A Comparison of Post-Disaster Experiences in Two Canadian Riverine Communities: Evaluating Managed Retreat as a Climate Change Adaptation Strategy

by
Shaieree Cottar

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Natural hazards pose a significant risk to local economies, critical infrastructure and public health and safety. Climate change compounds this risk by introducing a new existential threat to Canadian riverine communities, amplifying the risks of flooding for homeowners. Ensuring the long-term sustainability of communities requires the implementation of climate change adaptation and disaster risk reduction strategies. Managed retreat – the act of purchasing, demolishing and/or relocating homes that are under the threat of flooding - is one of the few government-supported policy options that are available to Quebec homeowners facing repeated long-term flood-damage, through the General Indemnity and Financial Assistance Program Regarding Actual or Imminent Disasters - Flooding. An alternative policy option, which is available in Ontario, is the Disaster Recovery Assistance for Ontarians (DRAO) program that is used to aid homeowners in repairing, cleaning and replacing damaged essential property (Government of Ontario, 2016). The 2017 and 2019 Ottawa River floods, which affected both Constance Bay, Ontario and Pointe Gatineau, Quebec, indicated the need for increased government assistance for homeowners to cope with flood related events. Effective policy deployment in both jurisdictions, along with future support and retreat options for homeowners, could be offered in advance to help mitigate flood disaster risks. This research adopts the protect, accommodate, retreat and avoid (PARA) framework in the context of climate change adaptation and disaster risk reduction. This approach allows for the examination of the perspectives of different stakeholders who have vested economic, political and social interests in Canadian flood related disasters. Semi-structured interviews provided insights into why different policies were created in Ontario and Quebec (despite sharing a common river and flood risks), how the policy deployment strategy that followed the 2017/2019 floods evolved, and how the policies prompted homeowners to make the decision to retreat or rebuild. This research provides insights into flood adaptation strategies that are cost effective and highlights the successes and challenges associated with government-sponsored home buyout and disaster recovery assistance programs. This research is intended to assist policy makers to make informed, evidence-based decisions that can protect communities from inundation risks and build long-term resilience against flood hazards.

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List of Abbreviations

AB: Alberta
BBB: Build Back Better
BC: British Columbia
CBBCA: Constance & Buckham's Bay Community Association
CBDG: Community-Block Development Grant
CBDG-DR: Community-Block Development Grant Disaster Recovery Program
CCA: Climate Change Adaptation
DFAA: Disaster Financial Assistance Arrangements Program
DRAO: Disaster Recovery Assistance for Ontarians
DRR: Disaster Risk Reduction
EU: European Union
FCM: Federation of Canadian Municipalities
FEMA: Federal Emergency Management Agency
GHFMC: Greater Houston Flood Mitigitation Consortium
HCFCD: Harris County Flood Control District
HUD: U.S. Department of Housing and Urban Development
IBC: Insurance Bureau of Canada
ICLR: Institute of Catastrophic Loss Reduction
IPCC: Intergovernmental Panel on Climate Change
KI: Key Informant
M1: Manuscript 1
M2: Manuscript 2
MDRA: Municipal Disaster Recovery Assistance
MMAH: Ministry of Municipal Affairs and Housing
NCR: National Capital Region
NFIP: National Flood Insurance Program
NJDCA: New Jersey Department of Community Affairs
NJDEP: New Jersey Department of Environmental Protection
NS: Nova Scotia
NYRBP: New York Rising Buyout Program
ON: Ontario
ORE: Office of Research Ethics
PARA: Protect, Accommodate, Retreat, Avoid
QC: Quebec
RHP: Road Home Program
RVCA: Rideau Valley Conservation Authority
USDA: United States Department of Agriculture
USGPO: United States Government Publishing Office
WHO: World Health Organization

Chapter 1: Thesis Introduction

1.0 Research Problem

Changing climatic conditions are increasing the frequency of flood-related disasters in Canadian coastal and riverine communities due to sea level rise and extreme precipitation events. Flooding is Canada's most costly and common natural hazard that has led to a significant incline in property insurance claims (Thistlethwaite & Henstra, 2018). Increased anthropogenic pressures on coastal and inland systems and low-lying areas will adversely affect local ecological and social networks. According to its last assessment report, the Intergovernmental Panel on Climate Change (IPCC) recorded an increase in global temperatures, decline in snow and ice cover, rising sea level and intensified hydrological patterns resulting in recurrent storm surges (IPCC, 2014). These observed impacts are likely to increase the risks of inundation, soil erosion and loss or damage to critical infrastructure in communities that are located in the floodplain. These risks are further amplified for rural and marginalized communities that are more vulnerable to flooding due to insufficient services (i.e. hospitals, schools, evacuation centers), lack of essential infrastructure and living in exposed areas (IPCC, 2014). The damage from coastal or inland flooding in communities can be unprecedented, with unforeseen expenses that can have long-term impacts on the financial and social wellbeing of disaster-stricken communities.

Climate change will continue to displace coastal and riverine communities while increasing inland migration rates from developed floodplains (Hino, Field & Mach, 2017). The implementation of climate adaptation strategies requires systematic consensus from homeowners, governments and insurers to pragmatically secure the longevity and sustainability of flood-prone communities. Managed retreat, which is the act of buying out and relocating homes that are under the threat of flooding, is one of the few policy options available to some at-risk communities (Alexander, Ryan & Measham, 2012). The acquisition of homes in flood-prone areas can eliminate the risk of future damage to properties through the ecological restoration of natural floodplain functions. The practice of managed retreat has historically been met with opposition due to the social, financial and political complications that

arise from expropriation and the displacement of community networks. Canadian communities are ill-equipped to fortify residential properties from flood damage due to the lack of affordable flood insurance premiums, which further burdens government-sponsored buyout and disaster recovery assistance programs.

In April 2017, immense rainfall and snowmelt in the Ottawa (i.e. Ontario jurisdiction) and Gatineau (i.e. Quebec jurisdiction) regions led to the worst flooding seen by many riverside communities in decades. The flood left many basements submerged, homeowners displaced, and essential services temporarily shut off for months. The damage from the floods left many homes in disrepair with minimal aid from insurers and provincial governments (CTV, 2019b). After the 2017 floods, residents in Pointe Gatineau were offered ad-hoc buyouts and some disaster recovery assistance from the Quebec government. Approximately 30 homes were demolished and homeowners were offered up to $200,000 as compensation to relocate (CTV News, 2019). In stark contrast, 380 residents in Constance Bay were offered disaster recovery assistance from the Ontario government to repair and replace damaged essential property (CTV News, 2019). In May 2019, inland flooding once again affected both communities, which hampered recovery efforts, insurance reimbursements and assistance payouts from the previous flood.

The 2019 floods, which were essentially a repeat of the 2017 floods in both regions, showcases the need for formalized, robust policies and programs that help communities adapt to the repeated risks of inundation. This research focuses on evaluating existing jurisdictional policies (i.e. DRAO and Quebec Buyout Compensation) in two Canadian Provinces bordering the Ottawa River. Both ‘retreat’ and ‘rebuilding’ are examined as flood responses for homeowners that do not have flood insurance, along with the amortized cost of repeatedly offering compensation (i.e. recovery assistance) to communities that would benefit from buyout offers and restricting future development in high-risk zones. The research is intended to shed further light on government intervention as a tool in disaster risk reduction, improve the administration of funding for post disaster reconstruction assistance, examine the extent to which government policies impact homeowners’ decisions in retreating or rebuilding, and advance existing community planning processes to create resilience to future

hydrometeorological disasters. Changes in government, policies and access to information has drastically altered the scope of how homeowners make decisions within a post-disaster environment. This study exploration is timely given the current Canadian political climate surrounding disasters, and the need for a national climate adaptation strategy that considers a wide variety of PARA options, including managed retreat, which aims to mitigate the risks and social vulnerabilities faced by homeowners who experience flooding.

1.1 Research Gap, Purpose, Questions

Despite the abundance of existing research on the development of coastal and riverine climate adaptation and disaster recovery strategies, there is still a lack of consensus on how and when to adopt voluntary managed retreat for vulnerable communities. The simple idea of retreating from high-risk flood prone zones, because homeowners are unwilling or unable to afford the costs of repairing or rebuilding their homes, is a proactive adaptation tool, and some researchers suggest it may be the most financially feasible option (Siders, 2019). Ensuring practical disaster risk knowledge and safe communicative forums are available and accessible to afflicted homeowners is crucial in the successful implementation of recovery or retreat programs. The ability to research the different social, environmental and political determinants that influence governmental and homeowner decision making can help to reduce the gaps in knowledge on retreat as a climate change adaptation strategy for Canada. The demand for further empirical research that focuses on Canadian cross-jurisdictional, post-flood recovery strategies illustrates the need for increased awareness, capacity-building and policy guidance when it comes to the administration of home buyout programs or disaster recovery assistance. More simply, we need to compare what different jurisdictions are doing about the Canadian flood problem.

The purpose of this research is to further expand knowledge on riverine flooding and adaptation by comparing the use of buyout programs to alternative disaster recovery funding models that are financially feasible for governments, and ecologically and socially sustainable for residents. Through a comparative study of the communities of Pointe Gatineau, Quebec, and Constance Bay, Ontario, this research aims to understand the current riverine flooding

adaptation policies in two provinces, and to examine which policies are more effective in curbing or compensating for flood damage to residential infrastructure.

Government-sponsored home buyout programs are intended to relocate people who live in high-risk zones by purchasing and demolishing their homes, but this is often a contentious task for any government to implement because of potential political backlash. The use of disaster recovery assistance to assist homeowners to rebuild in place can be viewed as a laissez-faire policy that is meant to help communities on an "as needed" basis. This comparative study critically examines the purpose of such policies and programs, and assesses the long-term impacts (i.e. social, political and financial) of repeated government assistance on community well-being. The objectives of the research are to:

- investigate provincial policies (i.e. home buyout programs & disaster recovery assistance) in relation to climate-induced flood disasters;
- identify the barriers that restrict homeowners from making decisions that relate to retreating;
- understand the reasoning behind the planning and deployment of policies;
- offer recommendations to improve existing funding models related to post-flood assistance programming.

These objectives are salient in light of the events surrounding the 2017 and 2019 floods that took place in the National Capital Region (i.e. Constance Bay & Pointe Gatineau) that resulted in the worst damage seen in decades. Both communities have undergone major transformations within the last 2 years, and it is pivotal that researchers observe the impacts of these changes for the long-term vitality and sustainability of community networks. Knowledge about managed retreat is quite limited because many communities are hesitant to apply such policies, due to the social and psychological difficulties that often arise from displacement, regardless of the potential economic and political benefits (Hino, Field & Mach, 2017).

The research themes of the project focus on the *barriers*, *challenges* and the *supports* that communities and homeowners receive from governments in preparation for, or reaction to, a flooding-related disaster. To better understand the sensitivities surrounding managed

retreat and coastal & riverine adaptation, the main research questions that drove the research are as follows:

1. How have municipalities (i.e. Pointe Gatineau and Constance Bay) adapted to climate change-related disasters through the use of home-buyout programs or disaster recovery assistance?
    a. How effective are these strategies (i.e. administration of the program, financial feasibility, community participation, homeowner/municipality satisfaction)?
2. What factors or policies affect homeowner's decision to retreat from or rebuild their homes after the flood damage in 2017 and 2019?

1.2 Study Area

Despite its promise as a risk management strategy, applications of managed retreat are rare in Canada, though recent studies have focused on home buyouts after inland river flooding events. These case studies often focus on only one jurisdiction and do not compare the differences in policy administration and disaster recovery strategies across different jurisdictions. In order to fill that gap, this study researched Pointe Gatineau, which is located in the province of Quebec, and Constance Bay, which is located in the province of Ontario, and both are part of Ottawa's National Capital Region (NCR). These communities were identified as the ideal research sites because they both experienced record-setting floods in both 2017 and 2019. Each province then implemented its respective policies to cope with the aftermath of the floods and to aid communities with post-disaster recovery.

Pointe Gatineau and Constance Bay are situated along the Ottawa River, which often faces a rapid icrease in water level during spring snowmelt season. More than 3,100 homes in Quebec were struck by spring flooding in 2017, with more than 1,400 people forced to evacuate, many of whom were located in the Pointe Gatineau area (CTV, 2019b). The wider City of Gatineau has a total land area of 342.8 square kilometers and a total population of approximately 277,000, most of whom reside in single-family homes (Statistics Canada, 2016). Pointe Gatineau is a working-class community with approximately 60,000 residents, with 28.2% earning between $10,000 to $29,999 CAD, and 53.7% of residents earnings range from $30,000 to $99,999 with

only 6.7% of residents earning more than $100,000 (Statistics, 2016b). The cost of homes in the area ranges from $110,000 to $300,000 CAD, though floods in the area have drastically reduced the value of homes (Ottawa Citizen, 2019). The low-lying topography of the area, coupled with fluctuations in water levels from the Ottawa River, makes this area extremely vulnerable to the impacts of climate change and inland flooding.

Constance Bay is relatively smaller in size, with a total land area of 5.56 square kilometers and a population of 2,314 people, the majority of whom have resided in the area for more than 50 years (Statistics Canada, 2016a). The area is a popular seasonal destination for cottage vacationing and summer rentals for Canadian tourists because of its close proximity to major water bodies and the Ottawa city center. Many homeowners have remodeled older cottages and reclaimed them to be modern cottage rentals as supplementary sources of income (Ottawa Citizen, 2019). Constance Bay is an amalgamation of different incomes with 25.2% of residents' incomes ranging from $10,000 to $29,999 CAD, and 52.8% of residents earnings ranging from $30,000 to $99,999 with 16.6% of residents making between $100,000 and $150,000 (Statistics Canada, 2016a). The price for homes in the area can exceed $340,000, depending on remodels, upgrades and flood prevention investments. The fewer number of residents (i.e. lesser population density) in the area also impacts municipal operating and capital costs, which are imperative to the timely delivery of goods and services in the area. These two study communities were chosen partly because they face the same flooding problems, but the execution of their recovery strategy and deployment of homeowner assistance programs varied considerably due to the different policies and programs established in the two provinces.

1.3 Community Resilience & the PARA Framework

Natural disasters can have catastrophic impacts on coastal and riverine communities. Post-disaster relocation can be a cost-effective adaptation strategy that can save lives and transform the urban landscape into natural preservation lands. The use of home buyout programs and disaster recovery aid is increasing across Canada, and further research regarding policy tools and homeowner experiences with these tools is required to better understand the relationships between community social capital networks, resilience, social cohesion and adaptive capacity. Community resilience refers to the collective ability of a neighbourhood or geographically

defined area to deal with stressors and efficiently resume the rhythms of daily life through cooperation following shocks (Aldrich, 2012). Individual and community social capital networks are integral in providing access to resources in disaster situations, including information, aid, financial resources, childcare, and the emotional and psychological supports which are essential in recovery (Aldrich & Meyer, 2015). Understanding social capital, which is described as bonding, bridging and linking familial connections, social groups and the ability to empower citizens to make the most appropriate decisions, is essential to disaster recovery (Aldrich & Meyer, 2015). For instance, maintaining social networks and community ties in the face of buyout and recovery programs will increase homeowner participation rates for buyout programs or recovery assistance.

This research identifies the indicators of CCA and DRR and assesses the effectiveness of home buyout and disaster recovery policies along with projected outputs and defined outcomes which may include long term cost-effectiveness, maintenance of social capital, enhancing community resilience to future hazards and community autonomy /control over the recovery process. Homeowner risk perception is another area explored in this project since risk is subjective to the stakeholder's perspective. For example, a homeowner's perceived probability of future losses (i.e. life and property) affects perceptions about the possibility of losing property, financial stability and or moving away from community networks. The possibility of lost property tax revenues or the inability to service debts directly relates to the stresses that politicians and government policy makers may face (Freudenberg, Calvin, Tolkoff & Brawley, 2016). According to the Lincoln Institute of Land Policy (2016), it is imperative to improve existing home buyout programs by making them more financially generous based on the geographical location, and incentivized for the homeowner to relocate so that governments can reap the financial benefits in the long-term. Given that flooding is an immediate threat for many Canadians, it is important to examine and refine the many applications, policies and programs to better suit the needs of municipalities and residents. An especially important priority is better emphasis on collaborative governance and participation from homeowners when it comes to relocation, home-buyout, recovery assistance and climate adaptation frameworks.

The protect, accommodate, retreat or avoid (PARA) framework informs this research by suggesting a suite of possible adaptation strategies that, for example, can mitigate climate risks, restore the environment using nature-based solutions, and retain financial welfare for affected homeowners. Managing the risk in flood-prone areas and reducing long-term structural damages and construction costs could benefit all stakeholders affected by inundation. To illustrate the PARA framework, it can be applied to residential areas. In that context, a *protect* approach might involve the construction of engineered structures to prevent flood waters from reaching homes; an *accommodate* approach might reinforce or retrofit existing houses to limit future damage to properties; a *retreat* approach might involve permanent relocation of communities in high risk zones, and an *avoid* approach might proactively prevent development from occurring in areas that are likely to face flood risks (Doberstein, Fitzgibbons & Mitchell, 2018). Upon initial analysis, it appears that in Pointe Gatineau the Government of Quebec opted for the retreat approach, whereas in Constance Bay the Government of Ontario has not formerly adopted any of these strategies (i.e. since disaster recovery assistance is not meant to improve the resilience of communities, but rather to simply rebuild and replace what was lost). Developing a better understanding of how Canadian communities are employing managed retreat and recovery assistance as forms of climate adaptation is vital to the success of resilience-building approaches in post-disaster recovery.

1.4 Thesis Organization

This thesis follows a manuscript approach in which the research is presented as two independent papers that draw independent findings but answer the overarching research questions. The first manuscript (chapter 2 in this thesis) sets out principles for effective property buyout programs, and it is followed by a linking piece that transitions the reader from the literature review to the empirical study. Chapter 3 is an independent methods section which provides context for the empirical study detailed in chapter 4. The second manuscript (chapter 4 in this thesis) presents the comparative analysis of flood policy responses in Constance Bay, Ontario and Pointe Gatineau, Quebec, and it is followed by a final chapter (chapter 5) that concludes the thesis by highlighting the main conclusions from both manuscripts as well as providing context for future research.

Chapter 2: Literature Review
Principles for Effective Home Buyout Programs in North America

2.0 Introduction

Climate change is exacerbating land degradation processes and coastal and riverine erosion through increases in rainfall intensity, flooding and temperature fluctuations which are adding to land use pressures and amplifying the risks for vulnerable communities (IPCC, 2019). Risks related to disaster recovery and climate change-induced land degradation are higher in areas with greater populations, significant pressure to develop land, low adaptive capacity and other political, social, legal or financial barriers that prevent adaptation (IPCC, 2019). Floodplains have historically been used as places for urban development because of the amenities they offered, including well-drained land for building, close proximity to water for various uses, access to waterways & transportation routes, and availability of a sink into which wastes could be dumped downstream (Montz, 2000). As urban areas located on floodplains grow, flood hazards increase because there is infrastructure at risk but also since the process of urbanization alters hydrology (Montz, 2000). In addition, land adjacent to water bodies is prone to soil erosion along the riverbanks. Recognizing the threats associated with flood hazards and land erosion is the first step to equipping urban residents with the skills, knowledge and adaptation techniques to effectively mitigate risks and encourage communal discourses about flood protection and remediation. Finding innovative mechanisms that enable communities to reduce their risks and expand their adaptation toolkit can increase community resilience and social capital in the face of stressful disaster-prone conditions.

Effective adaptation measures will have to be applied within natural and anthropogenic systems in order to alleviate the impacts of climate change. The First Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (1990) identified climate change response strategies focused on adaptation and mitigation which included; protection, accommodation and planned retreat (Bijlsma et al., 1996). The protect approach involves the construction of engineered controls, such as floodwalls, berms and dikes, designed to keep flood waters away from homes, communities and critical infrastructure (Doberstein, Fitzgibbons & Mitchell, 2018). Accommodate approaches are designed to allow for the continued use of flood-prone areas by

improving the resilience of communities to occasional flooding or by reducing damage in these areas (e.g. elevating properties, flood-proofing foundations) (Doberstein, Fitzgibbons & Mitchell, 2018).

Many coastal and riverine communities have already implemented retreat (e.g. home buyout relocation programs) and or realignment (i.e. moving critical infrastructure away from the coast) strategies which are often triggered by market, environmental or welfare changes rather than being anticipatory adaptation techniques (i.e. proactive measures that minimize the risk of property damage and critical infrastructure in flood prone zones) (Smit & Wandel, 2006). Governmental funding constraints and anticipated opposition can also deter from the use of managed retreat as an adaptation approach. The use of protect, accommodate and retreat options appears to be becoming more viable adaptation options amongst Canadian residents who live adjacent to water bodies. Homeowners face many difficult decisions after a disaster, including whether to rebuild or relocate to a new area (Greer & Binder, 2017).

2.1 Manuscript Organization

This manuscript presents results of an extended literature review (n=101) which began by systematically scanning the literature for journal articles and policy reports using the search terms ‘managed retreat’, ‘home-buyouts’, ‘community relocation’ and ‘climate change adaptation’, combined with the natural hazard context of floods or flooding. The paper then draws from the literature specific principles of best practice when considering retreat. These guiding principles are derived from Canada and other developed countries (i.e. U.S., U.K, Australia, New Zealand, Japan, EU countries) where proactive and reactive retreat strategies are being considered, especially for communities that have heightened vulnerabilities to flood risk.

The five guiding principles it derives can help stakeholders implement retreat as part of a coordinated climate change adaptation strategy that benefits both governments and communities at risk. Questions and concerns around floodplain mapping in high-risk inundation zones, land-use planning, and social acceptance of retreat heavily influence the use of managed retreat as an adaptation strategy in North America. The format for this manuscript follows a

sequential pattern in which five guiding principles are introduced, followed by a literature-based explanation of each principle, and then a case study where the principle was applied. Each principle is addressed further in the literature review.

2.2 Household Risk Reduction

Flood hazards in Canada are growing and so is the inability of Canadians to effectively tolerate and manage these threats without adequate government direction on household risk reduction. Communities along coasts and in riverine areas are disproportionately disadvantaged when it comes to protecting their properties from excessive water damage. Homeowners' lack of awareness about flood hazards cannot be fully placed on them since historically there has been a reluctance to restrict building in high flood risk areas or to require that builders disclose risk to potential buyers (Venkateswaran, Szönyi, Norton & MacClune, 2018). This practice of transferring the risk to the homeowner suggests a cycle of maladaptive behaviour that can have serious financial and social consequences for communities in the long-term. Household decision making in Canadian communities post-disaster is often bound by provincial and municipal disaster recovery policies, and the range of programs that are developed from them, limiting homeowners' abilities to reduce their individual flood risk (Greer & Binder, 2017). Restrictions (i.e. bylaws, development bans, zoning, hazard limits) on development make it easier for governments to control and protect properties in floodplains. Enacting rules that limit future flood liabilities reduces recovery costs and protects flood-prone communities, thereby decreasing individual household risk.

Equipping homeowners with the right information and tools regarding environmental risks is imperative in aiding communities to prevent and mitigate future risks from natural hazards. The dependency that homeowners have on external stakeholders such as governmental organizations, emergency services, insurers, and disaster relief agencies illustrate the need for increased support and capacity building for these vulnerable and ill-prepared communities (Finch, Emrich & Cutter, 2010). Historically, flood risk reduction strategies that reinforce, fortify and prevent further damage to critical infrastructure and assets have been the best received option by governments, although the use of relocation has sparked interest across Canada, particularly for communities that face repeated flooding (Lemmen et. al. 2016).

The use of traditional flood risk mitigation measures (e.g. structural/home elevation, insurance, flood walls) is long gone and thus the need for a coordinated risk reduction strategy that incorporates an efficient, robust and proactive administration of a managed retreat or strategic relocation (e.g. home buyouts) strategy must be considered as a possibility to mitigate the impacts of riverine or coastal flooding in Canadian communities.

2.3 Managed Retreat – A New Adaptation Option

Changes in climatic conditions that result in flooding are notable across Canada through increased frequency of rainfall, rapid snowmelts, riverine erosion, intense storm surges, infrastructure failures and urban stormwater runoff, all of which necessitate a search for adaptation options. The conventional PARA (i.e. protect, accommodate, retreat and avoid) model discusses several options for hazard risk reduction which, when applied to climate change-related hazards, are understood as adaptation options. One adaptation option that aims to increase community resilience is the removal and relocation of assets from harm's way as a possible method to reduce risk to livelihoods and properties, avoid financial loss and prevent future damage in hazard prone areas.

The 'retreat' portion of the PARA acronym refers to "the permanent relocation of community and infrastructure that is forced by natural hazards, but also the integration of restoring and elevating livelihoods in the planning process" (Greiving, Du, Puntub, 2018, p.7). A retreat strategy is either proactive (i.e. enacting a plan before a climate induced hazard occurs) or reactive (i.e. post-disaster) in nature, which means policymakers have to consider the legal, financial and social trade-offs involved with implementing a measure that can greatly reduce or even eliminate future risks. Managed retreat options (e.g. property buyouts, relocation programs, coastal realignment) are generally the least expensive in the long term as opposed to protect and accommodate strategies, which often incur ongoing maintenance, recovery, aid and emergency response expenses (Abel et al., 2011). Without outside intervention, many Canadian communities will have to self-retreat from flood-prone zones because they will not be willing or able to afford the costs of repairing or rebuilding their homes, despite aid from insurance and disaster assistance (Freudenberg, Calvin, Tolkoff & Brawley, 2016). The long-term

risks of climate change have made way for new managed retreat-related policies that focus on the design, planning, application and implementation of home buyout programs and related disaster recovery assistance that have effective outcomes and benefits for all affected stakeholders. Similar programs also exist for the managed retreat of infrastructure such as roads, railways and industrial plants. The remainder of this paper focuses solely on the managed retreat of individual properties through the implementation of home buyouts in flood-prone communities.

Managed retreat may seem like a feasible policy option given the long-term benefits of the strategy, but it is imperative to also consider the significant costs, livelihood disturbance and emotional impacts on individuals and the community level. One of the most evident benefits of retreat is the provision of a sustainable, long-term solution that prevents loss of life and minimizes damage to infrastructure. An ecological benefit that flows from retreat is the capacity of the land to return to its natural floodplain state. Homeowners who live in high-risk flood areas are likely to experience financial losses due to damages incurred by severe weather. Acknowledging that relocation is inherently disruptive for community social networks is important to consider when broaching the idea of permanent retreat. Homeowners often hold a 'place attachment' to the communities they live in, which is rooted in either place identity, which refers to self-perception of their identity surrounding their physical environment or, place dependence, which refers to the residents' self-perception of the community potential to address their needs (Jamali & Nejat, 2016). After a natural disaster strikes, homeowners are often emotionally overwhelmed by the damages and the ensuing recovery process. As a consequence of the short-term emotional shock that follows, property owner readiness to deliberate and take ,time to plan and evaluate the merits of buyout offers, or alternatively, to plan for risk mitigation, can be compromised (De Vries & Fraser, 2012).

2.4 Drivers of Managed Retreat

The literature review revealed several factors that have driven managed retreat in North America, and these can be classified further into environmental, political, economic, spatial and socio-cultural drivers. Despite the use of hard-engineered flood mitigation strategies to reduce future flood risks, the use of managed retreat is growing among communities. Environmental

drivers of retreat include changes in snow-ice melt and increased precipitation rates in conjunction with human alteration of the land through the engineering of rivers, destruction of natural protective systems and increased development on floodplains. In many parts of North America, this has resulted a heightened risk of destructive and costly floods that cause adverse impacts for neighbouring infrastructure and riverine erosion (Union of Concerned Scientists, 2018) and may lead to considerations of retreat. Environmental commitments and broader investments in adaptation projects suggest that there is higher political will to implement retreat due to new understanding of the overall societal benefits and its cost-effectiveness (Hino, Field & Mach, 2017).

Another driver of retreat is the greater investments for adaptation projects which support property buyouts in flood prone communities – these projects include scope for fair compensation (i.e. pre-flood value) and or financial incentives that further encourage retreat. The development and use of transparent adaptation policies and programs, in which the long-term impact of retreat plans is considered during the decision-making process, is yet another driver of retreat. Consideration of retreat is imperative to future proactive planning and alignment of climate change priorities in municipal climate change adaptation plans. It is evident that managed retreat requires significant commitment and courage from the policy, strategy and political actors as well as durability to withstand public rejection in order to be effective in the long-term (Hanna, White & Glavovic, 2018). Figure (1) below explores additional drivers of planned retreat by illustrating positive and negative direct causal relationships.

The remainder of this paper explores five guiding principles derived from the literature that can be used to improve the planning, implementation and effectiveness of home buyout programs. The presence of these principles is traced in various case studies across North America.

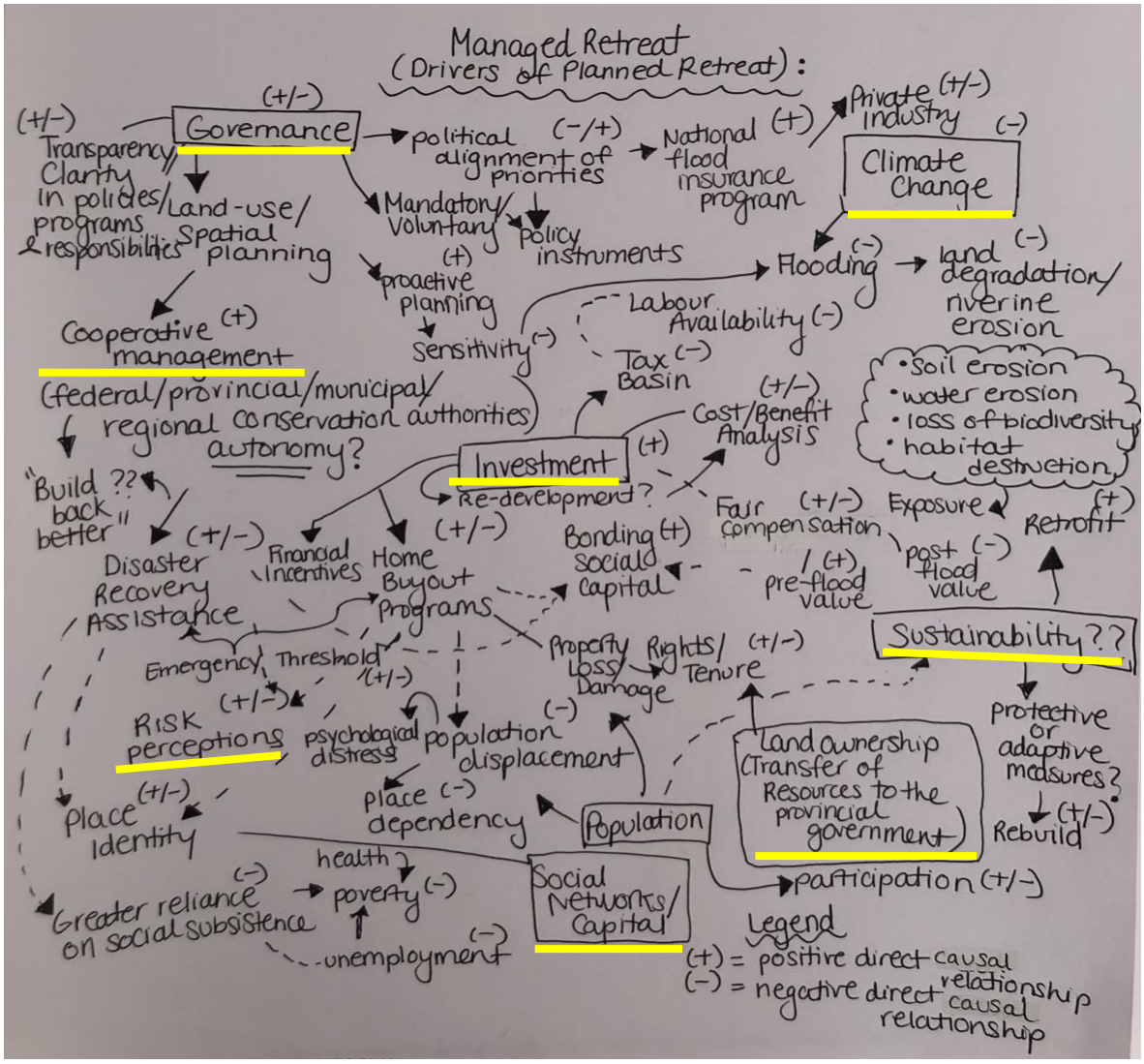

Figure 1: An influence diagram illustrating the drivers of adopting a managed retreat policy (Cottar, 2020).

2.5 Community-Based Participation

Principle # 1: *Governments should work collaboratively with communities and encourage homeowner participation by making home-buyouts more accessible, available and agreeable.*

Citizen participation is an almost unanimous recommendation in the literature on managed retreat as it increases public awareness and acceptance of home buyout programs in high-risk areas. The type and level of participation in buyouts stems from the composition of the community, the individual autonomy of homeowners and the hierarchy of institutions that influence decision making at the local, provincial and federal levels (Siders, 2018). Considering that buyout programs are most often initiated after a disaster, the question arises of why homeowners who are offered a voluntary option of pursuing a buyout choose to either accept

or reject that option (Binder, Baker & Barile, 2015). From the inception of a strategic plan to the mobilization of the policy on the ground, it is vital that administrators who are implementing the program carry out significant and multi-stage public engagement to effectively understand community needs and manage trade-offs (e.g. loss in tax base) that arise. As homeowners move through the different stages of the buyout process, their lived experiences will vary due to differences in program design (e.g. parameters for eligibility, inclusion of social services), the type and source of financial incentives offered to encourage participation, and the degree of support provided to homeowners by the government agency tasked with implementing the buyout (Greer and Binder 2017; McGhee, Binder & Albright, 2019; Tobin 1992). Based on the size of the community (e.g. city, town or village) and the social networks in place, the overall goal of community engagement processes should be to address competing interests about policy and planning, capacity building, investment decisions and the risks faced by all stakeholders involved (Alexander, Ryan & Measham, 2012).

Property buyout programs are often disruptive, prolonged and relatively chaotic, which further exacerbates the vulnerability of residents who are struggling to rebuild their lives post-disaster. Home buyouts are typically triggered in response to a natural hazard event (i.e. “a disaster”) and as such are often found to be relatively ad-hoc, disorganized and administratively chaotic (Neal, Bush & Pilkey 2005; Thistlethwaite & Ziolecki 2020). The disruptive nature of these one-off projects can leave homeowners feeling helpless, vulnerable and trapped, further exacerbating social vulnerabilities and alienating them from the decision-making process. Lengthy timelines and relatively unplanned displacements can permanently change the dynamics of the community, causing distrust of government administrators (Moore, 2020). The literature suggests that transitioning from one-off buyout projects to administering buyout programs that are guided by a long-term thinking, careful planning, true community engagement, and a focus on equity, will help to alleviate some of citizen concerns (Freudenberg Calvin Tolkoff & Brawley 2016; Greer & Binder 2017; Moore 2020; Siders 2018). Homes are a major financial asset, so it is important that residents are provided several feasible options (Hino, Field & Mach, 2017) that would increase uptake of voluntary home buyout plans. These options can entail attractive property offers and relocation plans which would incentivize

uptake of the program. Dialogues that are spearheaded or guided by the community can help to bring a sense of stewardship and belonging which can serve as a conduit to building relationships with local municipal authorities for making tough decisions (De Vries & Fraser, 2012). The impact of these decisions can be limited by the scope, size, planning, land use patterns and funding models of buyout programs which in turn help to reduce homeowner vulnerability (Maly, Kondo & Banba, 2017).

2.5.1 Example 1: Collective Community Participation in Oakwood Beach, New York

The Hurricane Sandy natural disaster of 2012 affected many communities across the New York metropolitan region, particularly the coastal area of Oakwood Beach (Binder & Greer, 2016). Much of Oakwood is located on the southeast portion of Staten Island, with properties dispersed across the beaches adjacent to the Lower Bay & Atlantic Ocean (Binder, 2014). The low-lying area of the neighbourhood borders the wetlands of the Great Kills Park which experiences regular nuisance flooding from even light rainfall (Freudenberg et al., 2016). The region has a long history of flooding from previous storms, such as the 1992 Nor'easter (extra-tropical cyclone) and Hurricane Irene in 2011, which caused destruction of property and loss of life (Greer & Binder, 2017). The community has a population of 22,000+ people, with nearly 3,000 residents living in what FEMA calls a "Special Flood Hazard Zone", meaning they are at high risk (Freudenberg et al., 2016). Oakwood Beach is home to properties ranging from single-family home dwellings raised on stilts to small residential apartments that line the coast and inland areas. With the increased frequency of storms due to climate change (Lemmen, Warren, James & Clarke, 2016), the number of homeowners at risk of flooding is increasing.

The 2012 floods brought on by Hurricane Sandy had significant impacts for the State of New York, offering a valuable case to highlight the benefits of collective, community-based participation that helped expedite buyouts across the community of Oakwood Beach, reducing the overall flood risk. The storm surge damaged the seaside berm that protected Oakwood Beach and continued on to rip homes from their foundations and flatten others (Freudenberg et al., 2016). Similar to what happened after the Nor'easter storm of 1992, residents gathered together to form an Oakwood Beach Flood Victims group that would decide how to address the

challenges that arose from Sandy's coastal flooding (Freudenberg et al., 2016; Greer & Binder, 2017). A property buyout program that offered residents post-flood property values was rejected in 1992 and many returned to their homes. However, after Hurricane Sandy residents sustained irreparable damages, once again changing the discourse about buyouts in their community (Greer & Binder, 2017).

The 1992 experience prompted local neighbourhood organizations to convene and work on aid distribution and disaster response strategies, and it was through these experiences that the idea of home buyouts began to take shape and be received positively by homeowners. The Oakwood Beach Buyout Committee was created, organized and led by local residents who advocated for the public buyout of properties that were severely affected by Hurricane Sandy. Organizers were vital in mobilizing homeowners to participate in the buyout, attract government support and demonstrate residents' high level of motivation and compliance to work with state officials (Maly, Kondo & Banba, 2017). The community-driven initiative of proposing a buyout to the state was initially ignored by local officials before senior state officials examined the situation and intervened.

Oakwood Beach qualified for the New York Rising Buyout Program (NYRBP) due to its susceptibility to future disasters, potential for risk reduction and community interest in relocation (Governor's Office of Storm Recovery 2015; McGhee, Binder & Albright 2019). Under the guidelines of the Program, the denoted home and land would be purchased from homeowners at pre-flood values and would receive a land restriction preventing any future construction (Cox & Cox, 2016). Although many residents had homeowner and flood insurance policies, the combination of insurance payouts and disaster aid was insufficient for most homeowners to return their homes to their pre-hurricane state (Greer & Binder, 2017). The financial burden and stress of rebuilding became the primary driving force for many residents to accept the buyout option. Collective consensus amongst the community about home buyouts enabled governments to implement the NYRPB because it met the needs of the community and was the preferred option of residents (Binder, Baker & Barile, 2015).

The rapid mobilization, efficiency and efficacy of the NYRBP illustrated that the program was successful because it was a combined state and community-driven initiative (Governor's

Office of Storm Recovery, 2015). Community outreach and voluntary citizen participation was vital in the planning, implementation and assessment of New York's post-disaster recovery plan (Freudenberg et al., 2016). In addition, state officials communicated with Oakwood Beach residents through online surveys, community meetings, mail invitations, in-person consultations and phone interviews (Greer & Binder, 2017). The NYRBP in Oakwood Beach had a 99% success rate: of 314 applicants, 306 buyouts were deemed closed with a total purchase cost to the State of New York of over $124 million dollars (McGhee et al., 2019). Properties with the highest flood risk and properties that could serve as buffers following ecosystem restoration were eligible for bonuses between 5% and 15% above the pre-storm value with an additional 10% bonus for adjacent property owners who volunteered their properties for acquisition (Contant, 2019). This case study emphasizes the critical role of community-driven participation in recovery efforts which helped to increase overall buyout uptake and fostered social cohesion amongst residents who experienced similar disaster realities.

2.6 Transparency and Flexibility in Planning, Funding & Program Guidelines

Principle # 2: *Governments should design, implement and offer home-buyout programs that are transparent and flexible to better cater to the financial and social needs of homeowners.*

Transparency and flexibility are vital components of establishing trust in government processes (Hood & Heald 2006; Siders 2018) such as the development, implementation and disposition of home-buyout programs. Collaborative and adaptive forms of governance, as a method of collective decision making, promote the capacity of organizations and community stakeholders to maintain flexibility to their evolving relationships in a dynamic environment of natural disasters (Kapucu 2006; Kapucu & Sadiq 2016). Building trust plays a critical role in complex decision making and is integral to institutional and land use planning, especially in the context of buyout programs.

Transparency means that people affected by government decisions or programs are able to know the facts and processes involved in those decisions, and this is important for home buyout plans (Siders, 2019). Due to the complex nature of disaster recovery operations, most residents are not well versed on the specifics of buyout programs, and this can lead to

confusion when it comes to the application process for the buyout (De Vries & Fraser, 2012). Housing recovery programs are often fragmented among different government levels or departments because they all have a different role to play in the development of the program, from logistics and financial compensation, to promotion and roll-out, which can skew homeowner's interpretation of the program (Hanna, White & Glavovic, 2019). The flexibility of human-decision making is hardly recognized by policy makers (Alexander, Ryan & Measham, 2012). Breaking down government silos and bridging the gaps between stakeholders can provide additional clarity on the eligibility criteria and documentation required to support application processing.

Beyond the basic program requirements, it is imperative that governments are transparent about relocation requirements (e.g. land swaps, similar asset valuation) and plans for the use of acquired properties (i.e. the land left over after homes are demolished) which may ease homeowners' concerns and provide an additional layer of accountability for the implementing agency (Greer & Binder, 2017). Programs in North America are often developed and administered by federal or state/provincial governments in conjunction with disaster relief agencies (Siders, 2018). Since homeowners are the primary stakeholders in home buyout programs, implementing agencies should provide clear information on how their program will be administered, including thresholds for inclusion in (and exclusion from) the program, and plans for the use of supplemental policy tools and projected timelines for implementation of the programs, including steps required of homeowners along the way (Greer & Binder, 2017). Eligibility criteria for disaster recovery aid or home buyout programs are often vague, which can distort homeowners' views of limits on assistance, perhaps explaining why many homes have not been offered buyouts (Siders, 2018). A single model for retreat is difficult to design because communities experience different realities and have varying needs. Increasing transparency within government processes and program guidelines can help to expedite decisions, increase target population compliance, legitimize future land-use plans and build communal social resilience.

2.6.1 Example 2: Flexible and Transparent Home-Buyouts in Houston, Texas - Making options known and available?

Texas' capital city, Houston, was hit hard by Hurricane Harvey, which made landfall on August 25, 2017, a category 4 storm with damage costs exceeding $125 billion USD (Amadeo, 2019; Venkateswaran, Szönyi, Norton & MacClune, 2018). The city and its neighbouring watersheds in Harris County have a long history of extreme flooding, with major floods dating back to 1990, 1992, 1994, Tropical Storm Allison in 2001 and the April 2016 Tax Day flood which recorded water levels above 5 feet (Venkateswaran et al., 2018). Hurricane Harvey caused catastrophic flooding brought on by a four-day period of extreme rainfall which amounted to 3.9 feet (Venkateswaran et al., 2018) in parts of Harris County. The flooding significantly impacted business operations and emergency response, and caused damage to critical infrastructure and loss of life. All 4.7 million people in Harris Country were impacted directly or indirectly during the flood and after the floodwaters receded (HCFCD; 2018). The combination of repeated flooding, hurricane storm surges and infrastructure defence failures triggered the largest and ongoing buyout program across the continental U.S. (Patterson, 2018).

Houston's geographic context makes resilience planning and the administration of home buyouts challenging for city officials due to its low-lying, hazardous topography that makes the city prone to tropical storms, hurricanes, tornadoes and floods. During Hurricane Harvey, the Harris County region alone saw 204,000 homes with flood damages, including many multi-family properities, and three quarters of the damaged houses were located outside the floodplain and so were not insured for floods (Amadeo, 2019). Homes located within the 100-year floodplain were built before the current by-laws and elevation regulations took effect, meaning that older homes did not need to be elevated unless homeowners opted to rebuild 18 inches above the base flood elevation (Cardenas, 2018). Since Harris County Flood Control District (HCFCD) buyout program inception in 1985, one adaptation approach that was initiated was the use of voluntary buyouts in conjunction with flood control infrastructure development in order to provide land for floodplain restoration, parks and open space and improved housing stock (Greater Houston Flood Mitigation Consortium, 2018). The main goal of the buyouts was to acquire properties in floodplains so that new flood control infrastructure could be built, and stormwater capacity could be increased through enlarged channels, greenspaces and drainbasins. Between 1985 and 2017, $342 million in federal and local funds has been spent

through the HCFCD buyout program to acquire over 3100 properities in floodplains (Patterson 2018; GHFMC 2018). The majority of properties acquired in Harris County were single family dwellings (98.7%) while the remaining 1.3% were manufactured homes (Patterson, 2018).

For the residents who choose to participate in the buyout programs, the steps to initiate the application are straightfoward though lengthy, but because the process is clear it is judged to reflect the principle of buyout program transparency. The process to secure funding from government agencies (e.g., FEMA, Community-Block Development Grants, state level emergency grantees [ex. Texas Water Development Board] and local level subgrantees [ex. City of Houston and Harris County Flood Control District]) could take anywhere from 8 months to 1.5 years. Step 1 of the application process occurs after homeowners decide to voluntarily engage in the buyout program (i.e. due to financial losses incurred, emotional and psychological trauma, risk perceptions, and availability of recovery assistance resources). Step 2 is when damaged homes are assessed by county officials to see if they qualify for the buyout (i.e. based on district and federal eligibility, source of flooding, location and depth within the floodplain, cost effectiveness, potential for future floodplain preservation and compatibility with community and natural values) (HCFCD, 2020). Step 3 entails the approval and appraisal process, which includes the evaluation, sale and transfer of asset procedure, and lasts approximately four additional months of the buyout process. As of July 2020, the HCFCD has considered 4,000 homeowners for the buyout program, of which 1,100 homes were eligible properities, and it has allocated an estimated $310 million USD as compensation for the buyouts. In total, 401 of these applicants are currently in the appraisal process and 522 of these cases have been purchased and an open space deed restriction consigned to the property.

Houston area's home buyout program has faced some criticisms, but the combination of mitigation (e.g. flood control) and adaptation measures (e.g. buyouts) have made Harris County more resilient to flood-related events. Since the Harris County Flood Control District's voluntary program began in 1985, nearly 2500 structures have been purchased with federal grants (98% from FEMA) and 1305 properties (65% with structures) have been purchased with Flood Control district funds (HCFCD, 2020). Compounding these results, over 1300 acres have been restored to a natural floodplain state, benefiting storm water storage (HCFCD 2020;

GHFMC 2018; Patterson 2018). It is likely that buyouts will continue to be a component of the Harris County flood risk reduction strategy but will also rely heavily on other options that aim to protect or retrofit existing infrastructure depending on the feasibility and costs of these mitigation measures. This case study highlights the value of having transparent guidelines that streamline the buyout process in a post-disaster setting.

2.7 Fair and Equitable Financial Compensation in Buyout Processes

Principle # 3: *Governments should fairly compensate homeowners in a way that covers their existing mortgage and allows them to relocate with financial dignity.*

The literature is clear in recommending that the provision of fair and equitable compensation should be a foundational component of home buyout programs. Policy makers and practitioners are increasingly relying on adaptation strategies such as home buyout programs to manage the impacts of climate change and reduce hazard vulnerability for homeowners whilst preserving their financial dignity. The case for buyouts in North America has been largely met with mixed reviews due to large unknowns surrounding compensation, financial incentives and future relocation plans. By pre-emptively planning and implementing proactive solutions to physically move away from the hazard, municipalities can significantly reduce their flood risk with minimal cost to the taxpayer along with savings in avoiding the long-term costs of repeated disaster assistance payouts for victims.

The question that remains is what to do about existing development in the floodplain. Because the value of damaged homes declines significantly post-disaster, most buyout programs offer sellers the pre-storm value of their property even though federal funding sources give program designers the choice of offering either the pre-storm or post-storm value (Freudenberg et al., 2016). The weakness of offering pre-storm value is that more public funds are required, but nonetheless this can be a huge incentive for homeowners to participate in the buyout and relocate from harm's way. Proposing additional financial incentives, such as covering relocation costs, should be considered to increase homeowner uptake. The challenge associated with a buyout program that lacks a relocation plan are the additional financial costs (e.g. value of support services, vulnerability assessments, post-move studies) borne by

taxpayers. Offering post-disaster market value reduces programmatic costs but may also reduce participation rates (Siders, 2018).

An alternative approach that has been experimented with is the use of a 'compensation cap' (CBC, 2019) which offers homeowners a maximum payout regardless of the value of their home. This cap is generally determined by provincial or state authorities who might base the cap on a variety of factors such as availability of funding, average prices of homes in the area, aggregate value of disaster assistance offered, number of times the property has been flooded, type of floodplain, size of tax base or the value of the land based on property tax (Freudenberg et al. 2016). This type of offer can be challenging for residents to accept, especially for those whose homes are much more valuable than the average in the area (e.g. waterfront location, extensive renovations or retrofits, and high quality of the house) (CTV, 2019b). Despite the criticism and cost associated with the home buyouts, governments should consider these alternatives for communities that are hit repeatedly by seasonal floods to reduce future risk (IBC, 2019).

Fiscal considerations are important when determining fair and equitable compensation rates that will benefit afflicted homeowners and the local municipality. An emergent theme in the literature review was how compensation offered to homeowners should inherently benefit the greater good of the community (Hino, Field & Mach, 2017). Offering payouts to residents that sufficiently cover existing mortgages, account for relocation costs and provide housing counselling heavily incentivizes participation and program success in small scale communities (De Vries and Fraser, 2012). But such payouts typically require support from higher levels of government since it is difficult for communities to mobilize themselves in order to adequately protect themselves from the impacts of climate change (Siders, 2018). When a city considers its options post-disaster, it weighs three choices, including (1) allowing rebuilding (i.e. replicating the previous structure); (2) facilitating rebuilding that reduces future flood damage (e.g. floodproofing); or (3) relocating development to remove the risk of future damage (Freudenberg et al., 2016). The direct and immediate costs that municipalities will incur following a property purchase include pre-acquisition costs (e.g. legal fees, costs of feasibility studies, appraisals, zoning charges etc.), purchase price (pre-flood market value, post-flood

market value, compensation cap), property maintenance and demolition (Freudenberg et al., 2016). The trade-off that local governments contend with is the possible loss of property tax revenue (i.e. if homeowners relocate to new communities) and how to offset those impacts by helping homeowners to relocate within the same municipalities.

2.7.1 Example 3: Pre-Flood Market Value Compensation in New Jersey via Blue Acres Buyout Program

The case of Blue Acres, New Jersey is similar to that of Oakwood Beach, New York – in both cases, Hurricane Sandy made landfall in October 2012, ravaging much of the east coast and leaving many communities in the New York /New Jersey /Connecticut urban area exposed to the storm and related floods. The storm inundated homes, disrupted critical infrastructure and disabled power plants and transmission lines, leaving 8.5 million customers without electricity and resulting in damage to over 600,000 homes and killing 60 people (Pirani & Tolkoff, 2014). The storm caused $65 billion in damages (Pirani & Tolkoff, 2014) across multiple municipalities, triggering a consensus that new adaptation and risk reduction strategies were needed.

The 2012 Hurricane changed the spatial, temporal and political landscape of how recovery efforts were deployed in the U.S. and created a window of opportunity for retreat in flood risk reduction. Two related programs, the Green Acres program established in 1961, designed to serve growing recreation and conservation needs, and the Blue Acres program established in 2007, were important foundations for post-Sandy retreat (NJDEP, 2020). The Blue Acres Buyout program developed by New Jersey's Department of Environmental Protection committed to spending $300 million in federal disaster recovery funds to voluntarily acquire approximately 1,000 properties in tidal areas affected by Hurricane Sandy and another 300 properties in towns that faced repeated flooding (NJDCA, 2020). The Blue Acres Program has been active in fourteen municipalities and complements a wide range of storm-resiliency efforts, including construction of a state-wide system of engineered beaches and dunes, development of protective standards for elevating homes in coastal areas, protecting and improving water and wastewater infrastructure, and assisting local governments with flood mitigation and adaptation projects (NJDEP, 2017). The goal of the program is to purchase flood-

prone properties at pre-storm value, further reducing the risk of calamitous flood damage to coastal communities (NJDEP, 2017). The financial incentive of offering pre-flood market value for homes prompted homeowners to consider the offer and gave them the financial support to relocate to adjacent communities where house prices were similar in value. The 100% pre-flood fair market value was offered to homeowners state-wide through a clustered approach which looked to maximize the amount of land acquired for conversion into open space (NJDEP, 2017).

As people vacate areas of high flood risk, it becomes more challenging for municipalities to provide essential services for isolated homes that frequently flood, so targeting homes in clusters attempted to counter the common "checkerboard pattern" seen in some buyout programs (Plastrik & Cleveland, 2019). An additional incentive offered through the Blue Acres program was mortgage debt forgiveness, which aided struggling homeowners in financial peril (NJDEP, 2017). The State of New Jersey completed short sales and lender payoff approvals for 64 properties amassing to a total debt forgiveness of $4.5 million USD (NJDEP 2017; Patterson, 2018). Effective use of quick deployment, federal disaster funding and pragmatic planning all aided with New Jersey's long-term recovery efforts. From its inception, participation and compensation were huge factors that influenced the program design of the Blue Acres Buyout program deeming it a pragmatic adaptation tool against natural disasters.

Numerous factors led to the success of the Blue Acres Program. First, the Blue Acres program is designed to provide sellers with a fair and equitable compensation value in conjunction with an implementation team that assigns a case manager to work closely with property owners seeking to sell their homes to the state. Offering pre-storm market value acts as a self-promotion technique in which interested homeowners will approach the state as opposed to the state trying to convince prospective property owners. Second, to streamline the process and accelerate the lengthy acquisition process, Blue Acres commissioned a team of appraisers, environmental hazard inspectors, title reviewers, GIS experts and real estate professionals to expedite the acquisition process and minimize red tape (FEMA, 2018b). Of the nearly 900 offers made by the Blue Acres program, 678 have been accepted, with the remaining moving through the process, and more than 460 homes have been demolished, creating open space that will mitigate flooding and protect homes (Patterson 2018; NJDEP 2017).

Another aspect of the program that was highly regarded is the level of transparency and support provided through the program, which allowed homeowners to appeal the appraisal, hire their own appraiser for a second opinion, or even opt out of the home buyout process at any time (FEMA, 2018b). The State of New Jersey also provided tools and resources for low-income residents who lacked the means to hire an attorney or appraiser by offering financial assistance and pro-bono legal services for selected homeowners (Patterson 2018; FEMA 2018b). These multiple factors produced a program which successfully garnered community support and encouraged the notion of managed retreat as a viable adaptation option that works to create positive outcomes for afflicted homeowners, communities, government agencies and the natural environment. This case study highlights the value of offering fair and equitable compensation to property owners who are ravaged by natural disasters and the benefits of advancing program uptake through financial incentives, thereby increasing the autonomy and agency of residents.

2.8 Critical Discourse and Engagement amongst Federal, Provincial/State & Municipal Authorities

Principle # 4: *Governments must engage in a multi-tier dialogue about flood risk reduction and climate adaptation strategies that are viable, effective, economical and long-lasting.*

The role of government agencies is critical to the planning, operations, logistics and management of essential response and recovery measures (including the managed retreat option) that are implemented at the local, provincial and federal level. Stimulating productive and critical dialogue to engage key stakeholders who hold decision making authority and have the capacity to support citizens through financial resources and provisional services is imperative in creating workable buyout programs. Municipalities and lower-tier governments interested in buyout programs should collaborate in encouraging upper-tier governments to develop funding mechanisms and guidelines that can support local programs (Thistlethwaite & Ziolecki, 2020). In turn, federal and provincial/state governments should be proactive in working to support local governments by providing technical assistance and helping local governments to evaluate their fiscal impacts (Freudenberg et al., 2016). Provinces/states are increasingly becoming more reliant on resources provided by the federal government to spread

the financial burden when disasters occur, but it is still unclear how much of that funding is allocated for buyouts vs. land-use planning, emergency management operations and resiliency building to mitigate future impacts.

Flood hazards can impact and spread across multiple jurisdictions, which further exemplifies the need for federal government entities to streamline governance practices that can help to coordinate recovery plans and mitigation projects such as buyouts (Moscovitz, 2018). However, this could trigger the related challenge of having multiple tiers of authorities involved on the planning and execution of buyout programs. Jurisdictional conflicts may arise since municipalities are often responsible for local adaptation and flood management, yet may not have full access due to multi-jurisdiction boundary issues (Doberstein, Tadgell & Rutledge, 2020). The combination of a national flood risk reduction strategy, support mechanisms, partnerships and information-sharing networks help to educate and mobilize communities that are the most vulnerable to flood hazard (IBC, 2019; Thistlethwaite, Henstra & Ziolecki 2020). The use and type of policy instruments in Canada varies drastically from jurisdiction to jurisdiction, depending on the priorities and level of government involved, which can impact land use/spatial planning, capital investments and mitigation /adaptation projects. Understanding contrasting dynamics, stakeholder interests and political tensions that might be present amongst jurisdictions is essential in avoiding coercive buyouts that could be maladaptive in nature (Binder & Greer, 2016).

Budgetary constraints related to multiple levels of government being involved in managed retreat are an important consideration. Looking at existing structures across the US, it is evident that local governments often have to apply for funding from upper tier government agencies (e.g. FEMA) in order to support buyouts. Funding from upper governments can reduce the trade-offs for local governments between buyouts and property tax revenue, and guidelines can create a 'level playing field', reducing the potential for developers to seek other locations with fewer regulations (Thistlethwaite & Ziolecki, 2020). Regardless of the level of government that is providing the funding, it is important to consider costs and benefits associated with managed retreat strategies since buyouts may bear consequences for community structure but have an overall positive impact on mitigating the impacts of flood damage.

2.8.1 Example 4: Documenting Critical Governmental Dialogue on Floodplain Management Post 1993 Mississippi River Flood

The Great Mississippi River Flood of 1993 was unprecedented in magnitude, scale and duration, ravaging much of the American midwest and leaving behind extensive damage and loss of life (Freudenberg et al., 2016). Riverine flooding impacted large portions of nine Midwestern states and resulted in the federal government declaring disaster areas in more than 420 counties (Bhowmik & Demissie, 1994). Damage from this catastrophic event resulted in over $20 billion USD in damages, 130 people lost their lives, and the event was considered at the time the largest U.S. economic loss triggered by natural hazards (Galloway, 2008). The unparalleled economic loss prompted a federal review of the U.S. flood control policy, both before and after the 1993 flood, concluding that the optimium strategy for reducing flood losses was to limit or reduce infrastructure development on floodplains (Pinter, 2005). This flood event was particularily noteworthy since protective structures such as dams and levees along the Mississippi and Missouri river systems were breached, spilling over and flooding adjacent croplands and transportation routes. The extent of the flooding and the scale of the damage led Illinois and Missouri, the two most impacted states, to engage in FEMA-funded buyouts of 7,700 properties located in the floodplain that were acquired at a cost of $56.3 million USD (Pinter, 2005).

The Midwest Flood was the first time that property buyouts funded by FEMA took place during 1989-2008, with most flood damage occuring during that time period (Mach et al., 2019). During that period, U.S. governments looked to reduce the costs associated with future flooding whilst also shifting the paradigm away from mitigation measures as the most appropriate way to manage risk. Properties that were purchased in low-lying areas were converted to open space, wetlands or restored floodplains. Following the events of 1993, the federal government responded by forming a special committee to examine the causes of the Mississippi riverine flooding and recommend changes to the national floodplain management policy which included promoting retreat through property acquisition (Siders, 2018). The committee declared that the national goals of floodplain management should be congruent with those of the federal, state and local governments in collectively reaping the benefits and

sharing the costs of protection measures, reducing flood damage, enhancing the natural environment and supporting economic growth (Galloway, 2008). The 1993 floods impacted communities differently and changed the way recovery efforts were deployed in the U.S. Organizations from all tiers of governments (eg. FEMA, HUD CDBG-DR, Agriculture and Interior Wetlands Accquisition, Transportation) worked together to finance buyouts, relocations and other alternatives, such as floodproofing and elevating buildings above the floodplain (Conrad, 1998). Each of the states divided themselves into ten Housing Recovery Zones to administer their buyout funds on a more local level, with each of them designing an administrative plan and selection criteria for the buyouts in their separate zones (Freudenberg et al., 2016). The swift coordination and emergency response from local, state and federal governments demonstrated that collective action could eliminate bureaucratic barriers and provide much needed disaster relief and buyout programs to communities in peril.

The intermittent committee on floodplain management determined that there would need to be changes in order to reduce flood risk for Americans living in floodplain zones, and both managed retreat and multi-tier intergovernmental coordination played a key role in this. Guided by the goal of the reduction of flood damage, the experts determined that they would address floodplain management issues and encourage ecological succession by avoiding use of the floodplain for development unless it was intended for water-oriented alternatives; minimize damage to development in floodplain zones by relocating, floodproofing, upstream storage, or use of flood defences; mitigating damages through education programs like insurance or early warning systems; and addressing floodplain management on a watershed basis (Galloway, 2008). The ability for governments to collectively assess the limitations and benefits associated with buyouts and the cascading implications those actions have on communities, tax dollars and the environment should be praised as a commercial success (Binder, Barile & Baker, 2019). The state of Missouri sought funding from FEMA in order to mobilize the Missouri Buyout Program which enabled the City of Arnold to offer residents who lived in the floodway a preflood valuation on their properties along with a deed restriction that prevented further development and converted the land to green space (FEMA, 2003). As of 2006, the U.S. Army Corps of Engineers stablished the National Flood Risk Management

Program to take the inaugural steps of bringing together all levels of government and private sector entities who had a stake in flood risk management to work on a unified national flood risk strategy whilst eliminating internal program conflicts (USGPO, 2008). Innovative cost sharing solutions between federal, state and municipal governments are required in order to effectively use voluntary home acquisitions to reduce the risk of future flooding for communities located in floodplains. This case study highlights the value of collaborative efforts spanning all levels of government and exemplifies that internal silos need to be broken down in order to effectively assess, adopt and implement climate change adaptation solutions such as managed retreat.

2.9 Integration of the 'Build Back Better' (BBB) Model in the context of Relocation Programs & Alleviation of Administrative Backlog in Disaster Recovery Assistance or Home Buyout Programs

Principle # 5: Governments should integrate the Build Back Better model in relocation programs when buyout mechanisms are not available or applicable; *authorities responsible for processing the disaster recovery assistance or buyout payments should aim to reduce or eliminate administrative backlogs and streamline the delivery of retreat-related services to afflicted homeowners.*

Mitigation has historically been the cornerstone of any preventative action or risk reduction strategy, but most notably has been made prominent within the climate change domain. Risk mitigation is often the primary force driving relocation though risk can be subjective depending on the collective values people have, the current or future hazards in a particular location and the prepardness of communities in response to developmental change (Scott et. al., 2020). Most buyout programs serve the purpose of permanently moving away from the hazard to minimize future risk and thus adaptating to the system state post-disaster. Buyouts are especially suitable for properties facing repeat losses, though a noteworthy feature of one Canadian voluntary buyout program (e.g. Quebec) is that homeowners who choose to stay in high-risk areas are not eligible to make future claims from government disaster assistance programs (Insurance Bureau of Canada, 2019). An alternative to property buyouts are disaster recovery assistance programs which provide homeowners financial support to cover unforseen costs associated with cleaning, repairing and replacing of any damaged

essential property (Government of Ontario, 2019). Communities that are offered property buyouts through provincial/state governments often have access to a parallel disaster recovery assistance program that homeowners can apply to in the event the losses do not exceed the damage threshold required for community retreat. However, there are often stipulations associated with these programs which could waive property owners' rights to access future financial assistance if they forgo the aid offered and continue to live in their home (Boudreault & Bourdeau-Brien, 2020).

A key consideration in designing buyout and recovery assistance programs is the ability to streamline efforts to encourage uptake while minimizing the administrative backlog that ensues after program delivery. Administrative staff responsible for program implementation and the technical evaluation of applications should help homeowners understand the full range of available financial compensation options prior to committing to one (Freudenberg et al., 2016). Maintaining transparent and open lines of communication between all stakeholders involved is crucial in disseminating accurate information during all stages of recovery. Having designated 'buyout/disaster assistance' staff on the ground in the community will help to minimize confusion about eligibility and provide support for residents through the application process to minimize errors. Residents and buyout staff report that buyout processes are extremely sensitive and contentious at times due to factors such as length of time between buyout agreement and relocation; miscommunication between internal program staff, recovery agencies and residents; homeowners' lack of trust in the process; and city officials and buyout staff ultimately making homeowners feel coerced into participating in the buyout process due to the lack of other reasonable options (Fraser, Elmore, Godschalk & Rohe, 2003). In the aftermath of a disaster, residents do not want to deal with an additional administrative backlog that can hinder homeowners from receiving disaster assistance or essential services, or further disrupt their lives. Unfortunately, post-disaster planning is often heavily constrained by limited funding and human resources (Olshansky, Johnso, Horne & Nee 2008). Considering that buyouts are emotionally, mentally and financially taxing on property owners, it is important to cultivate positive working relationships between residents, agencies and other government authorities to help ease the transition and streamline the information and application process.

2.9.1 Example 5: Rebuilding Properities through the Road Home Program (RHP) as an Alternative Post-Disaster Recovery Strategy in New Orleans, Louisiana

An alternative approach that has been considered in many flood devastated communities is rebuilding properties to higher flood-resistant standards (including via relocation/buyout programs) as a potental mitigation and adaptation measure. This mode of recovery has been particularly evident in New Orleans, Louisiana through the development of the Road Home Program (RHP) that has helped the city to recover from Hurricane Katrina. In August 2005, Hurricane Katrina, a category 5 hurricane, made landfall in New Orleans devastating homes and destroying businesses while the storm surge breached levees and flooded arterial parts of the city which lie below sea level and are prone to flooding (Moore, 2007). Hurricane Katrina damaged 71% of housing or 228,000 housing units in New Orleans, making this event the largest residential disaster in American history and afflicting a diverse socioeconomic spectrum of residents with widespread damage (Finch, Emrich & Cutter 2010; Olshansky et al. 2008). An estimated 1,200 people lost their lives as a direct result of the storm, which also cost an assessed $108 billion USD in property damage making it the costliest storm on record (Gibbens, 2019). The extent of the storm triggered widespread response from all tiers of government, which committed to spending nearly $95 billion USD to suppport Gulf Coast disaster relief with one of the programs being Louisana's Road Home Program that supported rebuilding (Green & Olshansky, 2012). The aftermath of the storm exposed a series of physical vulnerabilities and social inequities that crippled local economies and changed the future of business and industry in the region.

In the months following the hurricane, plans for recovery, disaster assistance, and rebuilding and home buyout programs began to emerge from state and local governments. Federal funding was disseminated through the Community Development Block Grant (CDBG) and directed to the Louisana Recovery Authority (LRA) to support the RHP proposed at $7.5 billion USD, and this aided residents to either rebuild or sell their homes in the form of a buyout (Green & Olshansky, 2012). Eligible residents were offered the choice of three assistance options (detailed below) under the RHP with compensation grants valued up to $150,000 USD (RHP, 2017). Grants were funded through a number of different governmental and non

governmental agencies such as FEMA, National Flood Insurance Program (NFIP), USDA, private insurance and state emergency funds.

Residents were offered three different options under the State's disaster recovery assistance program. Under option 1, applicants could stay in their homes and receive funds either based on the uncompensated cost of damage or loss of value up to $150,000 USD, although the stipulation attached to this option was that all applicants were required to have flood insurance. In the event the applicant was located in the floodplain and did not have insurance, a 30% deduction would be applied to the total eligible compensation grant (RHP, 2017). Residents could also tap into an 'elevation incentive' to elevate the damaged home , based on the type of construction and the square footage of the property (RHP, 2017). An alternative funding pot that applicants could apply to was the Additional Compensation Grant (RHP, 2017) for residents who choose to stay and rebuild, which tops up the gap between the estimated cost of damage and the compensation received. Option 2 gave residents the ability to sell their properties to the state and relocate to another home within the state with similar compensation conditions as option 1 (RHP, 2017). Option 3 allowed homeowners to partake in a buyout and move out of Louisiana or become a renter. Homeowners that transferred their properties to the state were offered pre-storm value on their properties. The three options collectively were part of 'The Road Home Program (RHP)' which was established and approved for homeowner particpation in 2006: the Program funded project rebuilds and buyouts from 2006 until until March 2018 when the program was officially concluded.

The Road Home Program has now concluded and program assessments have revealed its many successes. As of March 2020, 100% of the 130,053 homeowner applicants have had their benefits dispersed, with disembursements totalling $9,030,223,344 USD with the average grant being $69,436. Ninety-two percent or 119,173 of homeowners opted for option 1 which was to stay and rebuild in Louisiana for a total expenditure of $8,100,733,711 billion USD and an average grant of $67,975 (RHP, 2020). Option 2 which was to sell but stay in Louisiana warranted $748,254,133 in funding for 8,490 residents (RHP, 2020). 2,390 homeowners partook in option 3 which totaled $181,424,555 USD (RHP, 2020). Many of these applicants also

applied for the elevation incentive which cost the program a total of $942 million USD for 32,388 applicants (RHP, 2020).

Reimbursing losses after a disaster perpetuates a cycle in which resources available to protect communities from flood damage are instead used to re-create vulnerability, which creates a climate of 'moral hazard' where people fail to take appropriate actions to reduce their risk (Gordon & Little, 2009). The use of rebuilding initiatives which include the elevation incentive incorporates higher safety protocols and flood resilient standards, which can help to migitate storm-induced property damage in the future. Despite many program shortfalls related to compensation, timeline delays and lack of eligibility clarity, the RHP provided options that incorporated both retreat and accommodation (i.e. rebuilding homes with added elevation) as hazard mitigation and adaptation supports. This case study highlights the value of integrating a protect/rebuild better option within the jurisdiction's mainstream disaster recovery assistance program in order to give homeowners the option and the autonomy to make their properities more resilient to natural hazards, especially when buyouts or relocation were not chose by homeowners.

2.10 Conclusion

As much as is known about managed retreat practices, there are undoubtedly still many uncertainties, especially in the context of jurisdictional authority and government intervention. In this chapter, five best practices emerging from the literature were highlighted regarding the planning, development and implementation of home buyouts across North America. The guiding principles for managed retreat revealed in the literature include: consensual collective community-based participation; transparency and flexibility in program and funding models; fair and equitable financial compensation; critical dialogue and engagement of federal, provincial & municipal authorities; and alleviation of administrative backlog, and integration of the build back better model into relocation programs and long term spatial planning. Each of the five case studies, Oakwood Beach, Houston, New Jersey, Mississippi and New Orleans, depict elements of these principles that were used in the buyouts in these cases. The Case of Oakwood Beach highlighted the importance of community driven participation and collective

bargaining to increase uptake of buyouts in the community. In Houston, the use of flexible and transparent options for homeowners was crucial in helping individuals to decide whether to protect, rebuild or relocate their assets. In New Jersey, major capital investments were made in order to offer homeowners pre-storm values for their properities despite their risk tolerance level. Mississippi, the oldest case study highlighted, is particulary interesting because of the intergovernmental dialogue and mobilization that occurred in order to find active solutions, including retreat, to combat flood hazards. The final example of New Orleans is unique in highlighting the integration of build back better strategies in recovery assistance for individuals and communities where managed retreat may not be the most feasible option available. Further research is required to outline additional steps and possibily principles that can help lead to better buyout plans and implementation frameworks. This chapter is meant to highlight and further recommend best policy practices or starters that can be adopted to enhance the delivery of home buyout programs.

Linking body between Literature Review (Chapter 2/Manuscript #1) and Comparative Analysis (Chapter 4/Manuscript #2)

The purpose of this linking body is to explain the connections between the two manuscripts written in this thesis.

The first manuscript entitled 'Strategies for effective home-buyout programs in North America' is a collection of best practices or lessons that can be used by policymakers to enhance the delivery of residential property buyouts regardless of any external challenges such as jurisdictional authority or funding limitations. Manuscript 1 (M1) provided the author, Shaieree Cottar, with a base of knowledge on managed retreat and home buyouts within the North American context as her proceeding manuscript drawns upon her own primary research with case studies in the Canadian environment. The format of M1 amalgamates policy, theory and the application of case studies into one body of literature which can be used to evaluate the relative success and efficiency of buyouts on a community scale.

The first manuscript also provides a skeleton of how policymakers should approach and proceed with large scale home buyouts through the use of basic principles that act as foundational knowledge for the reader. Manuscript 2 (M2) is the empirical portion of the thesis which traces how managed retreat was or was not applied across two Canadian communities of Constance Bay and Pointe Gatineau. This manuscript is an analysis of the *DRAO* and *General Indemnity and Financial Assistance Program Regarding Actual or Imminent Disasters-Flooding* programs that exist in Ontario and Quebec respectively. The use of primary research, conducted by the author, and secondary research (e.x. government reports, policy papers, media news articles) has aided the development and writing of M2 which outlines the programs that were enacted in these communities post the 2017 and 2019 Ottawa River floods. The practices addressed in the first manuscript have aided in enhancing the narrative around managed retreat in the Canadian context by addressing design variations, implications, limitations, policy applications and general knowledge base for readers outside the climate change adaptation space.

Chapter 3: Research Methods

3.0 Introduction

This chapter describes the research methods applied in the empirical study (chapter 4). The purpose of this section is to provide insights into the qualitative methods utilized to assess the practice of managed retreat in the context of climate change adaptation and disaster risk reduction in two communities in Ontario and Quebec. This chapter also analyzes the methodologies used to conduct the comparative research study by describing the recruitment process of participants, interview methods, data collection and coding analysis undertaken for manuscript #2. The empirical study is informed by primary (e.g. interviews) and secondary (e.g. reports, academic journals, news articles) data. Note: This study was reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41255) under the auspices of the Department of Geography & Environmental Management. This project is funded by the Institute of Catastrophic Loss Reduction (ICLR) under its 'Quick Response Program for 2019 Spring Flooding'.

3.1 Key Informants/Participants

The research study engaged different particpants (n=20) who expressed an expertise in the areas of managed retreat, home-buyouts, disaster recovery, climate change adaptation, flood management or actors who were directly or indirectly involved in the 2017 or 2019 flood events in both jursidictions. The project focused on interviewing experts in the field about the application of government sponsored home buyout and diaster recovery assistance programs, deliberately omitting homeowners from the sample due to challenges associated with granularity and privacy concerns. By interviewing an array of different professionals, the researchers were able to exact a renewed understanding of municipalities are adapting to climate related disasters. Interviewees were recruited and selected purposefully based on their experience /knowledge/role of existing disaster recovery or flood compensation programs and, or post-flood decisions to retreat. The participants were afflitated with municipal/ provincial /federal governments, academia, research institutes, insurance, real estate, disaster relief

agencies and community organizations. Since this study compared two different municipalities in two provinces, some key informants were chosen specifically to gather knowledge on one of the case study communities. Researchers made conscious efforts to interview an equal amount of participants from each jurisidiction for equivalent representation. For the purposes of simplicity, key informants are denoted by 'KI #' throughout the chapter in chronological order of when the interviews were conducted.

The process of recruitment for participants was initated after ethics clearance and commenced in December 2019 by email invite (refer to appendix A for recruitment letter) inquiring if the potential interviewee was interested and available to participate. Participants were selected after browsing the internet for the most appropriate interviewees for the study based on job title, organization affiliation and focus of work in relation to the goals of the study. Once the participant acknowledged they were willing to partake in the study, an information and consent letter (refer to appendices B & C) were forwarded and interview (e.g. in-person/virtual) schedules were finalized. In total, 20 interviews were conducted for this study and the interviewing process ceased abruptly in March 2020 when the World Health Organization (WHO) declared the global Covid19 pandemic. Limitations regarding scope of the project, timelines, participant availability and the global pandemic resulted in the interviewee tally.

3.2 Interviews and Data Collection

Interviews were conducted upon receiving ethics clearance and primary data was collected from December 2019 to March 2020 in Ontario and Quebec using semi-structured discussions (n=20). Post recruitment process, interviews occurred over a span of four months at interviewees office, coffee shops, universities or through Zoom virtual meetings. All interviews were audio recorded to facilitate accurate collection of data upon receiving participant consent. The average semi-structured interview lasted from 35 – 75 minutes, comprising of pre-determined list of interview questions (see appendix D) that were shared with participants in advance of the interviews. Examples of themes that were explored in the interview include the following: awareness and details about home-buyouts/flood compensation programs that lead

to either rebuilding/non-building in case study sites, factors that influence hoeowners when considering retreat/non-retreat options and opinions about programs needed under future climate change projections. Notes were also taken by researchers to supplement audio recordings. Following the completion of each interview, a thank-you/follow-up email was sent to the interviewees as an appreciation for their participation, some key informants provided additional resources through email to the research team that would prove useful for the study.

3.3 Coding & Data Analysis

After the interview process, the research team began coding to analyze the qualitative data collected. The preferred method of transcription for the audio-recordings was the use of online transcription software (e.g. Otter and Rev) for all 20 interviews. Once the interviews were transcribed and converted into a MS Word file, manual analysis of the interviews began with the researcher coding for common themes that arose such as 'program design', 'benefits', 'barriers', 'factors influencing homeowner post-flood decisions', 'flood event narrative' etc. These codes were compiled collaboratively with the research team and then added to independently as analysis progressed. Researchers utilized open and axial coding techniques to correlate interdependencies between common themes and narratives. Once codes were matched to corresponding quotes, they were compiled in a MS Excel file to compare themes and verify the validity of the data to supplemental sources and then synthesized for analysis purposes. For the purposes of simplicity and anonymity, all quotes used in Chapter 4 are labelled by 'KI' followed by the number of the interview. Any notes that were taken throughout the interviews were corroborated to provide further insight into the events described in the interview. The research team also had supplemental field notes and photos of post-recovery measures that took place in Constance Bay, ON and Pointe Gatineau, QC that have been used enhance Manuscript #2 which follows on the next page.

Chapter 4: Evaluating Applications of Managed Retreat and Disaster Recovery Assistance (Rebuild) within the Canadian Context: A Comparative Analysis of Constance Bay, Ontario and Pointe Gatineau, Quebec

4.0 Introduction

Climate change is increasing the intensity and frequency of extreme weather events across Canada, which is prompting communities to consider adaptation alternatives (IBC & FCM, 2020). Spatial development, land use patterns and changing climatic conditions are exposing riverine communities to increased flood risk. Given the growing costs of protection (e.g. coastal defences, sea walls) and limits to accommodation (e.g. property elevation or floodproofing), adaptation measures such as retreat are becoming more pressing, particularly in light of models that show intensifying climate change (Mach et. al. 2019). Flooding in Canada is the costliest natural disaster, accounting for three quarters of payouts under the federal Disaster Financial Assistance Arrangements (DFAA) program, totalling $3.7 billion as of 2014 (IBC & FCM, 2019). As governments invest in flood defence infrastructure and target properties at high risk of repeated flooding for buyouts, overland flood insurance is becoming more available and affordable since the risk is primarily borne by the homeowner (IBC & FCM, 2019).

Managed retreat as a climate change adaptation tool is still considered an evolving policy instrument in many Canadian jurisdictions due to the challenges (e.g. financial, political, legal, social, etc.) associated with implementing voluntary property buyouts. Retreat is an age-old idea that has historical ties to relocating to higher ground in the face of nature's adversities (Carey, 2020) but still remains a contentious proposition for vulnerable communities that face the repeated threat of flooding. Voluntary property buyouts in the Canadian context have been sparse to date but with increased annual flood related events, governments are beginning to explore a wide range of adaptation options, including retreat/buyouts to secure the future well-being of at-risk communities.

Climate change adaptation (CCA) is inherently entwined with managing hazard-based risks and building capacity to respond to natural disasters through sustainable solutions such as retreat. Analyzing the current state of adaptation across Canada is imperative to understand

the costs, benefits and implications that affect disaster recovery programs, developmental planning and decision making that is directly linked to enhance community resilience. Although advancements have been made in climate modelling, floodplain mapping and hazard-based risk assessments, policymakers must consider the opportunities, risks and financial capacity associated with enabling programs (e.g. disaster recovery assistance and home-buyouts) in communities that are prone to repeated riverine flooding. Studies of riverine adaptation in U.S. communities suggest that retreat is a feasible CCA strategy that can be adopted by municipalities to mitigate future risk and prevent damage to critical infrastructure and residential properties.

Figure 2: The PARA (Protect, Accommodate, Retreat & Avoid) framework illustrates four strategies to reduce risk and enhance future flood resilience (Doberstein, Fitzgibbons & Mitchell, 2018).

The 'PARA' (Protect, Accommodate, Retreat & Avoid) framework offers a suite of actions to better prepare communities to cope with flood hazards so that they can recover quicker from flooding episodes (Doberstein et al., 2018). These four strategies are often used in conjunction with disaster risk reduction (DRR) and can be applied to riverine, coastal or pluvial flooding scenarios to mitigate flood impacts. The literature on Canadian flood risk reduction strategies has historically reflected the use of 'structural engineered' approaches as opposed to 'soft' or 'nature-based' solutions to mitigate risk, but Canada is gradually engaging in retreat alternatives to ehance resilience to future flooding scenarios and to reduce disaster costs. This paper evaluates the applications of both retreat and rebuilding as responses to flood hazards in Canadian communities to support disaster recovery.

This paper considers whether and how disaster recovery policies after the 2017 and 2019 Ottawa River floods incorporated land use planning and flood management mechanisms to address risk, primarily in the form of property buyouts or disaster recovery compensation, and examines post-flood decisions about retreat or rebuilding communities. The analysis compares the programs administered the Quebec Ministère de la Sécurité Publique and the Ontario Ministry of Municipal Affairs and Housing in response to the 2017 and 2019 Ottawa River floods, including the deployment of recovery efforts that preceeded both flood events. The research uses primary and secondary data sources to compare the impact of recovery programs in two jurisdiction which experienced successive floods - one with a government sponsored home-buyout program (i.e. Pointe Gatineau (PQ), Quebec) and one without (i.e. Constance Bay (CB), Ontario).

4.1 Research Objectives

The main purpose of this paper is to assess provincial policies (i.e. Home Buyouts and Diaster Recovery Assistance) and the feasible implementation of retreat plans as a climate change adaptation strategy for Canadian communities in Pointe Gatineau, Quebec and Constance Bay, Ontario. I argue that the five principles of effective home buyouts can be used as an assessment framework for communities building resilience to flooding through managed retreat, and also that these principles can be used to guide jurisdictions that have not yet set up

buyout programs. These guiding principles have been derived from the managed retreat literature and, prior to this research, had yet to be collectively verified in the field in relation to these two particular Canadian cases. The research described here compared the successes, challenges and barriers experienced in each of the programs, and explored program influence on how retreat or non-retreat decisions were made in each community. This research draws upon decision making factors that led flooded homeowners to retreat or rebuild based on formal government policies and programs related to disaster recovery. This study affirms that managed retreat is a notable climate change adaptation strategy that should be explored further within the Canadian domain. The following research questions guided this evaluation:

1. How have municipalities (i.e. Pointe Gatineau and Constance Bay) adapted to climate related disasters through the use of home buyout programs or disaster recovery assistance?
2. What factors, policies or programs affected homeowners' decision in retreating or rebuilding their homes after the flood damage in 2017 and 2019?
3. What factors influence governments to choose managed retreat as risk management strategy in the post-flood period?

4.2 Case Studies – Selection Criteria

This study was conducted in the communities of Pointe Gatineau and Constance Bay (n=2), located in the provinces of Quebec and Ontario, respectively. The principal factor guiding the selection of these two particular communities was the fact that both areas were exposed to severe riverine flooding in both 2017 (April – May) and 2019 (April –June) resulting in catastrophic damage to residential properities. Another key criteria for case selection was the similiarity in geographical location of the communities in relation to the Ottawa River – the two communities are located just 30 kms apart. The third criterion, which is of utmost importance, is that the communities are situated in different provinces with different programs and policies on disaster recovery and managed retreat. Both communities are centrally located near the National Capital Region, also referred to as Ottawa-Gatineau. The two cases provide sufficient similarities (i.e. exposure to riverine flooding, geographical location, types of dwellings,

intergovernmental coordination) and differences (i.e. programs and policies, culture, population size) to conduct a comparative analysis on how and why managed retreat was or was not implemented in these communities. It is important to note that these cases are not representative of all Canadian buyout programs, as these were reactive in nature, relatively small in size and did not involve assisted relocation as part of the managed retreat process. Lessons learned though this comparative analysis will help to identify ways to enhance resilience in flood-prone communities through the use of managed retreat and or other protect/rebuild strategies.

4.3 Research Methods

This research used a qualitative, comparative case study (n=2) method, which analyzed the Canadian communities of Pointe Gatineau and Constance Bay. The study employed primary and secondary data sources to inform the project goals. Primary data was collected through semi-structured key informant interviews (n=20) in both jurisdictions through October 2019 to March 2020, based on guidelines developed as part of a research grant funded by the Institute for Catastrophic Loss Reduction (ICLR). Many of the interviews were conducted with people who were knowledgeable about retreat in Canada. Semi-structured interviews were used to elicit participants' experiences with or knowledge about flood recovery programs (e.g. buyouts or recovery assistance), along with their perceptions of what would influence homeowners to consider or not consider buyouts.

For the purposes of this study, key informants (KI) were identified through purposive and snowball sampling methods. KI's chosen for the study came from a variety of different backgrounds including municipal government, provincial government, federal government, insurance, real estate, disaster relief agencies, community organizations and special interest groups. Including homeowners as study participants was outside the scope of the project due to ethical concerns about interviewing disaster survivors. Government participants worked in the areas of planning, policy and research within the disaster risk reduction (DRR) and climate change adaptation (CCA) context. Secondary data sources (n=101) used for the study included a wide range of sources such as journal articles, policy reports, newspaper articles, government reports and other grey literature. In addition, the research team and I conducted two field

observation trips (June 2019 & February 2020) to Pointe Gatineau and Constance Bay to assess the impacts of the floods and ongoing recovery, and to detail visualized progress of home-buyouts that had already been initiated.

4.4 Case Study Results

4.4.1 Pointe Gatineau, Quebec

4.4.1.1 Timeline: Pointe Gatineau after Successive Floods (2017 & 2019)

The community of Pointe Gatineau, located in the City of Gatineau, is bordered by the Ottawa River along the northern banks and has recently experienced severe weather events. This municipality faces recurrent severe flooding caused by heavy rain as a result of its proximity to the river, its sizeable watershed and the impacts of climate change (Government of Canada, 2019). Many neighbourhoods in Quebec were impacted by the 2017 and 2019 Ottawa River floods as these communities were built on floodplains and did not have any sort of structural protection to defend homes (Boudreault & Bourdeau-Brien, 2020).

Widespread damages and ensuing consequences were seen after both major flood events in Pointe Gatineau. On April 5, 2017 the Rideau Valley Conservation Authority (RVCA) released a warning for heavy rain, combined with heavy snowmelt that caused flooding in low-lying regions with rainfall records surpassing 30mm (CBC, 2017). Flood levels in the City of Gatineau steadily increased by the following week and water spilled onto adjacent streets and dwellings, while simultaneously the municipal government mobilized and offered protection measures (e.g. sandbags) to afflicted residents. By April 19, the Quebec government announced emergency funding for 10 Outaouais municipalities for damages not covered by insurance, and 23 homes in Gatineau were evacuated due to increased flood risk (CBC, 2017). On May 1st, record rainfalls surpassed 55mm as water levels broke a 20 year high with more than 143 residents being voluntary evacuated out of Gatineau (CBC, 2017). The highest flood peaks in Gatineau reached 45.13 metres on May 7, surpassing previous records from the 1974 floods (Ottawa River Regulation Board, 2017). The subsequent weeks brought several days of continuous rainfall, increased mobilization of military services and disaster relief agencies (e.g.

Red Cross), and further evacuations along riverine communities in Quebec and Ontario. One key informant noted that:

> *"The difference in psychology of the people in 2017, people were come to me asking me, like help us find ways that we can save our house from the floods, you can rebuild and you can raise it and so on…In 2017, for the floods we asked the government for $5.9 million like those are the expenses we claimed, and we're anticipating $3.4 million from them with the balance being paid out by the foot of the city." (KI 13)*

Considering the severity of the disaster, community members echoed sentiments of staying back, overcoming the floods and recovering collectively. By mid-May 2017, community members started to return and assess the damages to their properties, while Quebec provincial authorities announced disaster relief provisions for primary residence holders (CBC, 2017).

The flood events of 2019 were essentially a repeat of the previous season although flood levels were slightly higher than those of May 2017. The *Commission de Plantification de la régularisation de la rivière des Outaouais* informed both municipalities and residents on April 18 that actions would need to be taken to prepare for the onset of flood damages. The City of Gatineau commenced its municipal intervention plan, which included constant communication with partners, the distribution of sandbags and loose-sand at several sites, the use of rockfill in high alert areas (e.g. Masson-Angers sector) as a preventative measure, and the deployment of emergency authorities to remind residents about safety precautions (Ville de Gatineau, 2019). Residents were advised to be vigilant and ensure the protection (i.e. sandbags) of their properties while keeping up to date with flood alerts. Gatineau officials confirmed that 111 homes had been evacuated, 923 damaged and 885,000 sandbags had been distributed (CBC 2019e; CBC 2019f). Recovery efforts were considerably longer as water levels took longer to recede compared to 2017, and residents were left to fend for themselves or retreat to higher grounds. A key informant noted visible differences between both flood events:

> *"But in 2019, it took so long for the water to recede, the army had already gone. So, we were like, nope, not this time, and there were much more sandbags everywhere than in 2017…and actually in 2019 people were more critical about what help are they really bringing us? It took like six weeks for the water to just leave. So, in 2019, our cumulative expenses were $11.4 million." (KI 13)*

The flooding this time around affected more than 250 municipalities, including Pointe Gatineau, and more than 10,000 people had to be evacuated despite major roads and essential services being closed (Government of Quebec, 2019a). By mid-April, Quebec Premier François Legault announced that the province would compensate homeowners dealing with flooded properties up to $100,000, after which the government would then offer to buy the home at a maximum cost of $200,000 (CBC, 2019a). Post recovery evaluations noted that more than 100 homes had been affected by the floodwaters in Gatineau, and $25.9 million had been paid out through financial aid across the province (CBC 2019a; Montreal Gazette 2019).

4.4.1.2 Canadian Policies: Quebec's Disaster Financial Assistance Program

As a result of the 2017 and 2019 major floods, the Government of Quebec revamped its financial assistance program specifically for flood disaster victims. The *General Indemnity and Financial Assistance Program* for actual or imminent disasters introduced on April 15 (Montreal Gazette, 2019) by the *Ministère de la Sécurité Publique* provided financial compensation to homeowners and tenants whose primary properties had been damaged by the floods. This was the first time that funding for home buyouts was available for Quebec homeowners who wanted to eliminate or reduce their risk of flooding on their properties (Government of Quebec, 2019). Under the new program, eligible residents who were prohibited from repairing or reconstructing could receive financial assistance corresponding to the cost of the new home, up to a maximum of $200,000 with a possibility of an additional $50,000 for the land, which would be granted as the buyout offer or departure allowance (Government of Quebec, 2019b). This home buyout option is directly linked to properties located in the special intervention zone (ZIS) or 1:20 year floodplain, the Government of Quebec previously issued a moratorium affecting 776 municipalities on the construction or reconstruction of buildings to promote a rigorous management of flood-prone regions (Government of Quebec, 2020). In accepting the buyout from the province, homeowners agreed to transfer their property to the municipality for the sum of $1 after which the city had ownership over the vacant land (Government of Quebec, 2019b). The Ministry of Public Security also committed to fund $20.5 million to improve disaster plans and update floodplain maps to combat future disasters (Montreal

Gazette, 2019b). This revised program illustrates that new and robust options are available for Quebec residents who are unable to protect their homes, though there are criticisms attached with these stipulations.

Since the new iteration of the buyout program, there have been amendments made to the financial compensation structure for residents looking to rebuild or repair their damaged homes. As detailed by Boudreault and Bourdeau-Brien (2020, p.2), "the new decree sets a ceiling on cumulative compensation for recurrent flooding, whereas the previous assistance program treated each flood independently and allowed owners to be compensated after each flood". Considering that the 2017 and 2019 flood were successive events, the lifetime accrued amount of financial assistance received for a residence cannot exceed 50% of the replacement cost or the upper threshold of $100,000 (Government of Quebec, 2019). The explanation for this change was that the government was unable to repeatedly offer compensation to disaster victims because this was unfair to other taxpayers, and the new program incentivized homeowners to move from these flood-prone communities. A major condition attached to the decree was that no further financial assistance would be granted for subsequent disasters (after the $100k cap was reached), if residents previously refused the financial assistance offered (CBC 2019b; Government of Quebec 2019). This indicates that the province wanted to absolve all future financial responsibility through these one-time buyout offers. Regardless of the type of disaster compensation selected by homeowners, the neighbourhood structure and social organization of these communities will inevitably change after the flood.

Being one of very few provinces in Canada to offer successive buyouts as an integrated option within the Quebec provincial disaster recovery program, the case for managed retreat in Pointe Gatineau was met with a relatively positive reception by municipalities and numerous homeowners, especially after the 2019 flood events. Despite funding being disseminated by the province, it was the responsibility of municipal governments to identify neighbourhoods located in the 1:20 flood zone, assess the damages to properties and work with homeowners through the application process. Many interviewees valued the use of home buyouts as a way out for disaster victims, but also indicated that bureaucracy and lack of coordination between

intergovernmental partners was a major challenge in the retreat process. As one key informant stated:

> *"No, it wasn't a joint effort, we tried like there was a lot of discussion and conversation between our team and the provincial government to dissect the situation and sometimes we'd get answers and sometimes not. It was really dependent on the case…but it was really our initiative at the municipal level because we had to implement a lot of the regulations that have been adopted by the provincial government…what you are allowed to rebuild and what to do in the special intervention zone, which is basically the zone that has been flooded in 2017." (KI 11)*

4.4.1.3 Applications of Managed Retreat in Pointe Gatineau

While not explicitly marketed or labelled as managed retreat, the community of Pointe Gatineau was the focus of two successive waves of home buyouts, which followed the Ottawa River floods in 2017 and 2019. Although managed retreat in Pointe Gatineau was reactive in nature and used as a response to the two 100-year floods, the Province has essentially begun mandating buyouts to residents by creating a lifetime limit on disaster aid and banning rebuilding for properties at risk of repeated overland flooding (i.e. those in a 1:20 flood zone). The Province's mixed approach of voluntary buyouts, the use of special intervention zones, by-law regulations prohibiting reconstruction, and limited future financial aid, puts pressure on homeowners to either stay and shoulder all future risk or relocate with a finite amount of funds. The narrative in Gatineau illustrated that it was simply too costly to repeatedly bail out residents with disaster aid and a more permanent solution was required to avert future flood risk.

In the aftermath of the 2017 floods, Quebecers who sustained damage to their properties or valuables were eligible to apply for disaster financial compensation after which the city would assess the damage thresholds to see which properties qualified for financial compensation or buyouts. Thus, the buyout was widely perceived as non-inclusive since many homes in Pointe Gatineau did not cross the $100,000 damage threshold and were deemed ineligible for the buyouts though many residents wanted to participate (KI 13; NRCan 2020). Apart from some municipal assistance (e.g. property tax deferral, waiving fees, expediting demolition permits), there was minimal evidence to suggest homeowners were provided ongoing support during the buyout process (NRCan, 2020).

Land left behind by ad hoc retreat is rarely repurposed for communal benefit and may instead leave a patchwork of derelict land that can disrupt sense of community and lower neighbouring property values (Siders, Hino & Mach, 2019). Two participants elaborated on the consequences of the 'swiss cheese' pattern where some houses were demolished, and others were left standing, commenting on both Pointe Gatineau and Calgary experiences:

> *"Our (Pointe Gatineau) Swiss cheese is due to people not being eligible to a buyout. And their (Calgary) swiss cheese is due to people not being forced to take the money that's offered." (KI 13)*

&

> *"I have mixed feelings, we've heard in the news a lot the expression of cheese with holes in it, you know Swiss cheese. It's that the effect is that decisions are taken house by house as the problem is broader than that in it creates a land use that is, that presents many holes into it. So sometimes the decision should have been taken based on like your whole area together and then really more thinking of the long-term planning of it. I agree that sometimes it's okay when the houses are distributed here and there…But in the urban areas, it's not efficient or relevant because it creates some, it can create some social tensions between people because of the damage evaluation [one houses reached the damage threshold while another did not] or the amount of [unintelligible] payout is not sufficient." (KI 7)*

As for the progress of buyouts, the managed retreat process in Pointe Gatineau is still ongoing with files active for both buyouts and financial disaster assistance. Three years into the process, 185 properties have been demolished from which 148 have been officially transferred to the City of Gatineau, with the remaining plots in the process of being transferred to the city, and 34 of those being demolished following the 2019 floods, (KI 12, February 2020). The figure below provides a visual depiction of plots which have accepted home buyouts resulting in partial abandonment of the Pointe Gatineau neighbourhood.

Figure 3: This map illustrates a bird's eye view of all the major plots that were flooded and bought out in Pointe Gatineau after the 2017 and 2019 floods. The plots marked with a red box have been purchased by the provincial government and transferred to the city of Gatineau for demolition (KI 13).

After the completion of the majority of demolitions in 2019, the City of Gatineau has taken significant strides to revitalize and beautify the neighbourhood to make it more habitable for residents still living in the district of Pointe Gatineau. The city council allocated $1.4 million for redevelopment projects on vacant lots with additional funds being paid out from city councillor's discretionary budgets (CBC 2019). Community organizers banded together with councillors and local non-profits to circulate ideas on beautification projects (e.g. urban gardens, commemorative benches, arboretum, community walkway) that provided a sense of purpose and hope in a neighbourhood that had suffered immense physical and social trauma (KI 13). There are also continued efforts by the local government to secure additional funding for a long-term plan that would focus on community rejuvenation (KI 13). The conversion of

these vacant spaces into community parks serves as reminder of the devasting floods but provides an opportunity for the river to spill over in cases of severe inundation (KI 11,12 &13).

Pointe Gatineau's approach to home buyouts offers lessons for other Canadian jurisdictions looking to adopt managed retreat as part of their DRR or climate change action plans. The managed retreat process evident in Pointe Gatineau can be described as a formal, top-down, ad-hoc process that had opportunities for learning and assessment in future design, planning and implementation of buyouts. First, the overwhelming response in community participation, particularly after the 2019 floods, demonstrated that residents were desperate for a solution after dealing with consecutive disasters, but strict stipulations regarding eligibility disenfranchised those who otherwise wanted to participate in the buyout. This indicates that everyone who wants to participate in the buyout should be given the opportunity regardless of the eligibility criteria (e.g. amount [$] damage sustained, location/flood risk levels as it minimizes future expenses for the government. Second, municipalities that experience frequent inundation should consider integrating buyouts as part of their proactive long-term municipal land use plans to avoid reactive situations that can further exacerbate the vulnerabilities of disaster victims. Third, simplification of the buyout application process would alleviate the ensuing financial and emotional burden that residents face during post-recovery operations. One major criticism that was reiterated by both primary and secondary sources was that the application process in both flood events was time-consuming, extensive and required significant supporting documentation before payments were approved and paid out. As illustrated by Pointe Gatineau, property-owners who experience frequent catastrophic floods events are relatively open to the idea of buyouts as a long-term strategy even if it means giving up their properties and relocating.

4.4.2 Constance Bay, Ontario

4.4.2.1 Timeline: Constance Bay after Successive Floods (2017 & 2019)

Across the Ottawa River in Ontario, the community of Constance Bay faced a flood experience similar to that of Pointe Gatineau. Located in the northwest corner of the City of Ottawa, which sits alongside the Ottawa River, Constance Bay was inundated by floods

following severe rainfall and snow ice melt in 2017 and 2019. The West-Carleton district is situated in a 1:100-year floodplain and is known to have legacy development predating Ontario's floodplain planning policies (McNeil, 2019).

Many Ottawa communities (e.g. Cumberland, West-Carleton, Constance Bay, etc.) prepared for the 2017 spring run-off in early April with sandbags to defend against rising water levels which continued for the next 11 days (CBBCA, 2017). On May 5, 2017, the City of Ottawa recorded 40.4mm of rainfall breaking previous records set in 1985 (CBC, 2018). Initial reports indicated that, out of 310 Ottawa homes impacted by the flood waters, 289 were in the Constance Bay area, with substantial damage to waterfront homes (CBBCA 2017; Ottawa Citizen 2017). Community members, faith-based organizations (e.g. Mennonite Disaster Service, Sikh organization Langar for Hunger etc.) and relief agencies such as the Red Cross and Canadian military banded together to provide support, distribute supplies and evacuate residents whose properties were flooded. While surface water impacted the majority of flood-damaged homes during the 2017 spring thaw, prolonged ground saturation and foundation erosion were found to be the costliest damages to residents across Constance Bay (CBBCA, 2017).

Figure 4: A property in Constance Bay, ON is surrounded by sandbags to protect it from the flooded banks of the Ottawa River (Cottar, 2019).

A key informant described the differences in the successive floods and the physical impact of the floods on properties:

> *"That was the big difference between '17 and '19. '17, we had so much rain, and the temperature on April 26th reach 27 degrees, which is very unusual for that time. Almost that was a recipe for disaster, between the snow melt, between the rain, and the northern water…the river you have to consider is your backyard or front door, but the water comes under the ground too…also, the water in 2019 was almost 30 centimeters higher than 2017, but the worst thing is, it took five weeks before it started receding. That's why, this time around, a greater amount of black mold than we saw the first time." (KI 10)*

In the weeks after the initial flood in 2017, 380 homes, which were a mix of seasonal cottages and permanent homes, were damaged in the community with many residents having to tap into private insurance and apply for Ontario disaster recovery funding (CBC, 2018). The flood resulted in many homeowners facing repair and rebuild bills between $800 -$40,000 depending on damages sustained (CBBCA, 2017). After the 2017 floods, the province urged residents to apply for the Disaster Recovery Assistance for Ontarians program, and 108 applications were approved in defined parts of Ottawa (e.g. Constance Bay), Clarence-Rockland, Alfred and Plantagenet and Champlain (CBC, 2019f). In total, the program has distributed approximately $3.5 million in the areas for people who did not qualify for other forms of support, such as insurance (CBC News, 2019f). A key informant provided statistics on houses that had to undergo rebuilding in the Constance Bay area:

> *"The amount in 2017, we had 6 houses that were damaged beyond repair and had to be rebuilt and this year we are 20 plus. And those are the ones we know about to date, and some are still finding out other details." (K1)*

The 2019 Ottawa River floods brought on another round of devastating impacts to homeowners in Constance Bay still recovering from the 2017 disaster events. The *Ottawa River Regulation Planning Board* (ORRPB) advised that some areas would experience 50cm above levels reached during the 2017 floods with the nearest reservoir monitoring station to Constance Bay recording 60.67m above sea level and expected to rise an additional 18cm (CBC. 2019c). On April 25, 2019, the City of Ottawa declared a state of emergency, which prompted assistance from the Province of Ontario and the Canadian Armed Forces to assist with

evacuation (CTV, 2019c). Environment Canada issued a weather statement on April 30, 2019 for increased precipitation up to 40mm in areas like Constance Bay (CBC, 2019d). Under the emergency order, 155 residents in Constance Bay were asked to evacuate their homes as water levels continued to rise, power was shut off for safety concerns and 1.6 million sandbags were distributed (CBC 2019d; CTV 2019c). Volunteers rallied together to sandbag properties, disburse supplies (e.g. first aid, meals, clothes) and check on residents who stayed back to protect their homes. As of April 27, the ORRPB forecast that river levels would rise 50cm higher than the highest peak in May 2017 further extending recovery effort timelines (CBC News, 2019e). As a result of the increased water levels, extended recovery periods stretched into July 2019.

4.4.2.2 Canadian Policies: Ontario's Disaster Financial Assistance Program

Similar to other provinces in Canada, Ontario offers financial assistance to support recovery after natural disasters. As of March 2016, the province completed an overhaul of its Ontario Disaster Relief Assistance Program (ODRAP) and introduced two new disaster recovery programs: Disaster Recovery Assistance for Ontarians (DRAO), to help disaster victims repair and replace essential property to pre-disaster conditions and cover other eligible emergency costs and the, Municipal Disaster Recovery Assistance (MDRA), to reimburse municipalities for eligible extraordinary emergency response and repair costs (Government of Ontario, 2019). Ontario's DRAO program is not intended to be a substitute for insurance but rather covers the portion of damage not covered by private homeowner's insurance (Government of Ontario 2019; Henstra & Thistlethwaite 2017). These programs are delivered by the *Ministry of Municipal Affairs and Housing* (MMAH) and apply to abrupt, unexpected natural disasters with costly impacts, though a major stipulation is that the program must be activated by the Ministry for the affected zone in order for residents to be able to apply (Government of Ontario, 2019). Due to the high eligibility threshold, Ontario can only access federal funding under the Disaster Financial Assistance Arrangements (DFAA) program in the event that a disaster costs the province in excess of $46.2 million (McNeil, 2019). In the case of both floods in Constance Bay, this threshold was not met, so the majority of the financial burden was borne by the provincial treasury, municipalities and homeowners.

Following the 2017 and 2019 floods, the Government of Ontario deployed the DRAO program to afflicted homeowners in the Constance Bay area who were seeking financial relief. Many primary residents applied for the program through the aid of organizations such as West Carleton Disaster Relief (KI 1). The City of Ottawa conducted a series of consultations and public information sessions for residents affected by flooding in 2017 and 2019 with MMAH staff present to aid with streamlining applications (CBC News 2019g; KI 1). Eligible residents could receive up to a maximum payment of $250,000 with applications being paid at 90% of the eligible amount after the $500 deductible was applied (Government of Ontario, 2019). A condition attached to the disaster payment was that homeowners must rebuild in place or move elsewhere on their property in order to floodproof their homes, but *the payment could not be used for retreat purposes* (Government of Ontario 2019; KI 1). For example, if the cost of emergency expenses and damage replacement is $11,000, $9000 is covered by the insurer with a $700 deductible in the insurance policy, and then the applicant's eligible amount under the DRAO program is $1,300 though after the program deductible and 90% threshold, the applicant would only receive $710. Many key informants also expressed that the $250,000 cap was not sufficient for major repairs or rebuilding elsewhere on their property without considerable support from other sources:

> *"So, they can move on their property to a [safer location] – if they had catastrophic damage, that being said, the foundation is not fixable. That's the only way they can get funding to floodproof their homes to a point where it's impactful. So, for them to raise their houses, they would have to have had significant structural damage. If there's no evidence of structural damage, they will only be repaired to the point of the damage. So, they are still at risk. So, we have two things - one is that they cannot rebuild somewhere else, and two is that a lot of them didn't or because of how they protected their homes, they put a lot of effort into that, their structure wasn't damaged so now they can't floodproof." (KI 1)*

Ontario's DRAO program currently does not have any provisions that allow for home buyouts for properties located in floodplains. The program was historically created to aid homeowners in recovery by returning the property to its pre-disaster state, and amendments have not been made to the program to allow for improvements/ 'build back better' (e.g. elevating the house, floodproofing) to the property to increase its resilience. Many

interviewees echoed sentiments of residents wanting to floodproof their property, instead of simply rebuilding to the original standards, in order to reduce the overall long-term financial burden on governments and taxpayers and to mitigate future damage that might occur from flooding.

In late 2019, a consulting report on Ontario's flood problem and current flood management framework was released. This report made several suggestions on how to improve the existing flood policy framework, including the DRAO program. For example, an alternative strategy (i.e. recommendation #51) proposed in the *Ontario Special Advisor on Flooding Report* indicated that "the DRAO program be flexible to allow for the removal of the structure from the floodplain (buyout) if it is the only technically and financially feasible option" (McNeil, 2019). One key informant also noted that there is communal interest in Constance Bay for the provincial government to modify its policies to incorporate into its disaster recovery programs buyouts at pre-flood market value, especially for homeowners who are vulnerable and at heightened risk:

> *"So, we did a survey with some of our residents. We had 171 people respond to this survey and of that 53 of them would be in interested in the buyout…yes, so that not a compilation of the entire community and it might not be representative, but it is a significant number." (KI 1)*

4.4.2.3 Applications of Managed Retreat in Constance Bay

Despite recommendations in the *Independent Review of the 2019 Flood Events in Ontario* made by Ontario's Special Advisor supporting managed retreat as a potential climate change adaptation strategy, formal managed retreat was not implemented in Constance Bay after the 2017 and 2019 flood events. Field observations and published policy reports suggest that small-scale protection and accommodation measures are being adopted in the community as financial, legal and governmental constraints have prevented a community-wide retreat. This has apparently prompted many homeowners to adopt the accommodate measure from the PARA framework in order to rebuild their homes with floodproofing to reduce future risks. There is limited evidence from Constance Bay that individual homeowners have taken it upon themselves to retreat due to frequent flooding by selling their properties and purchasing homes on higher ground (KI 3).

Figure 5: These properties in Constance Bay are currently on the market for sale. The property on the (left), is located on Lane Street and listed for $269,000 CAD and the one on the (right) on Bayview Drive is recently renovated and listed for $479,000 CAD (Photos Credit (2020): Realtor.ca).

Selling one's flood-prone property inadvertently transfers the risk to the next unassuming homeowner who will have to deal with the liabilities associated with living in a floodplain and future flood disasters. Homeowners selling their properties are not required to disclose the home's flood damage history or its exposure to future flood risk (Henstra & Thistlethwaite, 2018). This type of isolated, reactive, piecemeal and unplanned retreat is a growing trend amongst homeowners in disaster prone areas (NRCan, 2020). Many interviewees confirmed that residents were moving away from flood-prone zones due to the astounding costs and the lack of governmental support as witnessed from the successive floods in Constance Bay:

> *"I have spoken to people that said they can't handle it any longer and are putting their house up for sale. And I know some people who would be doing that if their house was [unintelligible] salvageable right that they would just be out. So unfortunately, there are some people who had just moved in just the previous year, which is terribly sad". (KI 1)*

It is unclear whether planned managed retreat will be applied in the future for the community of Constance Bay or whether home buyouts will be incorporated into the Province's disaster recovery program as a climate change adaptation tool. Considering that managed retreat is a contentious adaptation strategy that requires immense public support and political determination, the municipality of Ottawa and the Ontario government will have to assess if managed retreat is financially feasible as a long-term strategy for Constance Bay. What is more certain is that as the frequency and magnitude of flood related events increases, appetite for home-buyouts will also increase in flood prone communities. Offering a voluntary buyout

option provides homeowners with the autonomy to make one of several possible decisions (e.g. rebuild or retreat) as opposed to being coerced into only one (rebuild).

4.5 Cross-Case Comparison

4.5.1 Similarities & Differences

The research conducted in Pointe Gatineau and Constance Bay revealed that the implications of climate change are changing societies' and governments' perceptions about the use of retreat and accommodate approaches to flood risk reduction. Firstly, both communities face increasingly frequent precipitation and fluvial flooding from springtime snowmelt on developed floodplains, as well as associated riverine erosion. Secondly, both jurisdictions have a lack of publicly available flood maps/data that model physical hazards, and the low risk awareness amongst residents about their hazard vulnerability. Thirdly, examples of 'accommodate' solutions under the PARA framework were found in both communities, as residents who faced persistent flooding were able to apply to the corresponding disaster financial assistance program, which provided funds for rebuilding to pre-flood conditions. However, some residents took it upon themselves to spend their own money to floodproof their houses. Fourth, both provinces have been working with municipalities to limit/prohibit risky activities, including development on floodplains, through legislative tools like the *Planning Act* in conjunction with provincial policy statements and the *Conservation Authorities Act* in Ontario (Government of Ontario, 2020). Simultaneously, in Quebec the declaration of a special planning zone was used to promote better management of flood zones along with the *Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains,* which prohibits construction/rebuilding in areas (i.e. 1:20 and 20:100 floodplains) that are prone to flooding (Boucher & Nolin, 2019). This suggests that multiple risk reduction strategies have been applied to increase resilience in both communities.

Despite the similarities between the two cases, there are also a number of key differences related to the application of disaster recovery policies/programs and the use of managed retreat. The most evident difference is that formal managed retreat policies were applied in Pointe Gatineau as a DRR strategy, whereas in Constance Bay formal policies were

absent. A more informal, unplanned retreat process has occurred in Constance Bay as individual homeowners have sold and moved away, but this simply transfers risk to the next homeowner. The inclusion of buyouts/departure allowance in the Quebec general indemnity and financial assistance program illustrates that some Provincial governments are cognizant of the benefits of the strategy and willing to support long-term adaptation that favours sustainable solutions. This makes Quebec one of the few provinces in Canada to integrate such a progressive and forward-thinking policy in light of climate change. Secondly, high municipal property valuations in Ontario make it difficult to offer 'fair' buyouts (i.e. market value) and this is a deterrent to implementing formal managed retreat in Constance Bay (KI 10), whereas in parts of Quebec, significant funds have been committed to support retreat. Thirdly, the Eastern Ontario/Constance Bay case is located at least partially in a 1:100-year floodplain (i.e. has a 1% chance of being flooded per annum) while Pointe Gatineau has the majority of properties located in the 1:20 year floodplain (i.e. has a 5% chance of being flooded per annum), so the risk profiles of the two communities differ.

In comparing and contrasting the two case studies, it is important to note particularly that the development, application and implementation of managed retreat plans varies between provinces. Provinces hold jurisdictional authority over deploying disaster financial assistance to municipalities. As noted by Doberstein et al. (2020), the implementation of managed retreat in provinces can be expected to vary due to differences in their political environment, assets at risk, timelines of retreat, socioeconomic status of communities, financial capacity of governments and planning processes that govern if and how these adaptation measures will operate. The two riverine cases compared in this paper do not represent the entirety of Canadian retreat cases as other jurisdictions (e.g. Calgary AB, High River AB, Truro NS, Grand Forks BC etc.) have also applied riverine retreat plans over the last several years.

4.5.2 Pointe Gatineau – Principles for an Effective Home Buyout Program

Considering that formal managed retreat was applied in Pointe Gatineau, but not Constance Bay, Quebec's home buyout program provides a basic framework of how retreat could look like in Ontario, though there are both successes and lessons to be learned from what

transpired in Pointe Gatineau. The comparison matrix below compares the Principles for Effective Home Buyout Programs in North America (Cottar, 2020) for the community of Pointe Gatineau to verify which principles were applied and which were not, with a supporting rationale.

Principles for Effective Home-Buyouts Programs in North America (Cottar, 2020)	Pointe Gatineau	Rationale
Community-Based Participation: Governments should work collaboratively with communities and encourage homeowner participation by making home-buyouts more accessible, available and agreeable.	✔	As the buyout programs were reactive in nature, there was limited engagement with communities though once the program was announced, community consultations and town halls were organized with program officers to learn more about the buyout offers.
Transparency and Flexibility in Planning, Funding & Program Guidelines: Governments should design, implement and offer home-buyout programs that are transparent and flexible to better cater to the financial and social needs of homeowners.	X	Criticisms surrounding the lack of clarity/ transparency in regards to the implementation plan and program eligibility were raised by municipalities and homeowners during both application periods.
Fair and Equitable Financial Compensation: Governments should fairly compensate homeowners in a way that covers their existing mortgage and allows them to relocate with financial dignity.	✔	Buyout offers consisted of compensation caps of $200,000 with additional $50,000 for the lot which was considered a reasonable offer based on municipal property valuations in Gatineau.
Critical Discourse and Engagement amongst Federal, Provincial/State & Municipal Authorities: Governments must engage in a multi-tier dialogue about flood risk reduction and climate adaptation strategies that are viable, effective, economical and long-lasting.	✔	Ongoing dialogue is occuring amongst the different tiers of government and insurers about creating a national flood insurance program (NFIP) that would support flood victims.
Integration of the 'Build Back Better' (BBB) Model in the context of Relocation Programs & Alleviation of Administrative	X	The 'BBB' model is not included in the Quebec disaster financial assistance program, though funds can only be used to rebuild the structure to its pre-

Backlog: Governments should integrate the Build Back Better model in relocation programs when buyout mechanisms are not available or applicable; authorities responsible for processing the disaster recovery assistance or buyout payments should aim to reduce or eliminate administrative backlogs and streamline the delivery of retreat-related services to afflicted homeowners.		flood state as opposed to an improved flood-proof state signifying the lack of BBB.
	✔	Criticisms regarding administrative backlog were brought up after the first round of buyout applications were processed in 2017. This led to a simplification (e.g. online application, less supporting documentation /proof of reciepts) of the program during the 2019 application round.

Table 1: This table illustrates the five effective principles for home buyouts (Cottar, 2020) in relation to the buyout program offered in Pointe Gatineau.

4.5.3 Constance Bay - Principles for Designing an Effective Home Buyout Program

As previously noted, Ontario does not have a formalized retreat or home-buyout program for citizens. However if Ontario wanted to add a retreat program to its CCA suite of options, then the application of the 5 principles when designing a managed retreat program would be advisable. For example, MMAH staff could engage with the community in a consultative process about the notion of proactive retreat to assess potential homeowner participation in future programs. This targeted retreat plan would help to ensure maximum uptake of the program. Once the design of the program was completed, it would be imperative that the user/ homeowner experience is streamlined, transparent and clear to expediate claims and to eliminate administrative backlog. The use of an online application portal hosted by the Government of Ontario with explicit rules on homeowner eligibility, compensation amounts, and damage ($) thresholds would provide additional clarity for disaster victims. Lastly, the integration of the 'BBB' model into the current DRAO program would help victims who have sustained damages that require structural transformation to use funds provided by MMAH to floodproof their homes as a risk reduction strategy. The integration of these principles into the design and implementation of a potential managed retreat program in Ontario would improve the Province's resilience to future flood scenarios.

4.6 Conclusion

The communities of Pointe Gatineau and Constance Bay experienced two consecutive climate related disasters (i.e. floods) which triggered the application of managed retreat as a climate change adaptation (CCA) and disaster risk reduction (DRR) strategy in one of the two cases. Faced with a multitude of challenges (i.e. social displacement, economic downfall, environmental damage, infrastrucuture upheaval, financial disarray), both neighbourhoods were able to recover from these disasters using an array of retreat and rebuilding approaches included in the PARA framework. This comparative analysis of the provincial disaster recovery programs revealed that home buyouts were adopted as a climate adaptation tool in Pointe Gatineau but not in Constance Bay, mainly due to jurisdicational differences with associated policies and programs. In Pointe Gatineau, the use of special intervention zones and a combination of voluntary and mandatory home buyouts allowed some homeowners to retreat, but gaps in program eligibility and implementation left some excluded from the process. Contrary to Pointe Gatineau, Constance Bay residents faced the grim reality of having to rebuild or individually retreat due to the lack of alternative recovery options offered by the provincial government. Although the 2019 floods were even more devastating for communities than the 2017 floods, the combination of damage sustained and recovery costs after both events was a significant enough reason for an increase in uptake of property buyouts among Pointe Gatineau homeowners.

Managed retreat approaches can only be effective if municipalities engage communities early on about retreat options and then proceeed to incorporate them into long-term strategic land use plans as an adaptation or DRR option. As the frequency of extreme weather events increases, especially for those located in floodplains, communities will have to consider alternative approaches to flood risk reduction. The reality of the 1:100-year floods that occurred on average every 100 years are expected to occure with greater frequency in the future and thus the inclusion of managed retreat in municipal climate change action plans offers a sustainable option for reducing the risks of climate change, by effectively moving people, properties and critical infrastructure to lower risk locations where they can thrive (NRCan, 2020). Employing home buyouts as a tool that enables managed retreat can help

communities to build adaptive capacity and resilience against hazards. The introduction of property buyouts as part of Quebec's provincial program illustrates that Canadian governments are embracing new flood management techniques in risk reduction and land regulation. Conversely, if buyouts are not planned for and implemented properly, individual retreat efforts could become maladaptive in nature and reduce progress towards resilience-building. Hence, there is a need to understand the complexities and the intersection of CCA/DRR. In order for managed retreat to be integrated into climate change adaptation plans, further research on the development, application and implementation of Canadian home-buyouts is needed.

Chapter 5: Thesis Conclusions

5.0 Introduction

Climate change is exacerbating flood hazards in communities across Canada, requiring more robust adaptation strategies such as retreat to be implemented. Considering the range of planned adaptation options, managed retreat—the purposeful movement of people and infrastructure out of vulnerable floodplains--is a viable long-term adaptation strategy that is gaining attraction in North America (Siders, 2018). This thesis has identified retreat (e.g. home buyouts) as a sustainable climate change adaptation and disaster risk reduction strategy for communities that have a heightened risk of repeated flooding. The first manuscript (Chapter 2) outlined key strategies that would facilitate governments in the design, planning and implementation of managed retreat plans. The second manuscript (Chapter 4) assessed Canadian examples of retreat in communities prone to repeated flooding. The results illustrated that governments in Canada are becoming more cognisant of climate-induced threats and are incorporating home buyout programs as part of provincial adaptation and disaster recovery toolkits, but there are still gaps on community relocation specific plans and the impact that will have on receiving communities.

5.1 Community Relocation Plans in the Context of Climate Change Adaptation

Given the complex and interdisciplinary nature of managed retreat, community relocation plans can help communities identify, prioritize, organize and coordinate a multi-step approach to climate adaptation for at-risk regions or a number of interested stakeholders (Georgetown Climate Center, 2020). The intersection of managed retreat and climate change adaptation was addressed in chapter 2, which detailed that retreat could be used a policy option for vulnerable communities who faced repeated risks of flooding considering the one time-financial investment needed by governments to support adaptation. As detailed in Manuscript 1, it is integral to adhere to certain principles to ensure maximum participation by ensuring that home-buyouts are accessible, agreeable and available. Post buyout, it is crucial to consider where these vulnerable communities will relocate to. As suggested by interviewees, further research about the individuals who participated in a buyout and where they relocated is

crucial to understanding the long-term impacts of retreat on social networks. By incorporating relocation into long-term municipal adaptation plans, governments can identify receiving areas (e.g. areas with higher elevations) within the same municipality that have the capacity to assimilate the displaced families. This way there are no changes to the tax base and local governments can work closely with districts to facilitate the transition. Proactive planning (e.g. post-buyout relocation plans) at the local level can support long term visions for communities while accounting for the financial prosperity of the municipality. Provinces can work collaboratively with local governments on the dispersal of funding, technical and logistical support in regard to housing and infrastructure development (Georgetown Climate Center, 2020).

5.2 Future Research

The research explored in both manuscripts outlined retreat as a climate change adaptation strategy within the Canadian domain, further providing insights on how to design and implement these programs on a provincial scale. The use of managed retreat within the context of CCA or DRR in Canada is still a fairly new concept and thus offers an opportunity for additional research to be completed on the interdependencies between retreat, home buyouts and community relocation specific plans. As outlined in chapter 4, there are distinct overlaps and linkages between the five principles and existing policies which provides decision makers with a framework that can be applied for similar home buyout programs in Canada. As advised by key informants, continuous engagement and communication about climate change adaptation strategies is encouraged between governments and communities.

The findings indicated that the design and implementation of the home buyout plans in Pointe Gatineau were top-down, ad-hoc and non-collaborative resulting in challenges for homeowners surrounding eligibility and provision of logistical support. Future research that maps the clients (i.e. homeowner) journey from the time of the flood disaster to the application process and then addresses the pain-points associated with eligibility, compensation, support and timeliness would help to alleviate administrative backlogs as mentioned previously in chapter 4. This research could entail a graphic representation of a client journey map in

addition to homeowner narratives that provide insights into their personal experiences which could help with the derivation of recommendations on how to improve the functionality of existing financial assistance programs to ensure transparency and flexibility. Each challenge identified would pose as a barrier that prevents the implementation of an effective retreat plan that protects communities from flood related threats.

An alternative avenue to be explored is the use of community-based adaptation research in the development of future proactive climate change action plans that entail a retreat component. By engaging municipalities prior to a disaster and informing them about their risk, governments can assess the risk tolerance of the community and work with homeowners to make decisions that minimize their future flood risk. Participation in retreat planning will differ as the one-size fits all model will not always apply as communities needs and priorities evolve based on their surrounding environments. Building trust and relationships across community networks will ease the retreat transition and allow for the community to come forth with the plan to strategically retreat as opposed to having it imposed. The application of the five principles framework (Cottar, 2020) for a floodprone municipality actively seeking proactive community-driven retreat would be significantly more effective as participation rates would be higher. Demonstrating the benefits of retreat to vulnerable communities can provide grounds for a more inclusive and productive dialogue in an environment where retreat can be considered as a long-term adaptation strategy. The perspectives portrayed in this thesis represent stakeholders who had a role in the implementation of a reactive retreat plan and should be contrasted with those in Canadian communities who are in the early phases of a proactive retreat plan. Findings from the empirical study about Canadian (Quebec & Ontario) retreat plans invites opportunities for future research.

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Appendix A: Recruitment Letter

Date: [day | month | 2019/2020]

Dear XXX:

I am contacting you in the hopes that you [or someone else from Organization if this is an institutional interviewee] will agree to a brief interview related to our research project entitled "Government-sponsored home buyout programs and post-flood decisions to retreat: case studies in Constance Bay, Ontario and Pointe Gatineau, Quebec". This project is funded by the Institute for Catastrophic Loss Reduction (ICLR) under its "Quick Response Program for 2019 Spring Flooding". This project is also carried out under the auspices of the Department of Geography & Environmental Management at the University of Waterloo, Ontario. Ethics clearance for this project has been obtained (ORE #41255).

The research questions guiding the project include:
1. To what extent and in what way are government-sponsored managed retreat (buyout) policies affecting 2019 flood victims' decisions to retreat from flood risk?
2. What are the most important factors post-flood that convince homeowners to choose managed retreat over reconstruction?

We expect our research will shed light on the factors which lead homeowners to choose retreat rather than reconstruction. We expect Provincial and possibly Federal Government buyout and compensation policies, either informal or formal, to be a key component of these decisions, and for insurance and Red Cross assistance to also play a role. Thus, we expect to develop basic recommendations related to this.

The team that has been assembled for this research includes:
- Dr. Doberstein (Team Lead/PI, Associate Professor, University of Waterloo Geography and Environmental Management): bdoberst@uwaterloo.ca
- Ms. Shaieree Cottar (Master's student, University of Waterloo Geography and Environmental Management): scottar@uwaterloo.ca
- Ms. Brittney Wong (University of Waterloo Honours thesis student, University of Waterloo Geography and Environmental Management): bj2wong@edu.uwaterloo.ca
- Ms. Melissa le Geyt (Master's student, University of Waterloo School of Planning): mjlegeyt@uwaterloo.ca

We are contacting you/[your Organization] in order to invite you to participate in a short semi-structured interview of approximately 30-45 minutes in length, to be conducted in-person, over the phone, or using an online platform such as Zoom/Skype. Examples of themes we may explore in the interview include the following:
- Awareness of and details about home buyout or flood damage compensation programs that might lead to non-rebuilding in case study sites
- Factors that influence homeowners when considering buyouts/ non-rebuilding

- Opinions about programs needed in the future/under future climate change scenarios

If you feel that you are not the most appropriate person to participate in this interview, feel free to forward this email to a more appropriate person. With your permission, the interview will be audio recorded to facilitate accurate collection of data, and later transcribed for analysis. After the interview has been completed, you may request a copy of the transcript to give you an opportunity to confirm the accuracy of our transcription, and to add or clarify any points that you wish. You may decline to have your interview recorded if you wish.

At the end of this project, our research team will generate a 10-12-page summary research report consisting of interview opinions, overall results and our conclusions. If you would like a copy of this report, please let us know either during the interview or via email.

We would like to assure your organization that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41255). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

If you [or a representative from your Organization] are interested in participating you are invited to contact me, Brent Doberstein, to discuss participation in further detail. If you would like additional information to assist you in reaching a decision about your [Organization's] participation, please contact me at [519-888-4567 x.33384] or by email at bdoberst@uwaterloo.ca

We hope that the results of our research study will be beneficial to the scientific and scholarly communities, and flood recovery agencies. We very much look forward to speaking with you and thank you in advance for your assistance with this project.

Yours sincerely,

Dr. Brent Doberstein Associate Professor
Department of Geography & Environmental Management, rm. EV1-220
Faculty of Environment, University of Waterloo
200 University Ave. W., Waterloo, ON
N2L 3G1
bdoberst@uwaterloo.ca
(519)888-4567 x.33384

Appendix B: Information & Consent Letter

Date: [day | month | 2019/2020]

Dear XXX*:*

Shaieree Cottar previously contacted you about possibly participating in research I and a student team are conducting on home buyouts in flooded communities, and because you have indicated interest, I am providing additional information and a consent form for you to complete. The research is entitled "Government-sponsored home buyout programs and post-flood decisions to retreat: case studies in Constance Bay, Ontario and Pointe Gatineau, Quebec", and is funded by the Institute for Catastrophic Loss Reduction (ICLR) under its "Quick Response Program for 2019 Spring Flooding". This project is also carried out under the auspices of the Department of Geography & Environmental Management at the University of Waterloo, Ontario. Ethics clearance for this project has been obtained (ORE #41255).

This follow up letter is an invitation to participate in this research. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Project description: 'Managed retreat' (i.e. buying out and demolishing flood-damaged homes, and then disallowing reconstruction in the area) is gaining considerable attention as a component of flood risk reduction and climate change adaptation/resilience. In a flooding context, the objective of managed retreat is to reduce the exposure of people and assets to flooding, by retreating from these threats in a planned fashion. Longer term, retreat from hazards is seen as a promising means by which to build resilience to the changing hazards expected under climate change.

Managed retreat was an important component of post-2017 National Capital Region flood recovery in multiple Quebec communities near the Ottawa River. Homes in several communities were demolished after owners accepted compensation (e.g. Quebec Government compensation, Red Cross and contents insurance compensation) to move to a safer location. This approach is particularly evident in the community of Pointe Gatineau where at least 30 homes were torn down after the 2017 floods, and multiple vacant lots are currently interspersed with homes that were rebuilt following the 2017 floods. By contrast, Ontario's Constance Bay community just west of Ottawa also saw extreme flooding in 2017, and despite 380 homes being damaged, we found no evidence of any home buyouts.

Our research sets out to uncover why these two flooded communities have such dissimilar responses to the 2017 flooding and examine whether this is still the case for post-2019 flooding. We will examine the various factors which might lead homeowners to choose retreat over reconstruction, or vice versa. We think that formal government policies and programs are likely a key factor: normally, insurance payouts for flood damage are conditional on rebuilding in place, so insurance payments alone are unlikely to lead to retreat. The recent announcement of a formal Quebec Government home buyout program (up to $200,000/home) is expected to influence Pointe Gatineau homeowners who were flooded again in 2019. At this stage, it is unclear whether the Ontario government will announce a similar buyout program, so

Constance Bay residents, for now at least, may not have the option to retreat unless they self-fund. These Provincial flood policy differences provide the unique opportunity to probe the impact of variable provincial policies on homeowner decisions to retreat from flood risks (or not), and to examine the extent to which the Provincial policies intersect with homeowners' recent experiences with repeat flooding.

Your participation in this study would entail a short semi-structured interview of approximately 30-45 minutes in length, to be conducted in-person, over the phone, or using an online platform such as Zoom/Skype. Examples of themes we may explore in the interview include the following:

- Awareness of and details about home buyout or flood damage compensation programs that might lead to non-rebuilding in case study sites
- Factors that influence homeowners when considering buyouts/ non-rebuilding
- Opinions about programs needed in the future/under future climate change scenarios

Participation in this study is voluntary, and you may decline to answer any of the interview questions if you so wish or end the interview session at any time by communicating this decision to the researcher.

With your permission, the interview will be audio recorded to facilitate accurate collection of data, and later transcribed for analysis. After the interview has been completed, you may request a copy of the transcript to give you an opportunity to confirm the accuracy of our transcription, and to add or clarify any points that you wish. You may decline to have your interview recorded if you wish.

"Identifying information will be removed from the data that is collected and stored separately. If you do not wish to be identified, your participation will be considered confidential and neither your name nor your organization's name will appear in any paper or publication resulting from this study. However, with your permission, quotations from your interview may be used and you will only be referenced by a coded interviewee number and whether you belong to a public, private or local resident group (e.g. "Interviewee #5, Community Representative"). Alternatively, you may choose to be identified by name and have your quotations directly attributed to you and your organization in study results."

Collected data will be securely stored in a locked office and on a password protected server for a minimum of 7 years. You can withdraw your consent and request that your data be removed from the study by contacting the researchers within this time period. Please note that it will not be possible to withdraw your consent once the results have been submitted for publication There are no known or anticipated risks to participants in this study.

The team that has been assembled for this research includes:

- Dr. Doberstein (Team Lead/PI, Associate Professor, University of Waterloo Geography and Environmental Management): bdoberst@uwaterloo.ca

- Ms. Shaieree Cottar (Master's student, University of Waterloo Geography and Environmental Management): scottar@uwaterloo.ca
- Ms. Brittney Wong (University of Waterloo Honours thesis student, University of Waterloo Geography and Environmental Management): bj2wong@edu.uwaterloo.ca
- Ms. Melissa le Geyt (Master's student, University of Waterloo School of Planning): mjlegeyt@uwaterloo.ca

We would like to assure your organization that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE #41255). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

Participation in this study may not provide any personal benefit to you. However, the results of this study may help to better inform the scientific and scholarly communities, and flood recovery agencies. We very much look forward to speaking with you and thank you in advance for your assistance with this project.

Yours Sincerely,

Dr. Brent Doberstein, Associate Professor
Department of Geography & Environmental Management, rm. EV1-220
Faculty of Environment, University of Waterloo
200 University Ave. W., Waterloo, ON N2L 3G1
bdoberst@uwaterloo.ca
(519)888-4567 x.33384

Shaieree Cottar, MES Candidate
Department of Geography & Environmental Management
Faculty of Environment, University of Waterloo
200 University Ave. W., Waterloo, ON N2L 3G1
scottar@uwaterloo.ca
4168050339

CONSENT FORM

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

I have read the information presented in the information letter about a study being conducted by Brent Doberstein, Shaieree Cottar, Brittany Wong & Melissa Le Geyt of the Department of Geography & Environmental Management at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses.

I am also aware that with my permission, excerpts from the interview may be included in papers and publications with the understanding that the quotations will be anonymous unless I explicitly agree to be identified by name.

I was informed that I may withdraw my consent without penalty by advising the researcher.

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#41255)). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca.

For all other questions contact [insert researcher's name and contact information].

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐YES ☐NO

I agree to have my interview audio recorded.

☐YES ☐NO

I agree to the use of anonymous quotations in any paper or publication resulting from this research (e.g. "Interviewee #5, Community Representative"). (NOTE: if you prefer to have your name associated with your quotations please check "NO" here, and then check "Yes" in the question below).

☐YES ☐NO

I agree to the use of quotations directly attributed to me and my organization in any paper or publication resulting from this research.

☐YES ☐NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

Appendix C: Feedback Letter

University of Waterloo

Date: [day | month | 2019/2020]

Dear XXX:

I would like to thank you for your participation in this study entitled "Government-sponsored home buyout programs and post-flood decisions to retreat: case studies in Constance Bay, Ontario and Pointe Gatineau, Quebec", funded by the Institute for Catastrophic Loss Reduction (ICLR). If you wish to receive a transcript of your interview, please feel free to contact any member of the research team by email.

As a reminder, the purpose of this study is to shed light on the decision-making factors that lead flooded homeowners to retreat (i.e. accept buyouts) rather than rebuild. The data collected during interviews will contribute to a better understanding of the role that formal government policies and programs related to retreat/buyout play in homeowner post-flood decision-making. Our main objective for this study is to compare and contrast homeowner retreat/do not retreat decisions in two jurisdictions - one with a government-sponsored buyout program (i.e. Quebec) and one without (i.e. Ontario).

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee (ORE#41255). If you have questions for the Committee contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or ore-ceo@uwaterloo.ca. For all other questions contact Dr. Brent Doberstein at bdoberst@uwaterloo.ca or 519-888-4567 x.33384.

Please remember that your identity will be kept confidential unless you have waived confidentiality at the consent stage of this research. Once all the data are collected and analyzed for this project, I plan on sharing this information with the research community through seminars, conferences, presentations, and journal articles. If you are interested in receiving more information regarding the results of this study, or would like a summary of the results, please provide your email address, and when the study is completed, anticipated by Aug 31, 2020, I will send you the information. In the meantime, if you have any questions about the study, please do not hesitate to contact me by email or telephone as noted.

Dr. Brent Doberstein, Associate Professor
Department of Geography & Environmental Management, rm. EV1-220
Faculty of Environment, University of Waterloo
200 University Ave. W., Waterloo, ON N2L 3G1
bdoberst@uwaterloo.ca
(519)888-4567 x.33384

Shaieree Cottar, MES Candidate
Department of Geography & Environmental Management
Faculty of Environment, University of Waterloo
200 University Ave. W., Waterloo, ON N2L 3G1
scottar@uwaterloo.ca
4168050339

Appendix D: Interview Questions/Themes

Project: "Government-sponsored home buyout programs and post-flood decisions to retreat case studies in Constance Bay, Ontario and Pointe Gatineau, Quebec"

1. Area you currently aware about existing disaster recovery or flood compensation programs in Ontario or Quebec? If so, can you speak about them?
    - Opinions and information about existing flood recovery programs/policies in interviewee's Province/jurisdiction
        - Ontario (Ministry of Municipal Affairs and Housing):
            - Disaster Recovery Assistance for Ontarians Program (DRAO)
            - Municipal Disaster Recovery Assistance (MDRA)
        - Quebec (Public Security Ministry):
            - Special Financial Assistance Program for the Flooding that occurred between April 5 and May 16, 2017

2. Can you please explain your understanding of home buyouts and flood compensation programs? Are there any specific case studies (i.e. Canadian/American) that come to mind?
    a) Can you speak to the 2013 Alberta floods and how home-buyouts were carried out in that jurisdiction?
        a. What are the details of the program?
        b. Which agencies are involved?
        c. How were homeowners eligible?
        d. In your opinion, was that buyout effective? And why?
    - Awareness of and details about home buyout or flood damage compensation programs that might lead to non-rebuilding in case study sites
        - Probes: Details of these programs, agencies involved, program requirements, restrictions, caps on payouts, etc.
        - If buyout programs are lacking, opinions on why these programs do not exist

3. What Barriers or constraints are present to riverine/climate change adaptation?
    a) Probe: financial, institutional, physical, knowledge, social, etc.

4. What are the benefits to voluntary buyout programs? (For homeowners, governments)

5. Could you please explain your understanding of the various agencies (i.e. government, NGO and private industry) and their roles in provincial buyout programs?
    - Role of various agencies in buyout programs:
        - Municipal Government
        - Provincial Government
        - Federal Government
        - Insurance Companies
        - Community Organizations
        - Advocacy /Special Interest Groups

- Other?

6. What factors do you think influence homeowners/businesses when considering buyouts?
    - Length of time in home/community
    - Disaster declaration (i.e. some programs only kick in once a disaster has been declared by a Provincial or Federal authority)
    - Existence flood buyout programs
    - Behaviour of others in the community
    - $ available for reconstruction vs. buyout
    - Risk perceptions
    - Previous experience with flooding/flood damages
    - Other

7. Was media coverage effective in publicizing flooding events in both jurisdictions?
    b) Do you think this added pressure on governments to immobilize programs and aid quicker? If so, why?

8. Apart from managed retreat, what other options do homeowners have to protect themselves from increased flood risk?

9. What programs (ex. municipally, provincially, federally) are needed to adapt future climate change scenarios?

Appendix E: GANT Research Timeline

The following GANT chart below depicts a rough timeline for the completion of my thesis. These timelines are subject to change and contingent on approvals from my supervisor and committee members.

		Months										
Tasks		Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20
	Proposal											
	Repository of Potential Interviewees											
	Literature Review											
	Ethics Approval											
	Data Collection											
	Analyzation of Data (i.e. coding, NVIVO)											
	Write Thesis											
	Thesis Revision											
	Thesis: Final Draft											
	Thesis: Defence											