate, but it always must be viewed in the same light as a decision

> rather than just procrastination or an inability to make up one's mind" (Londoño, Jarvis, Lopoukhine, & Mapesa, 2015, p. 361).

A *resilient-inclined-leadership-mindset* should challenge how local governments respond to, and adapt to disaster. By not making timely (resilient) decisions to avoid or reduce exposure to hazards, leaders can perpetuate human settlement patterns in high hazard-prone areas, which exposes more lives and property to danger, following more devastating disasters. As Londoño et al., (2015) suggest earlier, the natural physical environments are dynamic which means delayed actions only lead to a build-up of consequences.

Nonetheless, decision-making during natural disasters cuts across government bureaucracies or community size such that residents or local staff assisting in disaster response, can contribute to resilience. Small and mid-size communities have a form of capacity for emergency preparedness, as outlined earlier in Chapter 2, and tend to seek support mostly when the hazards are extreme, and when they exceed their local capacity. For example, in Canmore, the early and swift actions of leaders to hire local contractors to clear culverts from flowing flood debris along the Cougar Creek after the 2013 floods, protected homes adjacent to the creek and downstream, from flood damage.

> "For a town of 13-14,000, I think we're very well prepared. In the event - it came down to a few critical people making some incredibly difficult decisions around the actual disaster response. And so, regarding the flooding, that was the actions that were taken to try and minimize the impacts of the flooding. So that was a) leadership, b) it was a willingness to use private contractors to work immediately, in the middle of the night, to try and manage the flooding that was happening" (Interviewee F, personal communication, May 1, 2017).

The response above was one of the narratives where the interviewee contrasted planning capacity between larger cities versus small municipalities. The assumption is valid in that councils for major metropolitan cities with larger populations tend to draw on more

resources to respond to and prepare for natural disasters. Interviewees cited that, just as cities have access to technical expertise and services, small/mid-sized municipalities equally engage with internal municipal departments (public works, engineering, emergency services), or externally through contracts with private legal, planning or engineering firms, and regional planning agencies.

To be clear, the researcher observed that research participants in the four small/mid-sized local study areas were not operating in isolation and drew on the expertise of internal staff or external resources to develop plans and update bylaws. A closer look at the structure of municipal governance suggests that planning capacity may be at risk when there are no professional planners on staff. Therefore, when research speaks to the vulnerability of small communities' readiness to tackle climate change and disaster risk, it is essential to separate how leadership influences the financial resources that may advance or elevate the role of planning practice in a community.

4.6.2 Resilience is adaptable, honours public interest and is affective.

Research participants view community resilience as the ability of a municipality to learn, adapt, grow and change. Adaptability is synonymous with dynamic change: a natural disaster is an opportunity for growth, reorganization, and reassessment. One participant noted that resilience is making changes to ensure that natural hazard incidents such as wildfires do not ravage the functions of a municipality again, by building back, and build back better. Change in that regard was having apparent transformativity, such as incorporating wildfire risk reduction measures, in the way landowners design and build neighbourhoods and homes:

> "My definition of community resilience is to experience an incident -wildfire, flood- and to be able to make changes to our community, so it does not happen again. So, the next time a fire is in the community, we have FireSmart principals within the public [land], FireSmart principals within our land, within the wildland-urban interface, so that we don't have fires come into our community again and do that same kind of destruction" (Interviewee G, personal communications, July 20, 2017).

Another interviewee used economic examples to explain the concept of resilience as adaptability to changing economic conditions and advances in technology. Municipalities should consider how technological advances such as the rise of autonomous vehicles will impact current investments in hard infrastructure such as roads or transportation systems. Resiliency is therefore necessarily adaptable to change:

> "My idea of community resilience is adaptability to changing circumstances. That's it! Resiliency is about being able to adapt to new technologies to new challenges, to the changing economy, to changing politics. Even being struck by a natural disaster or having a Wal-Mart show up near the small town and think how to keep your *Mom-and-Pop* downtown core, what makes them viable? Resiliency is being able to adapt to changing circumstances." (Interviewee F, personal communications, July 20, 2017).

Interestingly, another interviewee defines resilience with imagery from the 2006 *Rocky Balboa* film directed by Sylvester Stallone (2006). Rocky, a retired underdog boxer defied odds by being persistent after being knocked down numerous times. He advises his son, "*it isn't about how hard you get hit, it's about how hard you can get hit and keep moving forward*" (Stallone, 2006; Tholas, 2017, p. 6). This motivational speech plays on the strength versus vulnerability duology which is appealing for the interviewee's concept of resilience. This definition was unique in that the movie symbols and imagery were used to describe the characteristics of resiliency such as determination, persistence, diversity, and commitment.

> "Resiliency is about trying every day. It's kind of like being committed to an outcome. Resiliency is the ability to make the decision to continue to move forward. In some cases, resiliency might be better helped by diversity. It can shed off what isn't working and build on what is. In some cases, you can build resiliency just by determination" (Interviewee D, personal communication, April 20, 2017).

Resilience likewise evokes affective responses from planners and individuals, following a disaster. The researcher noted the uniqueness of these definitions since planners focus on the physical aspects of land-use, and plan for and with residents, without necessarily planning for residents as people. The planners described resiliency in personal, affective terms, or experiential terms, which is different from the traditional understanding of planning and recovery. Planners in one municipality mentioned how resilience was the planner's ability to handle the agitated, anxious or angry residents across the counter in a municipal office; residents who primarily want to get their rebuilding permits approved so they can get on with their lives. In one municipality planners outlined several risks that were "keeping them awake at night." In that example, the interviewee altered the way they commute where there was a likelihood of a risk to occur. Disasters reveal the humanization of planners: planners as resilient themselves, planners whose purpose is to save lives as well as properties. Resilience, therefore, is more than getting residents back to their homes or getting their possessions: it is a daily progressive, secure mentality.

One planner made the connection to rebuilding in the western consumerism that is typical following a disaster. These economic spin-offs, benefits, tensions, and transactions are interesting aspects to consider. The planner suggests that resilience is not about amassing possessions but about embracing life.

> "It means that just because there's a fire—just because there's a disaster—it doesn't stop you from living life to the fullest. You need to take each day and be thankful for

> that day and do what you can with what time you have. And not worry —like—I know there was a lot of people that after the fire started collecting things that they didn't necessarily need—but they had lost everything.
>
> They had nothing left except for the clothes on their backs—and they couldn't handle it and the way they processed it was to start purchasing excess amounts and we saw in 2013 on Facebook that the *buy-and-sell* sites were going crazy with stuff "Brand new. Brand new!" Because people had bought, and overbought, and so the heart of [resilience] is being strong enough to face each day" (Interviewee E, personal communications, April 27, 2017).

Equally, planners who had experienced natural disasters directly by mandatory evacuations, or the loss of a home or damage to property, tend to have more apathy and therefore more affective perceptions of resilience. A research participant characterized their definition of resilience based on the technical pre-disaster, during the disaster and post-disaster aspects, as well as, the cognitive or traumatic mental aspects that impact an individual or personal resiliency following a disaster.

> "Yeah, I think it's a combination of understanding. Having good information of what the risks are. So, it's kind of an education or sort of an awareness of what the risks are. That sort of comes before an event. During the event, it's having a well-trained team to respond to an event. And then the third part of that is really about the community that can come together and largely socially.
>
> I mean there's a whole bunch of technical aspects of understanding and rebuilding roads and inspecting homes and rebuilding homes. *And I've been through it myself* is that rebuilding the house is not necessarily the hard part it's the sort of mental impacts of that trauma that people have gone through from suffering some kind of natural disaster" (Interviewee F, personal communications, May 1, 2017).

To accommodate resilient changes, participants noted the importance of planners taking the time to know better and understand what their community wants post-disaster. Interviewees noted how the short-term immediacy of planning action focusses on rebuilding and recovery, rather than longer-term strategic or land-use planning exercises. Time is a limiting factor: immediately after a disaster, the task of hazard risk assessment

or mitigation planning is an illusion. Planners noted to use this time to engage with residents directly or through informal or formal public consultation, as well as internally with local councils. In one municipality, the disaster changed the way planners think, analyze and resolve rebuilding problems. Planning for resilience in these communities was not static, but evolving.

> "For me, it's certainly about understanding the need. You need to know what your community values are. You need to really understand what your focus needs to be on. You need to understand all the risks. You need to understand the people within the community. I think through the wildfire—we certainly got to know our communities much better…Which has helped us be better planners and…change the way we do business—to change the way we think" (Interviewee B, personal communications, March 31, 2017).

Another planner framed their definition of resilience with the concept of public interest. Planners in the recovery phase of the disaster cycle, use the prevailing governance direction to determine resiliency. What does the local government council want? Which arm (policy or legislative) is the primary driver? Without this direction or clarity, planners cannot execute or implement any action. Participants in one municipality noted that the public interest, as defined by their local council after the major disaster, was to return to normalcy and to ensure residents returned to their homes and children back to schools. In that instance, planners suggested that the public interest of the local council, at the time, was not on relocation to less hazard-prone areas, alternative rebuilding strategies or broader structural mitigation efforts.

> "Public interest is inherent in planning in any community you work in, and you can't apply—you know what works in St. Albert or Edmonton or wherever—it's not going to work here necessarily. So, you have to know what your community wants. You have to engage them. You have to be part of the community and plan for it. And you know right now the drive [public interest] has been getting people back in their homes" (Interviewee C, personal communications, March 31, 2017).

Still, resiliency is not necessarily a linear or clear-cut approach; neither is it always discernible in execution. An interviewee in once community noted how an informal survey reported 76% of residents in a neighbourhood whose homes were destroyed by the 2016 wildfires, were adamant about rebuilding even though their properties were in a floodplain. Residents were willing to sign "waivers" or "save harmless indemnities," despite the knowledge about flood risks. Waivers or indemnifying agreements are legal documents used to manage risks through "clauses in contracts or agreements where one party agrees to protect the other party from legal action arising out of the contract or agreement. Waivers and hold harmless agreements may deflect and transfer liability if they are properly worded" (Insurance Bureau of Canada, 2017b, pt. 3(2) and 3(3)).

> We heard from our informal survey, 76% of people wanted to rebuild...And people are like, "Just let me rebuild. I'll sign a waiver; I'll do whatever, just let me rebuild." (Interviewee A, personal communication, February 10, 2017).

Residents' unrelenting appetite to rebuild, when supported by the local council, can be inconsistent with local land-use planner's advice. This is because the public lacks fulsome education about the risks, liability, and responsibilities associated with the individual decisions.

This type of societal dimension is difficult to grapple in disaster risk management. It suggests that decisions to rebuild may be divergent from the technical viewpoint that a planner may give about the hazard risk (through risk assessments). It also begs the question of whether planners' approvals of such rebuilding efforts in hazard-prone areas defies professional codes of ethics and professional conduct. In at least four interviews, planners' responses revealed the internal struggles they face when councils ignore the planner's

technical advice for a non-resilient action. Planners would respond to certain questions dualistically, either as a professional planner or as a government worker. The perspectives from either of the two 'hats' are not always in alignment. Consider a context where a council allows rebuilding in flood hazard areas or where homeowners rebuilt without incorporating FireSmart principles in the wildland-urban interface. The *hidden planners' silence* is a phenomenon where a planner gives up the fight to persuade elected officials on the 'right' recommendation (often based on hazard risk assessments by technical staff) and has no choice but to approve developments based on an unresilient political direction. The researcher found these power struggles in the study municipalities except for one municipality which chose a rigorous risk-based approach to plan for natural hazards.

Further research is required- together with various disciplines related to natural hazards- to understand how land-use hazard planning interacts with the societal impacts (such as mobility, demographic and cultural aspects) which result in, and are contrary to, disaster resilience. Mitigation may involve advocating or attempting to change social norms in a municipality over time, with active public participation and educational programs.

4.6.3 What resilience is not: Dichotomies and difficulties

Resilience is not impractical, unrealistic, or unattainable when development decisions have been made over a long period. *Resilience is not a continuity of the same old* but is forward-thinking by looking at how to best plan for sustainability, for future generations. In this sense, resilience is more than a short-term reactive disaster recovery concept. It should go beyond the immediacy of a disaster into the long-term, recognizing

that disasters have long-term recovery and mitigation efforts. Planners view resiliency as the restoration of essential infrastructure or ecosystem goods and services such as restoring wetlands, groundwater, and source water protection.

> "Resilience to me isn't having everything stay the same. That's not practical, it's not logical but making the best use of your assets whether they're hard or soft or non-structural—you know? It's using wetlands as a buffer. So, trying to make those optimal decisions and also, I think it's really important to not look in isolation just at your municipal or community boundaries" (Interviewee I, personal communications, August 3, 2017).

Another participant also noted that *resilience is not just a government responsibility*. In their view, and this appeared in the literature, resilience is a shared responsibility. Each stakeholder in the disaster management cycle including individual residents and landowners have a role to play in advancing disaster preparedness and mitigation. This requires communicating risk, and public engagement aimed at educating residents about hazard vulnerability and getting information about mitigation measures that home- or land-owners can undertake to reduce hazard risks.

> "I think that one of the keys to community resiliency is that for a truly resilient community I think you need to have the involvement and engagement both at the government level but also community groups, individuals. Because the community governments can only go so far in helping to make a community resilient. And I think that to the extent that people are engaged and active that will help the community to respond in the short and long-term" (Interviewee K, personal communications, September 21, 2017).

Planners cited that *resilience does not always have a logical result*. In the case of wildfire prevention, participants in the insurance industry noted how homeowners that experience total loss as a result of wildfires, and that have total replacement costs, have a choice as to whether to give up certain home features such as kitchen granite counter tops, in order to build with fire-resistant siding or more resilient building materials. At the time

of the research, homes in several neighbourhoods in the RMWB were built using the same building materials and only later in the reconstruction phase did landowners incorporate FireSmart roofing (metal roofs) or exteriors siding (hardy board siding).

Another finding is that *resilience does not mean total risk elimination* for all hazard risks. Interviewees from the insurance industry noted the importance of residents to understand how resilient rebuilding impacts (or not) insurance premiums. Concerning wildfires, for instance, insurance premiums do not automatically reduce once a homeowner rebuilds with a fire-resistant roof or exterior siding. This is because other risk factors contribute to the home's risk assessment, such as liability for slips and falls, vehicle break and enter or interior fires. Participants responses show that there is a need to bridge knowledge about risk, planning, and insurance requirements, all of which are non-structural mitigation measures.

> "Now one of the comments that came about is; "Oh well if I do build with say a metal roof and a hardy board siding, my insurance premiums should drop by 75%." And that's really not the case because when we look at the overall insurance premium, and we look at all the aspects that make up that premium—the wildfire risk is only one component out of many that we look at.
>
> If you put a metal roof and a hardy board siding that does absolutely nothing for more resilient, for sewer backup, or for overland flood, or for an interior kitchen fire, or for a vehicle impact or for a break and enter your house, and these are just some of the risks that that particular property may face" (Interviewee J, personal communications, September 21, 2017).

To conclude, the study results indicate that research participants have perceptions of resilience that generally align with literature. The following table summarizes the findings from this line of inquiry.

Table 4-1 What, exactly, is resilience?

Resilience is not…	**Resilience…**
Maintaining the *status quo* or having everything as it was pre-disaster.	Challenges the *status quo*, by developing differently, either incrementally or radically.
Illogical or impractical. It is unreasonable to remove large existing developments from harm's way.	Is logical and practical. It makes the best use of assets, both hard and soft, structural and non-structural.
Resilience is not unbalanced, does not stifle growth or ignore a changing climate.	Utilizes balanced land-use decisions optimally by accommodating growth and acknowledging a changing climate.
Resilience is not converting all 'developable' land into open green spaces or parks.	Supports economic development and growth, while utilizing green or naturalization.
Resilience is not isolated or myopic because disasters often cut across boundaries.	Is geographically or physio-graphically broad in nature and seeks cross-cutting mitigation solutions.

4.7 Conclusions: Incorporating a resilience narrative in land-use planning

As stated earlier, this research set out to understand the meaning of building community resilience in small/mid-sized municipalities in the Province of Alberta following the major disasters that occurred between 2011 and 2016. The objectives were to explore how planners and other participants define resilience and thus contribute to the growing resilience literature. Two research questions guided this research: what is community resilience in the context of hazard mitigation? And what does resilience mean in small/mid-sized Alberta municipalities? Using a qualitative approach, the methods included key informant interviews with lead planners in the study site, emergency management and government officials. Data was recorded electronically then transcribed and transferred into NVivo 12 software to assist in coding and data analysis.

The following section outlines the implications of critical findings and practical recommendations for planners and governments. The final section identifies several limitations of the research as well as additional research topics.

Planning continues to be an essential aspect of resilience and disaster risk reduction outcomes and will continue to play a critical role in the future given a warmer climate. The study found that resilience at local levels requires strong leadership and decision-making; is adaptable to and can respond to change and that resilience has affective responses and reactions. Leadership during the post-disaster reconstruction phase requires transforming disaster management policies into possible changes that protect communities in the long term (Wenger, 2017). The research suggests that planners and residents must equally clarify the nuances of the definition of resilience so that all stakeholders and organizations consistently understand the terminology.

One noteworthy implication is that municipalities must promote a sustained narrative on community resilience in land-use planning processes through robust public engagement processes to reduce disaster risk and to communicate hazard risks. While this is not new for planners, the difference is that there is a gradual overlapping of planning roles (technical versus advocacy) that encroaches into both private and quasi-political public domain. In other words, planners must advocate for resiliency in hazard-prone areas by engaging with residents early, proactively and consistently throughout the planning process, while navigating the political framework. Further refinement is required to understand whether planners defy professional ethics and code of conduct if they do not disclose their community hazard vulnerability or offer mitigative measures to councils.

Nonetheless, planners, municipal leaders, and residents must offer viable options for addressing the wrong choices that continue to place people and properties in areas at risk. Planners can learn from the social sciences perspectives as well as the 'human dimensions' of disaster risk reduction (Cagney, Sterrett, Benz, & Tompson, 2016; Sapirstein, 2006) to inform the practical challenges in practice.

Ultimately, a pertinent praxis implication is that planners must complement their technological planning expertise by engaging with other disciplines, the general public, organizations, and institutions, to understand what residents want/needs are, based on a shared understanding of resilience. There is a need to acknowledge and further determine whether overcoming a land-use planners *occulta silentio* (Latin phrase for 'hidden silence') is achievable, and the consequences of what it would mean if planners could voice out their challenge to decision-makers. Planners in academia can use their position to give voice to these hidden silences; to make the unspoken, spoken and the unheard, heard.

If one accepts the resilience as defined by UNISDR and the Canadian Emergency Framework, where does the land-use planning profession in Alberta and more broadly in Canada, situate its role in the long-term recovery and resilience? As seen in Chapter 3, land-use planning can and does incorporate risk-based approaches, but more governance or legislative support is needed to advance resiliency. Even though disaster risk reduction literature recognizes land-use planning in the mitigation phase of the emergency management cycle, the land-use planning profession itself must similarly share and promote this value of resiliency. The study recommends:

- Local governments and staff develop resiliency strategies or principles in local plans such as municipal development plans.
- Educators and professional planning organizations train planners on resiliency in natural hazard mitigation, for both practitioners and residents.
- Planners use their expertise, following disasters, to advocate for resiliency in planning practice during the development approval process.

The study recommends all levels of government reconsider and clarify the meaning of resilience (regional, provincial or national resilience strategy) in anticipation of future natural disasters, and prioritize policy agenda's suited to local conditions. As Birkland (2006) notes, "the complexities and subtleties of the agenda-setting process that accompany focusing events are extended, if not magnified, by the process that determines whether the policy will or should change after disasters" (2006, p. 2). Ideally, resiliency principles and subsequent implementation decisions should give planners clear direction, on how and whether to build or rebuild in hazard areas. Land-use planners can then incorporate aspects of resiliency in land-use plan development (mainly where hazard risks are known) and second, adopt resilient actions when reviewing and approving developments proposed by landowners and developers, in hazard-prone areas.

Further research

As indicated earlier in the limitations of the study, an immediate further research is to broaden the sample size by seeking the suite of planning capacities such as professional land-use planners and consulting firms, development officers who may also be Chief

Administrative Officers in small municipalities, as well as disciplines in emergency planning and engineering, that are involved in the municipal planning process.

There is a need to address outstanding framing of policy agendas and to answer more unanswered research questions. How do socio-economic demographic factors in Canada (income, gender, race, age, or political representation) impact the ability of a neighbourhood to be resilient? Do residents have clear guidance (from planning/risk assessments) to understand, recognize or comprehend hazard risks in their community? What other planning tools such as visualization or scenario planning, can the planner's engagement toolbox incorporate? How can planners (with the expertise of hydrologists, climatologist or engineers) *persuade* elected officials to make resilient land-use decisions, even if choices are unpopular with the electorate?

More specifically, since floods are the most prevalent natural disaster in Alberta, research regarding the efficiency or viability of various resilient mitigation measures is needed. For instance, what factors should governments contemplate when considering options such as voluntary buyouts or relocation of entire communities from hazard-prone areas? What lessons can one learn about resiliency through Alberta's Flood Relocation Program or other voluntary floodway property acquisition programs in Australia and the US? Understanding the factors for a successful buyout program will shed light on the (un)feasibility of resilient mitigation actions that have a direct impact to land-use planning (FEMA, 1998; Islam & Ryan, 2016, pp. 296, 298; Squires, Milner, & Daniell, 2014, p. 434).

Building on societal changes that influence development, studies that compare how residential property values change before, during and after a natural hazard can equally be useful to quantify the economic impacts to the Canadian residential housing sector (Eves, 2003; Eves & Wilkinson, 2014). Do residents' affective responses -such as fear of building in a hazard-prone area- impact property values after disasters occur, and is there a difference of such responses immediately after an event, or in the long-term, say several years after an event? To what extent are residents' cognitive or behavioural changes after a significant disaster indicative of, or conflictive with, a resilient disaster paradigm.

In summary, as scholarship on resilience, climate change adaptation and disaster risk reduction emerge, the land-use planning profession in Alberta will need to take up its call for managing land as a natural resource with a view to enhancing the resilience of their communities. As discussed in Chapter 2, planners require both deontological and utilitarian behaviours as they grapple with the uncertainty that characterizes the 21st-century human settlements.

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5 Final Conclusions

This dissertation outlined the role of land-use planning of land-use planning in small/mid-sized municipalities in natural hazard mitigation in the Province of Alberta following the major disasters that occurred between 2011 and 2016. This final chapter of the dissertation restates the research problem, the purpose of the research, a review of the objectives and methodology and research questions. This chapter discusses a summary of the findings in light of the theoretical perspectives and literature review and a discussion of practical implications. The last section identifies the limitations of the research and recommendations for further research. A reflective note on the failure, or not, of land-use planning wraps up this chapter.

5.1 Introduction

Municipalities are essential partners for advancing and incorporating climate change adaptation and mitigation measures yet small municipalities are inadequately prepared to address these risks. One of the prime functions of a municipality is to allocate land for different uses through the land-use planning process. Literature on climate change and disaster risk reduction, typically identify land-use planning as a non-structural hazard mitigation measure together with the insurance industry, and building codes (Burby et al., 2000; Olshansky & Kartez, 1998; G. Smith et al., 2006). Few studies focus exclusively on land-use planning in climate change adaptation and mitigation (Government of Manitoba, 2011). The gap in the Province of Alberta is that there is currently limited research regarding the role of land-use planning in natural hazard mitigation in small/medium sized municipalities. The lessons from this study with respect to the challenges of land use planning as a non-structural measure and the complexities of public interest, risk

perceptions and resilience, can be generalized to other land-use planning functions in other similar small/mid-sized municipalities in Canada and beyond.

This dissertation focused on the sub-theme of municipal land-use planning role in disaster mitigation in the Province of Alberta following three costliest disasters that occurred between 2011 and 2016; namely: the 2013 Southern Alberta flood, the 2011 Slave Lake wildfire and 2016 Horse River wildfire. These disasters come at significant economic costs: for example, the estimated insurable cost of the 2016 Horse River wildfire alone was $3.7 billion. Additionally, Alberta municipalities face continued threat of droughts such as in 2015 when thirteen municipalities declared a state of agricultural disaster due to drought (Giovanetti, 2015; Ramsay, 2016). Drought risks are atypical in that the role of land-use in mitigating drought risk is often understudied (Fu & Tang, 2013; Fu et al., 2013; Schwab, 2013). However, examples exist such as in the State of California where advanced drought risk mitigation measures have been developed to mitigate severe drought risk impacts through land-use planning (Mann & Gleick, 2015). Therefore, the research study explored the nature of drought mitigation in Alberta land-use planning to evaluate existing drought mitigation policies using the example of Brazeau County, which experienced major drought in 2015, followed by excessive precipitation in 2016.

As stated previously, the purpose of the research wass to achieve a clear understanding of how small/mid-sized municipalities incorporate and adopt land-use planning to reduce future natural hazards. Since planning is a core function of a municipality, the research aimed to outline legislative or planning process improvements

to better support small/mid-sized municipalities given the severity and impact of extreme weather related to climate change.

The research adopted a qualitative approach to the research design and used methods such as key informant interviews, focus groups and document content analysis of municipal development plans and land-use bylaws. Data was collected between February 2017 and September 2017. The research aimed to meet four research objectives. First, the research conducted interviews with lead planners in the study sites and other knowledgeable experts, and a focus group with planning practitioners and other respondents from the four study areas regarding changes (if any) to land-use practice following major natural disasters that occurred between 2011 and 2016. Second, the study conducted a document review of municipal development plans, land-use bylaws, any technical policy documents such as wildfire mitigation strategies, in order to document the extent of the incorporation of hazard mitigation policies in the local planning process. The sample included the four municipalities noted earlier, as well as other similar sized municipalities that incorporated natural hazard mitigation policies in their local plans and bylaws. Third, data collection via interviews with lead planners in the four study sites and focus groups with other participants (emergency, insurance, and government staff), to explore the diversity in the understanding of building community resilience in the context of Alberta municipalities and from the participants' perspectives.

The research questions that guided this dissertation were:

1. What is the role of land-use planning in natural hazard mitigation in small and mid-sized Alberta municipalities? Moreover, why is land-use planning important in addressing natural hazards through disaster risk management?
    - What are the challenges facing small and mid-sized Alberta municipalities in utilizing land-use planning in natural hazard mitigation?
2. How can municipal statutory plans and policies address natural hazard risk reduction?
    - To what extent does federal, provincial and municipal legislation address the capacity of small/medium municipalities in hazard mitigation?
3. What is community resilience in the context of hazard mitigation?
    - What does resilience mean in small/mid-sized Alberta municipalities?
    - How do municipal plans influence pre-, and post-disaster community resilience?

A summary of the research findings is provided in the following section based on the results outlined in the three independent, and related papers in Chapters 2, 3 and 4.

5.2 Summary of the findings

Municipalities that experience a major disaster must make difficult decisions including the restoring critical infrastructure such as roads, power; the form and design of reconstruction structures; or whether the development should be rebuilt in a hazard-prone area. In most cases, such decisions are made at the local government level by elected officials with guidance from land-use planners and other experts. The resultant land-uses are often driven by resident choices and by the contribution of the development industry in meeting the rebuilding needs of communities.

In the Province of Alberta, local municipal autonomy over land-use decisions is a distinguishing factor compared to other provinces (Saskatchewan, Ontario or Quebec). Municipalities can decide how and whether to rebuild after a disaster with minimal or no interference from the provincial government. Local autonomy, in the absence of regulatory oversight, means local government decisions for land-use planning can either promote or erode disaster risk reduction and adaptation. Thus, the theoretical framework around *performativity* described in Chapter 4 and *public interest* described in Chapter 1, leads to unintended results and inconsistent outcomes. For instance, in the year of the 2016 wildfire, the RMWB repealed an important flood mitigation bylaw which removed stringent flood proofing thus allowing re-development of homes in a floodplain. The outcome of this decision was the rebuilding of a flood-prone community in the provincial mapped floodway.

On the other hand, the Town of Canmore incorporated a rigorous risk-based assessment approach for multiple hazards (wildfire, groundwater flood, steep mountain creek flooding) which is prevalent in the entire land-use planning process. In both the RMWB and Canmore examples, the public interest was driven by the council's knowledge about an acceptable level of risk, and the legislative/democratic power dynamics that affect planning praxis (Flyvbjerg, 2012). Local council priorities/perspectives about risks in the case of one community conflicted with technical planners' knowledge or advice from risk assessments. The dual hats worn by planners indicated a difference between 'planners as professional entities' versus 'planners as local government staff' which raises interesting predicaments regarding ethical obligations. The researcher heard interviewees offer statements such as "in my opinion as a professional planner maybe not so much as a

[municipal staff], is I would have preferred if…" It seemed that there were always two opinions depending on the perspective described by an interviewee.

Local decisions are made based on local plans and bylaws, as enabled in provincial legislation. Adopting new and amendment plans, and bylaws typically have a public participation process (such as public hearings, open houses, stakeholder committee groups). Additionally, there are appeal mechanisms to either local or provincial appeal boards when there is dissent about a particular decision. These local practices and appeal outcomes are reflective of *point-in-time* decisions which 'have regard to' but 'are not bound' by the local plans and bylaws; they also reflect a gap and opportunity for risk reduction. One of the fundamental shifts that would enhance disaster risk resilience in Alberta is to adopt a culture and practice of risk reduction, and risk management approaches through the entire planning process -from long range municipal development plans to land-use bylaws and appeal mechanisms- as well as provincial legislation, in order to advance adaptation and disaster risk reduction. How can this be achieved?

As a start, revisions of the 'nebulous and non-enforceable' Provincial Land-use Policies and their prevalence in Alberta's Land-use Framework Regional plans, must reflect modern discourse about climate change adaptation and disaster risk reduction measures with direction for both public land and private, municipal land (see Chapter 2). Another finding is that provincial departments that act as land developers must take the lead on risk reduction measures that avoid the construction of public infrastructure or buildings in flood-prone areas or the urban wildland urban interface. Lessons from the 2011 Slave Lake wildfires which damaged provincial infrastructure and provincial buildings

indicate that higher order governments should lead the way by implementing climate change and disaster risk reduction measures on Crown land (see Chapter 3).

Overall, the research participants value the role of land-use planning as a proactive non-structural means of reducing future impacts of natural hazards. Prevention includes the prohibition of new subdivisions and development in floodplains, or in the wildland-urban interface and adopting water conservation for municipal uses and individual households to mitigate drought risk. The disaster cost benefits data from the US suggest that federal governments can save "$6 in future disaster costs, for every $1 spent on hazard mitigation" (FEMA, 2017).

Nevertheless, the research found serious planning gaps that remain to be addressed: wildfire WUI mapping at the municipal level and the steep mountain creek flood risk also known as debris flow risk (see Chapter 3). First, compared to flood mapping where the province produces flood hazard maps, there are no equivalent mapping products for municipalities in the Wildland Urban Interface (WUI) at a neighbourhood or individual land parcel level. Whereas Canadian mapping of the WUI has made significant progress through Johnston and Flannigan (2018) WUI mapping, more detailed WUI risk maps are necessary for local government planning. The quantification of the WUI risk and the anticipated spending for wildfire risks has been identified as a gap by Canada's Parliamentary Budget Officer (Office of the Parliamentary Budget Officer, 2017). Studies that evaluate the exposure of existing developments to ignition such as Beverly, Bothwell, Conner and Herd (2010) study for Fox Creek, Slave Lake, Whitecourt, and Swan Hills,

need replication in other high risk Alberta WUI, with assistance and data from federal and provincial departments (such as Alberta Agriculture and Forestry).

Second, steep mountain creek debris flood is a chief concern for existing alluvial fan development along several creeks in Canmore. Engineering studies about the impact of a debris flood to the alluvial fan indicate severe risk of loss of life and damage and indicate vulnerable land-uses such as daycares, schools or hospitals (Holm et al., 2016; Jakob et al., 2017). An apparent inquiry was why development was allowed in the alluvial fan in the first place: the approval was traced back to a decision in the 1980s debated between two provincial government departments. In the end, development was allowed to occur to stimulate Canmore's economic growth through residential development which trumped the environmental and debris risk concerns of development in the alluvial fan at the base of Cougar Creek. The consequent problem for planners is that, once such a decision is made, it triggers resultant development and growth with permanence to development that "we are stuck with" years after approval. Relocation of a 1 billion dollar Cougar Creek alluvial fan development is impractical (Holm et al., 2016, p. 8). Therefore, a combination of structural measures such as the construction of the $48.6 million 65 meters high debris net upstream of the Cougar Creek (Government of Alberta, 2017) and non-structural measures such as restricting further intensification or new developments, are plausible approaches to manage the risk.

As discussed in *Chapter 2-Role of Land-use Planning in Hazard Mitigation,* municipalities in the study areas can and were using existing legislative authorities under the *Municipal Government Act* (MGA) for land-use planning to incorporate natural hazard

mitigation in plans and bylaws. In small/mid-sized communities, it is not unusual to have few or no land-use planners; but in all cases, a development authority is typically on municipal staff. The concern around "planning capacity" in small municipalities is two-fold: legislative versus human resource capacity. In all four study areas, *legislative planning capacity* was existent in that tools such as the land-use bylaw, statutory plans, engineering standards and other policies (both municipal and provincial) were used to reduce future loss and damage. In terms of *planning human resource capacity*, larger towns and specialized municipalities tended to have more professional planners, while in one of the study sites, one small town had no professional planners, but instead had development officers who were responsible for land-use development. This is not necessarily a problem because, in the small municipality, major statutory plan revisions and land-use bylaw re-writes were contracted to planning agencies or consulting firms, that have more considerable planning and analysis capacity for complex planning exercises.

If small municipalities lack operational funding for planning contracts, or where there are no professional planners, the responsibility for land-use planning or adaptation planning may fall on other municipal departments such as public works, or the Chief Administrative Officer. Higher order governments must ensure there are resources must support non-planners on how they can reduce disaster risks through local planning efforts through guidance documents, templates and funding support. In the Town of Slave Lake, the 2011 wildfire overwhelmed the planning capacity such that planners were brought in from the Province and other surrounding rural municipalities to assist in recovery and processing development permits. In RMWB, the 2016 wildfire was managed by a team of

fully-staffed Planning Department that had enough planners and development officers to process development permits in the aftermath of the 2016 wildfires.

Thus, lessons learned about climate adaptation, and disaster risk reduction measures can address planning capacity by including the various 'arms' of planning (professional planners, planning agencies and development officers) as well as other municipal administration, that serve small communities.

Participants identified four challenges: blame and mistrust of governments (when it is delayed, or lack of direction); community opposition to resilient actions post construction (such as the Waterways floodway community scenario); a lack of education or risk unawareness and vulnerability (particularly for flood hazards); and the effect of short memories on pursuing resilience, over time.

One specific planning challenge raised was how to incorporate land-use planning mitigation measures to reduce the risk of floods or wildfire risk in existing built up or significant historical downtown developments. Vast portions of the City of Calgary, the Town of Drumheller, and Fort McMurray's downtowns are located in the floodway as seen in provincial flood hazard maps. Total relocation or abandonment of such vast developed areas in the floodway is economicaly unfeasible. Incremental development decisions (such downtown/neighbourhood redevelopments or gradual retreat of high hazard areas) take time to transform fully. Existing developments require investment in both structural mitigation such as the $432 million Springbank Reservoir Dam for the Elbow River, as well as changes in land-use, building codes and insurance. Decisions must balance the

investments of existing owners while imposing limits for new developments in hazard areas.

The study found gaps in collaboration between emergency and land-use planning functions at the local government level. While distinct, and independent, the two disciplines must collaborate, or confer with each other, at a minimum, when preparing long-term plans. The legislation requires that Alberta communities must prepare a municipal emergency plan to outline how they would respond to disasters and must adopt a municipal development plan and a land-use bylaw, but it does not ask for collaboration in addressing mutual priorities to achieve hazard mitigation in the preparation of these statutory plans. Interagency collaboration between emergency management, disaster relief finance, insurance and sociological disciplines, together with land-use planning, is necessary to build community resilience cumulatively. Examples of interagency collaboration exist in the FireSmart wildfire program, therefore adopting such a discipline for flood risk, would advance the shift towards the prevention and mitigation phases of emergency management of which land-use planning is a part (Public Safety Canada, 2002).

Concerning the wildfire disasters in 2011 and 2016, the research found that municipalities were using programs such as the FireSmart wildfire program to educate residents on measures that they can undertake to reduce the wildfire risk to their properties. Municipalities relied on Wildfire Preparedness Guides, and Wildfire Mitigation Strategies prepared wildfire specialists to understand wildfire behaviour and potential high-risk infrastructure at risk within their municipalities. Slave Lake and the RMWB, use the recommendations in these technical studies to make changes to their long-range municipal

development plans, land-use bylaws, and in the RMWB's case, the engineering servicing standards.

It was especially noteworthy that in the case of Slave Lake, there were reports that residents were not aware of wildfire risk in their community before the 2011 wildfire. Interviewees with historical knowledge remembered how the community had experienced 'close calls' in the past which never entered the community. The issue of concern is that with the passage of time, memory and risk awareness tend to fade. It is up to municipalities, to keep the risk communication front and centre every wildfire season, to ensure residents understand the risk and what each stakeholder's responsibility is to reduce that risk.

Land-use planners do not need to be experts in wildfire behaviour, vegetation management or fire suppression, but they do need to understand how their decisions in reviewing and approving development or subdivision applications can advance resiliency through wildfire reduction measures. This includes landscaping choices, setbacks from the WUI using environmental reserve buffers and incorporating conservation requirements. Planners talked about the need to 'educate residents' about wildfire vulnerability and FireSmart program; they also highlighted the importance of parcel-specific wildfire risk assessment as part of the subdivision and development process.

The most significant gap found and cited by both planners and other experts was the need to have regulatory guidance for managing flood risks in the province. The lack of regulatory clarity about the types of land-uses allowed or not allowed in a floodway, for example, can lead to increases in vulnerable new residential subdivisions, or provincially-funded infrastructure or facilities such as public schools or provincial hospitals

(Groeneveld, 2006, p. 11). Following the 2016 wildfires, planners raised concerns regarding increased construction costs which became a barrier to landowners to build resiliently. Since the economic climate before the disaster was unfavourable (for example RMWB was facing economic challenges before the 2016 wildfire), the increased cost of construction became a detriment to homeowners to build back better. Financial incentives such as rebate programs or grants, should be explored to support resilient actions.

Contrary to literature about the underutilization of land-use planning as explained in Chapter 3 *Risk Management Approaches In Land-use Planning And Natural Hazard Mitigation*, the document analysis of local plans and bylaws revealed that municipalities were referencing risk assessment methodology to guide decision-making. Municipalities control or impose conditions through local land-use bylaws at the subdivision or development permit phase of land development by requiring applicants to provide flood risk, wildfire risk assessments, or water conservation plans, prepared by professional engineers, architects or landscape architects.

Similar to chapter 2, the research concluded that a rigorous risk management approach to planning requires clear legislative or regulatory guidance from higher orders of government (Intergovernmental Panel on Climate Change, 2014, p. 1473). In the sample bylaws and MDPs of the communities studied, wildfire risk was noted to have advanced guidance through the FireSmart and wildfire risk strategy, whereas drought risks on private land were had minimal guidance from regional plans and or provincial land-use policies. The results indicate that flood risks policies are evident in municipal documents. Municipalities continued to reference the provincial flood hazard maps to identify the

subdivision or development requirements for the floodway and floodplain areas. However, flood hazard requirements in land-use bylaws were not always consistently applied, e.g., not all municipalities developed policies for the flood hazard areas.

Finally, the findings of the resilience paradigm were outlined in *Chapter 4 -A Commentary On Building Community Resilience: Perspectives From Planners In Recent Natural Disasters.* The term resilience is prevalent in Alberta's emergency management system and is a term that requires shared understanding by all stakeholders in the disaster management cycle. Planners and other experts noted that stakeholders, residents and decision-makers need to clarify the different meanings of resilience earlier in any post-disaster discussion. Resilience to a recovery specialist might be to build back better so that no additional funding costs are incurred in future, while resilience to a small community might mean rebuilding damaged homes so that a community can go 'back to normal' even if located in the same high-hazard areas. Planners and experts noted several characteristics and meanings of resilience such as the need for strong leadership, robust public engagement, interdisciplinary collaboration and the need for planning practice to advocate for and promote disaster resiliency. They also commented on how building community resilience requires strong leadership in decision-making such as the decisions made in Canmore after the 2013 flood, to save the community from further flood damage. Planners voiced the importance of local and provincial governments to make difficult redevelopment decisions if they choose to build back better, following natural disasters.

Transformational resilience, as discussed in Chapter 4, however, cannot be achieved by one agency alone (a local council or planning department). Participants reflected on the

importance of regular public engagement processes to promote cumulative and progressive actions in reducing disaster risk (Bogdan, Bennett, & Yumagulova, 2018). The study found that planners must collaborate with emergency management, professional engineers, and climatologists, in order to understand and communicate existing hazard risks and vulnerability to a community. The Town of Canmore, for instance, shows promising trajectories of how a municipality can incorporate risk in decision-making.

In addition to stronger regulatory guidance and adoption of risk-based approaches in land-use planning, the research found that planners are, and can by necessity, become an ardent advocate for disaster risk reduction. Honest discussions with residents can unveil common grounds to resolve redevelopment concerns in hazard-prone areas early. This intentionality of planning purpose is a proactive step in building community resilience. An innovative participatory approach to hazard mitigation, such as participatory GIS, or Citizen Science, are examples of what planners can implement to promote long term hazard awareness and build resilience against natural hazards (Gharaibeh et al., 2019; Hendricks et al., 2018).

5.3 Policy recommendations and implications for planning practice

Adopting land-use planning as a mitigation measure faces several challenges since "few local governments, however, are willing to adopt land-use measures to protect against natural hazards unless they receive strong mandates from a higher level government" (Board on Natural Disasters, 1999, p. 1945). The study proposes three policy implications for the advancement of disaster risk reduction and mitigation in land-use planning practice.

All levels of government must demonstrate strong leadership to protect public safety to ensure that future disaster to avoid increasing exposure and cost of major disasters. As outline earlier, the normative expectation of "good governance" including inspired political leadership; public accountability; transparency and the right to information; inclusiveness; responsiveness and non-violent conflict management (Friedmann, 2012, pp. 99–100), offer useful clues for how to manage future hazards. The federal government can continue to be responsive by the provision if disaster financial assistance payments or to support structural mitigation grants through the Public Safety Canada. Additionally, federal governments can take a lead role in the development of national resilience strategies such as the UK's national adaptation plan is an essential step to show leadership (Government of the United Kingdom, 2018, pp. iv–v). Resiliency principles and subsequent implementation frameworks should give planners clear direction which planners can in turn practically incorporate in land-use plan development and development approval processes in hazard-prone areas. For example, clarity concerning wildfire mitigation on private land is required; specifically, strengthening the legislative discipline by integrating wildfire as a development constraint in planning legislation. Examples to draw on include Ontario's legislation for planning which has a clear policy statement about not locating new development in the WUI, and if development must occur, the policy states that mitigation measures must be included through fire-resistant building materials and buffers from the forest edge (Ontario Municipal Affairs and Housing, 2014).

As climate change impacts increase in the future, planners in Alberta's and other Provinces and Territories, small and mid-sized communities must consider how to be resilient against natural hazards. In addition to land-use plans and bylaws, municipalities

and planners must advocate and develop climate change adaptation plans using existing guidelines prepared by the Canadian Institute of Planners (Bowron & Davidson, 2011) or the Federation of Canadian Municipalities. These adaptation plans should include disaster risk reduction components in the adaptation plan with clear implementation requirements for local planning decisions. The study also recommends that Alberta create a new class of statutory plan called a hazard mitigation plan at the municipal level similar to the existing practice in the United States. Federal funding for such as Infrastructure Canada's *Disaster Mitigation and Adaptation Fund* should broaden the scope of eligible projects to include non-structural mitigation, to fund the development of hazard mitigation plans. These plans should be revised every five years to maintain relevancy and currency.

An uncomfortable construct that requires further refinement is a planner's ethical obligations in natural hazard planning. Should a planner who approves a new development in a high-hazard area be failing in their ethical obligations to residents? To voice dissent contrary to a decision-makers' direction can jeopardize a planners employment. In such a case, a planner may step into an advocacy role in disaster risk reduction to overcome the *planners occulta silentio* ('hidden silence' in Latin). It is important to lean on professional land-use planners, or other disciplines, in academia who can use their individual academic liberties to give voice to these hidden silences. Further refinement in planning theory can reveal how the unheard perspectives of planners can be overturned.

In summary, the main recommendations specific to the research study area:

Provincial government

1. Enshrine creation of mandatory municipal climate adaptation plans (similar to Edmonton and Calgary) for all municipalities, using existing federal and academic resources.
2. Enable a new class of statutory local hazard mitigation plans specific to each municipality's hazard vulnerability; the plans can be stand-alone or integrated into municipal development plans, with a robust public engagement process.
3. Update provincial land-use policies to prohibit new subdivisions in hazard-prone areas through setbacks from wildland-urban interface areas, riverine or wetlands areas
4. Strengthen subdivision and development rules in land-use bylaws through mandatory requirements to reference Alberta provincial flood hazard maps and conduct wildfire, flood, or drought risk assessments, for subdivision and development applications

Municipal governments

5. Conduct 'all-hazards' risk assessment to determine vulnerable infrastructure or assets and develop plans to mitigate risks locally..
6. Build planning practice and knowledge on climate change adaptation and mitigation, and disaster risk management, and their interaction in land use planning.
7. Promote hazard risk communication to create awareness through ongoing public engagement, scenario mapping or visualization engagement tools.

Residents

8. Use existing resources to prepare for emergencies and to prepare homes, businesses or other land-uses by investing in mitigation measures such as flood proofing, FireSmart implementation or water conservation measures to reduce drought risk.
9. Advocate higher order governments for investment in both structural and non-structural mitigation measures to protect communities.

Academia

10. Advocate and advance scholarship about land-use planning as a cost-reductive disaster risk reduction and adaptation measure to legitimize the discipline in a warmer climate.

5.4 Original contribution and significance

This research contributes to the body of knowledge in the following three ways. First it expounds on the role and value of land-use planning as a non-structural mitigation measure in the broader climate change adaptation and disaster risk reduction discourse. Second, the study highlights the critical challenges of advancing resilient actions in local land use planning due to conflicting and multiple public interests, governance, and policy vacuums. Third, the study is unique in that it analyzed how risk management approaches to managing multiple hazards (floods, wildfires and drought) are currently being applied in municipalities and offers recommendations on how to further strengthen such an appoach in planning praxis.

This study is timely as communities grapple with the impacts of increasingly severe and unprecendented disasters due to floods, wildfires and droughts. The findings demonstrate land-use planning can be an effective mitigation measure when governance

and regulatory frameworks enable long-term resilience of communities. Limitations such as governments desire to make decisions in the public interest will continue to be debated if local governments decisions contradict the advise planners provide. Significant challenges and gaps remain in the future of land-use planning and municipal decision-making such as understanding public risk perceptions and the affective reasons or motivations that influence decision-makers to allow development in hazard-prone areas. While small municipalities are vulnerable to extreme weather as exacerbated by climate change, and have limited fiscal, adaptation and resource capacity, the research finds that there is a capacity to implement sound planning decisions (using a risk-management approach) by leveraging planning and legislative tools to protect lives and property.

The findings of this research will benefit other small and mid-sized municipalities in Canada and beyond, that desire to utilize land-use planning as a core measure in disaster risk reduction and adaptation planning. Policy makers will gain better understanding of the difficulties facing planning, and more importantly, how to strengthen and support the resiliency of communities against natural hazards. Therefore, the study makes several key recommendations to other similar small and mid-sized jurisdictions beyond the study sites:

- Local governments, as well as higher order of government, must demonstrate leadership to protect public safety by stringent land use policies that prohibit the location of new population settlements in hazard-prone areas such as floodplains or wildland urban interface areas.
- Where feasible, local governments must utilize both structural and non-structural measures to protect lives and property for existing developments

that are already located in a hazard-prone areas (avoidance, building codes, and insurance, including government-backed insurance).

- Higher orders of governments or agencies must provide financial and technical resources to support the capacity of small municipalities to prepare climate adaptation plans and consider developing local hazard plans to complement municipal development plans (official community plans).
- Land use planners must prioritize risk awareness about vulnerable hazards in their communities by innovative risk communication and public engagement with the sober recognition that competing resident and public interests may not always agree or align with their recommendations and, lastly,
- Planners should engage with, and rely on professional geotechnical engineers, hydrologists and climatologists to understand how a warming climate will impact their communities, and then make recommendations to decision-makers on how to mitigate risks when determining the suitability of developments proposed in or near hazard-prone areas.

The study concludes that legislative or regulatory means are the most effective and proactive tools for implementing local land use planning, especially in light of the challenge of most small and medium sized communities to invest in adaptation planning or in retaining professional planners. Any legislative conflicts that hinder municipal plans or by-laws must be resolved to ensure coherent alignment of hazard mitigation policies. Planners must continue to advocate and promote greater awareness about hazard risks within their communities, and realize that the planning discipline has a unique and crucial contribution in disaster prevention and mitigation.

5.5 Limitations

This research focused on hydro-metereological natural hazards (i.e., floods, wildfires, and droughts) and steered away from disputes on whether they were natural or human-caused. Regardless of the cause, the impact of any disaster affects people and land-use planning that exposed them to be impacted (such as homes or businesses damaged). As explained in Chapter 1, the research acknowledged and excluded the impacts of other chemical, economic, biological or radiological disasters. The research study areas excluded large urban centers such as Edmonton and Calgary due to their financial, planning and resilience capacity for adaptation and mitigation. Land-use planning in Indigenous communities was omitted because Alberta's planning framework for municipalities does not apply to federal Indigenous jurisdictions.

Another limitation is that the sample size of participants was based on the study areas. Interviewees were mainly from the four municipalities that had major disasters. The purpose of the research was not to determine the quality of the plans, instead, it was an assessment of whether or not land-use planning documents and bylaws integrate hazard mitigation policies.

Demographic or vulnerability analysis of Alberta's significant disasters was not part of the study objective. The study acknowledges that societal and cultural factors such as social capital, transportation mobilities, demographic, intercultural/social dependencies, and environmental factors, are important matters in the discourse on disaster risk management.

Lastly, the research did not have as its objective to evaluate the actual outcomes (number of subdivision or development applications approved or reasons why they were approved) based on the hazard mitigation policies included in the land-use bylaw or plans in the communities. The study is an initial scholarly 'scoping' of the use of land-use planning in hazard mitigation. As described in the next section, a future positivist study is necessary to identify and quantify actual progress, if any, of hazard mitigation planning for these disasters.

5.6 Further research

It is not uncommon to find land-use bylaws that are generically-crafted, or whose land-use bylaw requirement provides broad discretionary powers to development authorities, that would enable development in a hazard-prone area. Immediate research would be to analyze the number of approved or denied subdivision or development applications in hazard-prone areas based on the hazard mitigation policies included in a land-use bylaw for one of the communities that experienced a flood or wildfire. For example, how many developments were approved or denied, and constructed, in a flood or wild-land urban interface area, based on the land-use bylaw provisions, and why? What led to the final outcome and what level were they approved or denied (e.g., councils, planners, subdivision or development authorities or appeal boards?) This research would require access to development and building permit data, risk assessment studies and updated flood and wildfire risk mapping. The outcomes of such work can help analyze whether natural hazard mitigation requirements in land-use plans and bylaws is implemented in practice. Interdisciplinary studies can advance this research such as land-use planning linkages to

climate resiliency changes to National Building Codes and the role of insurance as other non-structural measures.

The literature identifies that the most vulnerable populations to natural disasters are those located in low-lying delta/coastal cities (Steinberg & Shields, 2008, pp. 78–93), coastal cities, forest-based communities in northern climates and highly populated urban centers (Baker, 2012; Davidson, Williamson, & Parkins, 2003). Small islands-states and developing countries are also at the highest risk (Pirani et al., 2018, pp. 12, B.6.2). According to the Canadian Red Cross, high-risk populations such as seniors, children, new immigrants, persons with disabilities and Indigenous communities are most vulnerable to natural disasters, and as such, the focus of non-structural mitigation measures should be to reduce impacts of climate change to these populations (Enarson & Walsh, 2007, p. 25). Disaster vulnerability and social impacts for the study sites would, therefore, contribute to the knowledge about how Alberta's disasters affected vulnerable populations. For instance, a mixed method study to measure the economic impacts of disasters to the residential housing sector would be beneficial, e.g., how do residential property values change, before, during and after a natural hazard?

In addition, international comparative perspectives of planning and disaster risk reduction in fast-growing regions (Awumbila, 2017; Bhavani, Vordzorgbe, Owor, & Bousquet, 2008; Igwe, 2018; Rumbach & Follingstad, 2018) can broaden the conversation about the role of land-use planning in adaptation and disaster risk reduction in a global context. Comparative demographic and vulnerability studies between developing or developed world would be fascinating to explore because of three reasons. Natural disasters

are presently viewed as a consequence of changing environments; locations with low literacy levels may not appreciate the risk exposure; and there is a perception in developed countries that engineering solutions can eliminate all risks (Vilimek & Spilkova, 2009, p. 336).

In Alberta's most recent disasters, there were no fatalities in the 2011 Slave Lake wildfires, one fatality in 2016 RMWB wildfires, and five fatalities from the 2013 southern Alberta floods. The economic impact and damage to critical infrastructure, however, was unprecedented. Disasters unfavourably lead to increased fatalities when low-income populations settle in densely populated urban centers in neighbourhoods or squatter settlements that are located in floodplains, by riverine areas or below mountain slopes (Igwe, 2018; Mal, Singh, Huggel, & Grover, 2018). It would be interesting to evaluate whether historically major floods in Canada have affected wealthy, mature or low-income neighbourhoods and the number of fatalities.

5.7 A Note on the Failure, but not the Failure of Land-use Planning, in Natural Hazard Mitigation

Every day, humans interact with land-use planning in one way or another: location of our homes, schools or workplaces; the daily use of running water, electricity or wastewater or sewage drains, to the sidewalks and roads for daily commutes. All these events or infrastructure are the result of decisions and choices made by individuals (walk, bike, or ride transit); by groups (families, ethnic groups); collectively by developers (low or high residential density developments); or by professionals (engineers, land-use planners, transportation experts). Planners have an essential role in managing where a community should develop in the long term, and determine the future layout of residential

homes, roads, schools and public utility systems. Planners must consider geographic or physical constraints such as valleys, bodies of water, and adjacent land-uses when determining possible settlements patterns. Therefore, the role of land-use planning is to manage the land as a natural resource efficiently and equitably. Planners do so by liaising and engaging with residents and local groups through public consultations, and then use that to develop policies and plans.

The characterization of land-use planning as "bad planning" (McMahon, 2018) or as "poorly planned," "inadequate," and "weak," (UNISDR, 2015a); suggests critical deficiencies in managing hazard in the planning process. However, planners do not, and cannot make decisions on land-use. The normative depiction of a "failure" in land-use planning, when developments proliferate in hazard areas, is not necessarily attributable to the planning profession. As literature has noted (Flyvbjerg, 2012; Lauria & Long, 2017; Lyles et al., 2014) a planner's role is to provide decision-makers with evidence- or factual-based recommendations/options and to offer advice to decision-makers. Ultimately, all land-use planning decisions are made by elected officials who adopt plans or bylaws, using their democratic enablement. While it is accurate that developments are and continue to be located in flood-hazard areas or in the wildland urban interface, the dynamics around property development, developer interest and local (public) interest as held by politicians, mean that development may, in fact, continue to proliferate, posing lives and properties at risk.

Subsequently, the research findings exonerate the planning profession from the view that land-use planning has failed to protect communities from natural hazards. Results from

the research were clear: elected officials meet the public interest by making decisions on whether to build or not build in a natural hazard area. Once elected officials provide the overall direction (through the adoption of municipal development plans or land-use bylaws and zoning), planners have little choice but to *toe the line* and approve new subdivisions and developments in high-risk hazardous areas. A planner's role consequently is advisory, mediatory and perhaps conciliatory, with the most significant impact being *before* decisions are made. Land-use planners must make an effort through public engagement and constant communication, to understand why developers or landowners want to develop in high-risk flood hazard areas, why elected officials decide to approve them, and why residents choose to build homes. Given the significant rising economic costs of natural hazards, elected officials, on the sound advice of planners or emergency management staff, should and could, do more to protect life and damage to property resulting from disasters.

In this research, a story surfaced about a resident in a town hall meeting who after hearing a presentation about structural and non-structural options for flood mitigation in the community, asked an elected official, "can you guarantee me 100% that this type of hazard will never happen again, and that any future work will not affect my property?" Another story shared publicly was from a family in the 2013 flood-ravaged Town of High River who on the day before the flood wrote:

> "It was raining, that fresh smelling rain that makes you open your windows and take a deep breath. We left our bedroom window open that night and fell asleep to the soothing sound. There was no flood watch in effect, and we had no reason to worry anything bad was on its way. In a town that sees minor flooding almost every June and saw a flood watch a couple of weeks prior, we felt we had made it through our very first High River flood season unscathed, as was expected.

> We bought our dream home several months earlier in Hampton Hills in the far S.E. where we were told repeatedly by anyone and everyone, it never has nor will ever flood" (Tymchyna, 2013, pt. Day-1).

A few things come to bear from these two narratives: the idea of absolute risk protection or elimination is a misconception. The scale of the events Alberta experienced in 2011, 2013 and 2016 were unprecedented, and while millions of dollars have been invested in capital projects such as the $432 million Springbank dam reservoir, there is a likelihood of much larger, more disastrous events. The flood design standard in Alberta, for example, is the 1% chance of a flood, and the structural measures are designed to withstand another 2013 flood level, but what would happen if a larger 1:200 or 1:500 flood event were to occur? More significant events can exceed the capacity of the 'protections' built and would not be adequately accord residents such as the ones noted earlier, guaranteed absolute protection. Another observation which is beyond land-use planning; but must be stated, is the requirement for home buyers to conduct due diligence to investigate whether their property is subject or vulnerable to flood or wildfire risks, and to use credible sources such as government agencies or mapping and risk models, about the risk prior to making a decision. In the first example of the blogger, homes sat in sewage for several weeks. Berms that surrounded their neighbourhood contained sewage water, and the Town, pumped water there to save the rest of the town from further flood damage.

Rather than look at why development was allowed in the past, the research goal was to focus on future land-use planning to address the problem of flooding such communities. Long before a home is built, there was an approval of a development permit based on a land-use bylaw, there was an approved subdivision plan for the neighbourhood, and often, there was a long term development plan. In this cycle, the only real influence a planner can

strategically have is at the beginning: when undeveloped or 'greenfield' development is under contemplation, and using existing tools to determine the suitability of land-uses to flood or wildfire hazards. Once a home is built, there is generally a permanence to development that takes several decades, which then allows residents to be rooted in a community, social ties or livelihoods or to have place attachment.

Geographers, planners and other social scientists have debated on the role of memory, sense of place and placemaking (see Dale et al. (2012, p.55) for theoretical concepts). Why do residents, following a natural disaster, bring to memory the mountain, dense forest, or river views, when justifying the rebuilding of aesthetically pleasing areas which are prone to hazards? The concept of sense of place or place attachment theory is a plausible answer. Place attachment is "the emotional bond between people and the environment"; it refers to the interdependence between people with "other aspects of place—for example, geographical and cultural qualities, relative rootedness in place, degree of personal and social involvement, quality of life, environmental aesthetics, individual and group identity with place" (Devine-Wright & Manzo, 2013, p. 12). Accordingly, place attachment describes the affective responses of humans or society as a whole have through deep-rooted connection to an object or to a community (Dale, Dushenko, & Robinson, 2012, p. 55). However, the permanence of structures is somewhat mainly temporal as more extreme weather events and disasters occur as evidence in recent wildfires in California and British Columbia.

A classic example about the social construction and meaning of disaster is in New Orleans, Louisiana after Hurricane Katrina. One of the first works about New Orleans post-

Katrina was in a Special Issue of *Space and Culture Journal*. In the book, *What is a City? Rethinking the Urban After Hurricane Katrina* (Steinberg & Shields, 2008), the chapter about "Repair and the Scaffold of Memory" (Spelman, 2008, p. 145) demonstrates residents accounts of reflexivity about memory and place attachment. Residents hope to restore similar affective, rootedness connections, which influences their decisions post-disaster choices. Therefore, planners, by necessity, must understand how historical developments of communities, rightly or wrongly, influence the resident's sense of place, and memory, and how to navigate these attitudes or perceptions, in post-disaster reconstruction and rebuilding. Perhaps this helps explain why residents pressurize municipalities to allow them to rebuild their homes even in high-risk areas. Could it be that land-use planners are not reconciling residents need to "scaffold memory" to re-connect and re-build a property in high hazard areas due to affective or place attachment reasons?

If that is the case, then what would land-use planning provide as an alternative to retain the sense of place while advancing public safety considerations outside harm's way? A few examples could include historic preservation planning and recognition of an existing community through commemorative urban design features including plaques, memorials, or monuments, while not necessarily rebuilding in hazard lands (M. E. Alexander, 2010, p. 9-13). Also, in a highly emotional public engagement sphere, as outlined earlier, planners must ensure that how risk communication occurs during public engagement for post-disaster options, is accurate and meaningful (Bogdan et al., 2018). Lessons from the public health sector about an effective crisis and risk communication can be valuable for planners when handling difficult post-disaster options discussions during public engagements (Covello, 2003; Hyer & Covello, 2017).

The future challenge facing the planning discipline and local governments is daunting given more frequent and natural disasters. The southern Alberta floods, Slave Lake and "the Beast" wildfires, are grim realities about the inability to entirely avoid disasters. The realities of past and present decisions reveal the difficulties of mitigation of human settlements in high hazard risk areas. Therefore, this is neither a failure nor weakness of land-use planning. It is a combination of risk tolerances, local decision-making and individual choices that drive development in valuable, yet high hazard areas. Communities that intend to be more climate adaptive in the future will only achieve this if, or until, governance structures make firm decisions to mitigate against natural hazard risks by implementing both structural and non-structural mitigation measures while striving to attain a shared vision of a resilient community.

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APPENDICES

Appendix A: Information Letter and Consent Form for Focus Group

Integrative Land-use Planning and Natural Hazard Mitigation in Small Municipalities
Lynne Mbajiorgu (Principal Investigator), Department of Earth and Atmospheric Sciences, University of Alberta

You are invited to participate in a focus group as part of my research project on the role of land-use planning in natural hazard adaptation and mitigation planning in small Alberta municipalities. The focus group will be held on February 22, 20,17 from 9-12pm at the University of Alberta, Tory Building, Planning Studio Room 3-57.

I ask you to be in this study because have expertise as a land-use planner, development officer, emergency operations personnel, government official or insurance provider, and can contribute to the discussion on how small municipalities can address natural hazards mitigation in their land-use planning policies and planning documents. The study specifically focuses on the long term recovery plans from Alberta municipalities that experienced natural disasters between 2011 and 2015. Specifically, the 2011 Slave Lake wildfires, the 2013 Southern Alberta floods-particularly the Town of Canmore- or the 2015 County of Wetaskiwin drought. Your participation will help in better understanding the long term actions taken by municipalities to prevent losses and damage as a result of future natural disasters.

The purpose of the focus group is to bring together the perspectives of participants from various disciplines on how land-use planning decisions can improve the resilience of communities. Your participation will be limited to your professional experiences and not necessarily your organization's position or affiliation. Name cards will not be used, nor required during the focus group. To safeguard your confidentiality, data will be aggregated to the various themes which will be largely technical e.g. building code materials to safeguard against wildfire risks, or contents of Hazard Impact Assessments, how land-use bylaws can address natural hazards etc.

I also hope that you will benefit from hearing the perspectives of others involved in natural hazard mitigation and that you will have an opportunity to reflect on successes that can be achieved by small municipalities to address future natural events. There is minimal risk to you by participating, other than potential feelings of stress when recalling the natural disaster event and the associated challenges during the response and recovery phases of the disaster planning cycle. These phases are not the main focus of the research; rather, the focus is on prevention and mitigation phases. The risks of participating will be no greater than those encountered in everyday life.

Participation in this research is *completely voluntary*. I will conduct the focus group as part of my PhD research. The focus group will be a half-day session with twelve participants. I will facilitate the discussion and will have three students assisting in note-taking during small table discussions. I will ask about how land-use plans changed or did not change in the 2011 Slave Lake wildfires, the 2013 Southern Alberta floods in the Town of Canmore or the 2015 County of Wetaskiwin drought. The focus group will be held in at the University of Alberta in Edmonton. *If you do not feel comfortable* responding to particular questions during the focus group, please let me know during the sessions.

I will be taking written notes on flip-chart paper and on a laptop. Your identity will be protected by changing names and other identifying information in all records and documents and by aggregating data. If you are interested, I will send a *What I Heard* document of the focus group for you to review (as indicated below). Any written notes or documents from this focus group will be kept on a password-secure computer and in a locked filing cabinet in my office. Access to data will be limited

to me and my two academic co-supervisors. If transcribers are hired, they will sign an agreement to keep your information confidential and secure. Identifiers will be destroyed following completion of this research (expected in Fall 2018) in a way that ensures privacy and confidentiality.

You have the right to withdraw from the research project without providing a reason and without consequences. If you decide you want some part or your entire participation withdrawn from the study, please contact me by May 31, 2017. The information collected during the focus group will be used by me for the dissertation, research articles, presentations, and teaching. The data may also be used in future research, but if this is the case, it will have to be approved by a Research Ethics Board.

If you have questions or concerns about the focus group or the research project as a whole, please ask at the time of the focus group sessions, or contact me at (780) 862-7940 or Lnmbajio@ualberta.ca. My academic supervisor, Dr. Sandeep Agrawal can also be contacted at or (780) 492-1230.

The plan for this study has been reviewed for its adherence to ethical guidelines and approved by Research Ethics Board 1 at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

Consent

By signing below, I indicate that I have read and understood the above information, and that I consent to participate in this research project. I have had an opportunity to ask questions about the research. I understand that I can choose not to answer any or all of the questions that are asked and can stop the focus group or withdraw from the research. I consent to the researcher using the results of the focus group discussions for the purposes specified above.

_____ _____

Focus Group Participant Name Signature Date

Please initial below for any items to which you agree:

_____I would like a copy of a report summarizing the findings of the focus group session ***OR***

_____I do not want a copy of a report summarizing the findings of the focus group session ***(Initial only one).***

If you would like further information on documents produced from research findings (e.g. publications), please contact me at Lnmbajio@ualberta.ca.

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Appendix B: Information Letter and Consent Form for Interviews

Integrative Land-use Planning and Natural Hazard Mitigation in Small Municipalities
Lynne Mbajiorgu (Principal Investigator), Department of Earth and Atmospheric Sciences, University of Alberta

You are invited to participate in my research project on the role of land-use planning in hazard adaptation and mitigation planning in small Alberta municipalities. This interview is part of my research project on how small municipalities address or respond to long-term planning after natural disasters in their land-use plans and polices.

I ask you to be in this study because you may have been involved as a land-use planner, development officer, emergency operations personnel or government official in the natural disasters that occurred in Alberta between 2011 and 2015. Specifically, the 2011 Slave Lake wildfires, the 2013 Southern Alberta floods-particularly the Town of Canmore- or the 2015 County of Wetaskiwin drought. Your participation in this project will help in better understanding the long term actions taken by municipalities to prevent losses and damage as a result of future natural disasters. The study will look at how recovery land-use plans change or did not change following the natural disasters. And what may have influenced the proactive steps by the municipality in increasing their resiliency. This study aims to benefit those involved in the plans and policies making at the municipal level through contributing and accessing the research findings.

I also hope that you will benefit from the research by reflecting on the successes you have achieved collectively or individually in addressing the natural event that impacted your community. There is minimal risk to you by participating, other than potential feelings of stress when recalling the natural disaster event and the associated challenges during the response and recovery phases of the disaster planning cycle. These phases are not the main focus of the research; rather, the focus is on prevention and mitigation phases. The risks of participating will be no greater than those encountered in everyday life.

Participation in this research is *completely voluntary*. I will conduct the interview as part of my PhD research. The interview will be semi-formal (conversational) and will probably take 40-45 minutes. I will ask about your involvement in the 2011 Slave Lake wildfires, the 2013 Southern Alberta floods-particularly the Town of Canmore- or the 2015 County of Wetaskiwin drought. The interview can take place at a time and location of your choosing. *If you do not feel comfortable* responding to particular questions during the interview, please simply indicate this during our interview.

I would like to *audio record* the interview in order to make sure I do not miss or misunderstand what you say, but will only do so if you give permission. I will also take some written notes. Your identity will be protected by changing names and other identifying information in all records and documents and by aggregating data. If you want to be identified (i.e., have your real name used) in publications, please indicate below. If you are interested, I will send a typed transcript of the interview for you to review (as indicated below). Audio recordings and any written notes or documents from this interview will be kept on a password-secure computer and in a locked filing cabinet in my office. Access to data will be limited to me and my two academic co-supervisors. If transcribers are hired, they will sign an agreement to keep your information confidential and secure. Identifiers will be destroyed following completion of this research (expected in Fall 2018) in a way that ensures privacy and confidentiality.

The interview process will begin in October 2016 and is expected to be completed in May 2017. You have the right to withdraw from the research project without providing a reason and without consequences. If you decide you want some part or your entire interview withdrawn from the study, please contact me by May 31, 2017. The information collected during interviews will be used by me for the dissertation, research articles, presentations, and teaching. The data may also be used in future research, but if this is the case, it will have to be approved by a Research Ethics Board.

If you have questions or concerns about the interview or the research project as a whole, please ask at the time of the interview, or contact me at (780) 862-7940 or Lnmbajio@ualberta.ca. My academic supervisor, Dr. Sandeep Agrawal sagrawal@ualberta.ca, (780) 492-1230 can also be contacted.

The plan for this study has been reviewed for its adherence to ethical guidelines and approved by Research Ethics Board 1 at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

Consent

By signing below, I indicate that I have read and understood the above information, and that I consent to participate in this research project. I have had an opportunity to ask questions about the research. I understand that I can choose not to answer any or all of the questions that are asked and can stop the interviews or withdraw from the research. I consent to the researcher using the results of my interview for the purposes specified above.

_____	_____	_____
Interviewee's Name	Interviewee's Signature	Date

Please initial below for any items to which you agree:

_____I consent to the interview being audio recorded ***OR*** _____I do NOT consent to audio recording and would prefer that the researcher only took hand written notes ***(Initial only one).***

_____ I would like for my name and identity to be used in this research project, and give permission to do so.

_____I do not want to review my transcripts ***OR*** _____ I would like to review my transcripts ***(Initial only one).***

_____I would like a copy of a report summarizing the findings of this research.

If you would like further information on documents produced from research findings (e.g. publications), please contact me at Lnmbajio@ualberta.ca.

Name of Interviewer _____

Signature of Interviewer _____Date_____

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Appendix C: List of Alberta municipalities for document analysis

Natural hazard type	Municipality	Type of municipality	Population (2017 federal or municipal census)
Floods (N=20)	City of Calgary	City	1,246,337
	Regional Municipality of Wood Buffalo	Specialized municipality	114,673
	City of St. Albert	City	65,589
	City of Medicine Hat	City	63,260
	Town of Cochrane	Town	26,320
	City of Red Deer	City	19,541
	City of Camrose	City	18,742
	Town of Canmore	Town	13,992
	Town of High River	Town	13,584
	Town of Whitecourt	Town	10,204
	Town of Drumheller	Town	7,982
	Town of Ponoka	Town	7,229
	Town of Slave Lake	Town	6,651
	Town of Red Cliff	Town	5,600
	Town of Pincher Creek	Town	3,642
	Town of Cardston	Town	3,585
	Fort McLeod	Town	2,967
	MD of Lesser Slave Lake No. 124	Municipal District	2,803
	Town of Black Diamond	Town	2,700
	Town of Turner Valley	Town	2,559
Wildfire (N=15)	Regional Municipality of Wood Buffalo	Specialized municipality	114,673
	Town of Cochrane	Town	26,320
	City of Red Deer	City	19,541
	Town of Canmore	Town	13,992
	Town of Whitecourt	Town	10,204
	Town of Hinton	Town	9,882
	Lac la Biche County	County	9,531
	Town of Banff	Town	8,875
	Town of Slave Lake	Town	6,651
	Town of Rocky Mountain House	Town	6,635
	Town of High Level	Town	3,992
	Town of Grande Cache	Town	3,571
	MD of Lesser Slave Lake	Municipal District	2,803
	Town of Fox Creek	Town	1,971
	Town of Swan Hills	Town	1,301

Drought (N=20)	City of Lethbridge	City	98,198
	City of St. Albert	City	65,589
	Parkland County	County	32,097
	Leduc County*	County	31,130
	Town of Okotoks*	Town	28,881
	Town of Cochrane	Town	26,320
	Sturgeon County	County	20,495
	City of Red Deer*	City	19,541
	County of Wetaskiwin No. 10	County	11,181
	MacKenzie County	County	11,171
	Yellowhead County	County	10,995
	Brazeau County	County	7,771
	Town of Slave Lake	Town	6,651
	Town of Cardston*	Town	3,585
	Thorhild County	County	3,254
	Town of Fort MacLeod*	Town	2,967
	Town of Black Diamond	Town	2,700
	Town of Nanton*	Town	2,130
	Town of Sedgewick	Town	811
	Village of Longview*	Village	307

*Municipalities are located generally within the Palliser Triangle in southern Alberta where droughts are a known natural hazard.

Appendix D: Sample Coding Sheet for Flood Hazards

Indicator: Hazard Mitigation and Reduction **Natural Hazard: Riverine flooding**				
Study area(s)	Hazard timelines	Descriptions of flood hazard policies in documents		
Name of municipality	Major disasters (years)	Title of Municipal Development Plan (year)	Title of land-use bylaw (year)	Title of other technical hazard studies, if applicable (year)

Evaluation descriptors	Comments
Municipal Development Plan (MDP)	
1. Does the MDP identify flood hazards as a potential threat to the municipality?	
2. Does the MDP discourage or prohibit development in the floodway?	
3. Does the MDP reference provincial flood hazard maps or flood hazard study?	
4. Does the MDP require floodproofing new buildings in the floodway or the flood fringe, or both?	
Land-use bylaw (LUB)	
5. Does the LUB define a floodway, flood fringe and/or, overland area as per provincial flood hazard maps?	
6. Does the LUB have permitted, discretionary or prohibited uses in the floodway, flood fringe and/or overland area?	
7. Does the LUB require an applicant to provide a flood risk assessment from a professional engineer or architect for a proposed subdivision or development in a floodway or flood fringe?	
8. Does the LUB have a setback from	
a. the top of the bank or the bottom of the bank, in steep slopes?	
b. bodies of water (rivers, lakes, etc.) or other riparian areas?	

Appendix E: Sample Coding Sheet for Wildfire Hazards

Indicator: Hazard Mitigation and Reduction **Natural Hazard: Wildfire**				
Study area(s)	Hazard timelines	Descriptions of wildfire hazard policies		
Name of municipality	Major wildfires (years)	Title of Municipal Development Plan (year)	Title of land-use bylaw (year)	Title of Wildfire Mitigation Strategy, if applicable (year)

Evaluation descriptors	Comments
Municipal Development Plan (MDP)	
1. Does the MDP identify wildfire hazards as a potential threat to the municipality?	
2. Does the MDP discourage or prohibit development in the wildland-urban interphase?	
3. Does the MDP reference the provincial FireSmart program for mitigation reduction?	
Land-use bylaw (LUB)	
4. Does the LUB identify wildfire risk behavior maps to determine vulnerable areas in the municipality?	
5. Does the LUB have permitted, discretionary or prohibited land-uses in the wildland-urban interface?	
6. Does the LUB require an applicant to provide a wildfire risk assessment from a professional engineer or architect for a proposed subdivision or development in the wildland-urban interface?	
7. Does the LUB have a setback for developments in the wildland-urban interface?	
Wildfire Mitigation Strategies (WMS)	
8. Does the WMS identify recommendations for the MDP or LUB for implementation of wildfire mitigation strategies?	
9. Does the WMS identify wildfire assessment maps by geographical areas in the municipality to determine critical structures vulnerable to wildfires?	

Appendix F: Sample Coding Sheet for Drought Hazards

Indicator: Hazard Mitigation and Reduction **Natural Hazard: Drought**				
Study area(s)	Hazard timelines	Descriptions of drought risk policies		
Name of municipality	Major droughts (years)	Title of Municipal Development Plan (year)	Title of land-use bylaw (year)	Title of other technical bylaws or studies, if applicable (year)

Evaluation descriptors	Comments
Municipal Development Plan (MDP)	
1. Does the MDP identify drought vulnerability as a potential threat to the municipality?	
2. Does the MDP identify water conservation goals, policies, incentives or education/awareness, for the municipality?	
3. Does the MDP reference the value of riparian areas or ecological features or the regional watersheds, for drought mitigation?	
Land-use bylaw (LUB)	
4. Does the LUB include drought areas or water shortage mapping to determine drought vulnerable areas?	
5. Does the LUB outline drought-tolerant species native to the municipality for *xeri-scaping* i.e. landscaping with minimal water use?	
6. Does the LUB recognise stormwater retention and infiltration systems such as rain gardens?	
7. Does the LUB include water conservation requirements such as rain collection?	
Water Restriction Bylaws (WRB)	
8. Does the municipality have a water restriction bylaw for reducing water consumption during droughts?	
9. Does the WRB identify the levels of restrictions from less restrictions to highly restrictive requirements for land-uses?	
10. Does the WRB make reference to the municipal land-use bylaw to align water conservation goals?	

Appendix G: Semi-structured Questionnaire for 1-hour Key Informant Interviews

Land-use planners/Chief Administrative Officers

1. Why should land-use planning be involved in hazard mitigation?
2. How does your municipality integrate hazard mitigation into the Municipal Development Plan and the Land-use Bylaws? Who is responsible for this?
3. How closely/often do the land-use planners work directly with the local emergency team on hazard mitigation?
4. What is your definition and understanding of community resilience?

Local Emergency Personnel

1. Why should land-use planning be involved in hazard mitigation?
2. To what extent, does the emergency management plan relate to the Municipal Development Plan or Land-use Bylaw?
3. How closely does the local emergency advisory committee engage directly with land-use planners on hazard mitigation?
4. What is your definition and understanding of community resilience?

Elected officials/Municipal associations

1. As an elected official, why is it important to integrate mitigation against hazards such as the [Insert year, name of disaster] or other hazards, in the planning and decision-making process?
2. In what ways can Provincial departments or municipal organisations address municipal planning capacity in order to implement mitigation initiatives?
3. What is the most challenging aspect of disaster relief funding for long-term mitigation?
4. What is your definition and understanding of community resilience?

Provincial, Federal and Insurers

1. What is the role of land-use planning in mitigating hazards in Alberta municipalities?
2. How do the various disaster relief programs and insurance incentives consider the?
3. How do provincial policies consider small municipality capacity for hazard mitigation?
4. What is your definition and understanding of community resilience?

Appendix H: Focus Group Agenda for Half Day Workshop

1. Introductions - 5 minutes

   State your name, affiliation, and role in land-use planning and hazard mitigation.

2. Opening remarks - 5 minutes

   Briefly describe the project status and objectives of the focus group.

3. Session 1: Table discussions - 30 minutes

   Why is it important to integrate land-use planning with hazard mitigation?

4. Coffee break - 10 minutes

5. Session 2: Table discussions - 15 minutes

   How does/could/should your organisation support small municipalities in hazard mitigation?

6. Group discussion on recommendations - 30 minutes

7. Concluding remarks - 5 minutes

Appendix I: Local and provincial authority to address hazard risks

	Does the governance level address the risk in its tools or regulation?			
	Municipal			Provincial
Environmental risks	Land-use bylaw	Statutory plan	Provincial direction	Statute/regulation/policy
Availability of potable water supply	Yes	Yes	Yes	Subdivision and Development Regulation (SDR)
Erosion, beds and shores, bodies of water	Inconsistent	Yes	Yes	SDR, Water Act
Flood risks & floodplains	Inconsistent	Yes, but not consistently	Limited	Provincial land use policies (PLUPS); Municipal Government Act (MGA)
Groundwater vulnerability	Yes	Maybe, inconsistent	Yes	SDR; PLUPs
Riparian areas, bodies of water or environmentally sensitive areas	Yes, but inconsistent	Yes	Yes	Wetlands Policy, Water Act, MGA
Subsidence & unstable slopes risks	Yes, but inconsistent	Yes, but not consistently	No	SDR; PLUPs

Anthropogenic risks

Environmental risks	Land-use bylaw	Statutory plan	Provincial direction	Statute/regulation/policy
Agricultural operations (confined livestock feeding operations)	Yes	Yes	Yes	Agricultural Operations Practices Act
Contaminated sites	Yes	No	Yes	Environmental Protection and Enhancement Act (EPEA)
Gravel Pits	Yes	Yes	Yes	MGA; EPEA

	Does the governance level address the risk in its tools or regulation?			
	Municipal			Provincial
Environmental risks	Land-use bylaw	Statutory plan	Provincial direction	Statute/regulation/policy
Incompatible adjacent development	Yes, inconsistent	Yes	Yes	SDR
Landfills	Yes	Yes	Yes	SDR, EPEA
Lands in proximity to airports	Yes, inconsistent	Maybe	Yes, Calgary & Edmonton	Airport Vicinity Protection Area Regulations; Transport Canada
Oil and gas facilities, pipelines and wells (sour, conventional & abandoned wells)	Maybe, inconsistent	Yes	Yes	SDR; Alberta Energy Regulator-Abandoned Wells Directive 071
Private sewage disposal systems	Yes	Yes	Yes	Safety Codes Act
Registered historical resources or sites	Yes	Yes	Yes	Historical Resources Act, SDR
Solid waste management facilities	Yes	Yes	Yes	SDR; EPEA
Subsidence related to undermining issues	Yes, not well understood	Maybe, inconsistent	Limited, one community	SDR: Canmore Undermining Review Regulation
Wastewater facilities	Yes	Yes	Yes	SDR