Navigating Floodwaters:

FLOOD RISK GOVERNANCE AND MANAGEMENT IN MANITOBA

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Supervised Research Project, August 2024

Aerial Photograph of the 1997 Flood
Brooks, 1997

ABSTRACT

Intensifying and changing flood patterns pose significant challenges to municipalities across Manitoba. Effective flood risk management (FRM) requires a collaborative governance approach involving provincial, municipal, and watershed district stakeholders. This study evaluates the state of flood risk management across Manitoba by analyzing the policy instruments utilized by these stakeholders. The research methodology includes coding policy instruments in the FRM framework, assessing projects funded by the mitigation and preparedness program to discern provincial and municipal priorities, reviewing municipal zoning bylaws for FRM integration, and conducting semi-structured interviews with key-informants. The findings indicate that Manitoba's FRM encompasses a diverse set of strategies including flood prevention, defense, mitigation, preparation, response, and recovery. While there are strong strategies, programs, and legislation in place to guide FRM, numerous challenges prevent their effective implementation. Proper FRM enforcement is hindered by inadequate data and information availability, resource and staff constraints, and competing interests. The current approach to assess flood risk omits social vulnerability factors and considers changing climate risks in a limited fashion. Addressing these gaps is crucial for building a resilient and adaptive flood risk management system that can respond to current and future challenges.

RÉSUMÉ

L'intensification et l' évolution des régimes d'inondation résentent de grands défis aux citoyens du Manitoba. Une gestion efficace des risques d'inondation (GRI) nécessite une approche de gouvernance collaborative entre les parties les parties prenantes provinciales, municipales et des districts hydrographiques. Cette étude évalue l'état de la gestion des risques d'inondation au Manitoba en analysant les instruments de politique utilisés par ces intervenants. Les résultats indiquent que la gestion efficace des risques d'inondation (GRI) du Manitoba englobe un ensemble diversifié de stratégies, notamment la prévention, la défense, l'atténuation, la préparation, l'intervention et le rétablissement des inondations. Bien qu'il existe des stratégies, des programmes et des lois solides pour guider la GRI, de nombreux défis font obstacle à une réponse efficace face aux inondations. La disponibilité insuffisante des données et des l'informations, les contraintes en termes de ressources et de personnel, ainsi que les intérêts divergents, empêchent une mise en œuvre adéquate. L'approche actuelle de l'évaluation des risques d'inondation omet les facteurs de vulnérabilité social et une considération limitée aux risques climatiques changeants. Il est essentiel de combler ces failles pour mettre en place un système de gestion des risques d'inondation résilient et adaptable, capable de répondre aux défis actuels et futurs.

ACKNOWLEDGEMENTS

Completing this study would not have been possible without the generous assistance provided by many individuals. I would first like to extend my sincere appreciation to my supervisor Dr. Madhav Badami. Thank you for the guidance, support, and encouragement to make the completion of this document possible. Thank you to the participants of the study who generously took the time to provide valuable input.

A heartfelt thank you Mama and Papa. Despite a 2,200 km distance, you were always available to listen to me, and provide encouragement and unwavering support. This degree reflects your hard work, just as much as it does mine, I never would have been able to achieve this goal without you – spasibo.

Lastly, I could not have completed this program without the support of my community of fellow MUPS. Thank you for your help along the way, for the laughs shared, the memories made, and for making the move to Montreal so enjoyable. I have learned so much from each one of you and cherish the two years we got to spend with each other.

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CHAPTER 1

INTRODUCTION

OVERVIEW

There are four seasons that people know and come to expect annually: Summer, Fall Winter, and Spring, but flood events are so common in Manitoba that "Flood" could be considered the unofficial fifth season. The low-lying prairie province was formerly the lake-bed of glacial Lake Agassiz, resulting in a geographic condition where a large part of the province is considered a floodplain due to its low and flat topography (Di Baldassarre et al., 2013; Rannie, 1998). Flooding is characteristic of a floodplain ecology and important for its biodiversity, however, large-scale floods have the potential to become natural disasters and pose a major threat to settlements, infrastructure, health, and well-being (Haque et al., 2022; IPCC, 2014). Floods are considered the costliest natural disaster that municipalities across Canada face (Public Safety Canada, 2022a). Towns and villages across Manitoba have experienced the social, economic, and environmental consequences of flood events through evacuations, disruptions of road networks, and extensive property damage (Haque et al., 2022). In response, numerous stakeholders and levels of government have attempted to address the challenges caused by flooding and have invested significant resources into flood impact reduction efforts.

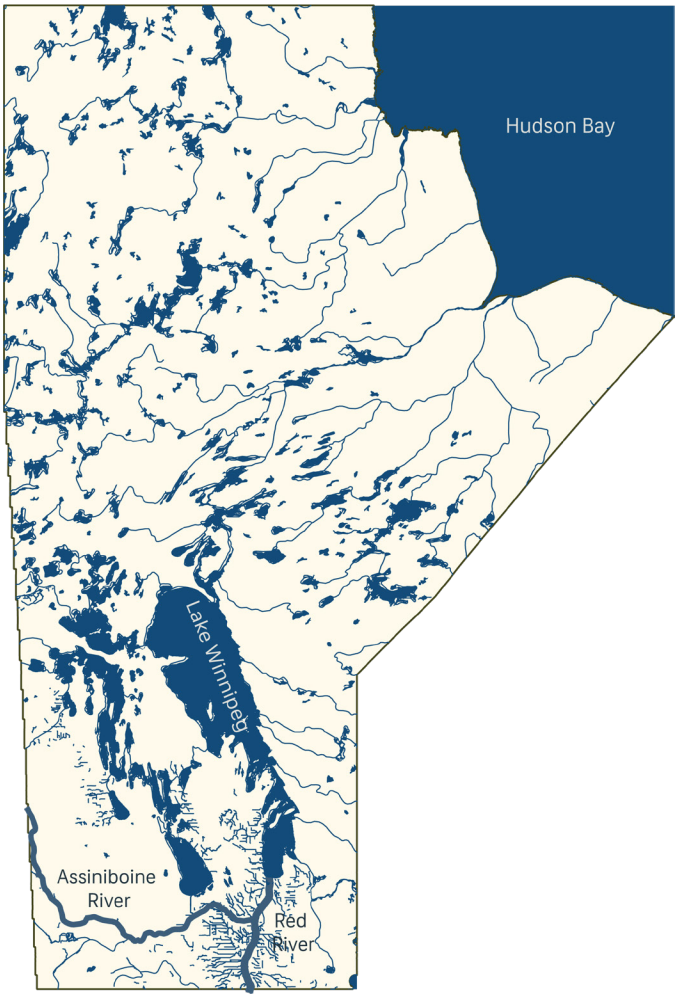


Figure 1: Map of Manitoba

Despite significant and ongoing investments into protection from flood events, the social, economic, and environmental impacts of flooding are rising in Manitoba (Haque et al., 2022). There are multiple factors leading to increased flood risk across the province but climate change and population growth in flood-prone areas play major roles. The IPCC (2014) anticipates that flood events are expected to increase in frequency and severity due to climate change, becoming more extreme and unpredictable.

Indeed, trends of extreme and unpredictable floods are emerging in Manitoba, half of the ten largest recorded floods in the province's history have taken place in the last 30 years (Haque et al., 2023). The Red River basin is the most densely populated watershed basin in the province and although it regularly faces flood events, its population is steadily increasing (Statistics Canada, 2022). Given the changing nature of flood events due to climate change, population growth in an area vulnerable to flooding is concerning because it exposes more people and increases the vulnerability of these areas (Morrison et al., 2018b).

There are a variety of policies, decisions, and actions that can help reduce the impacts of flooding, referred to as Flood Risk Management (FRM) (Shanze et al., 2006). Governance is a critical component of the FRM process. Governance refers to how actors, resources, and discussions interact to drive FRM policies and actions (Hegger et al., 2018, Dordi et al., 2022). The Manitoba Water Management Strategy conceives of governance as the structures that define the roles and responsibilities of all actions related to management (Gov MB, 2022b). The governance framework uses legislation, enforceable regulations, and involves strategies, policies, and programs to achieve its mandate and goals. Managing flood risk is complex and involves many actors, institutions, policy instruments,

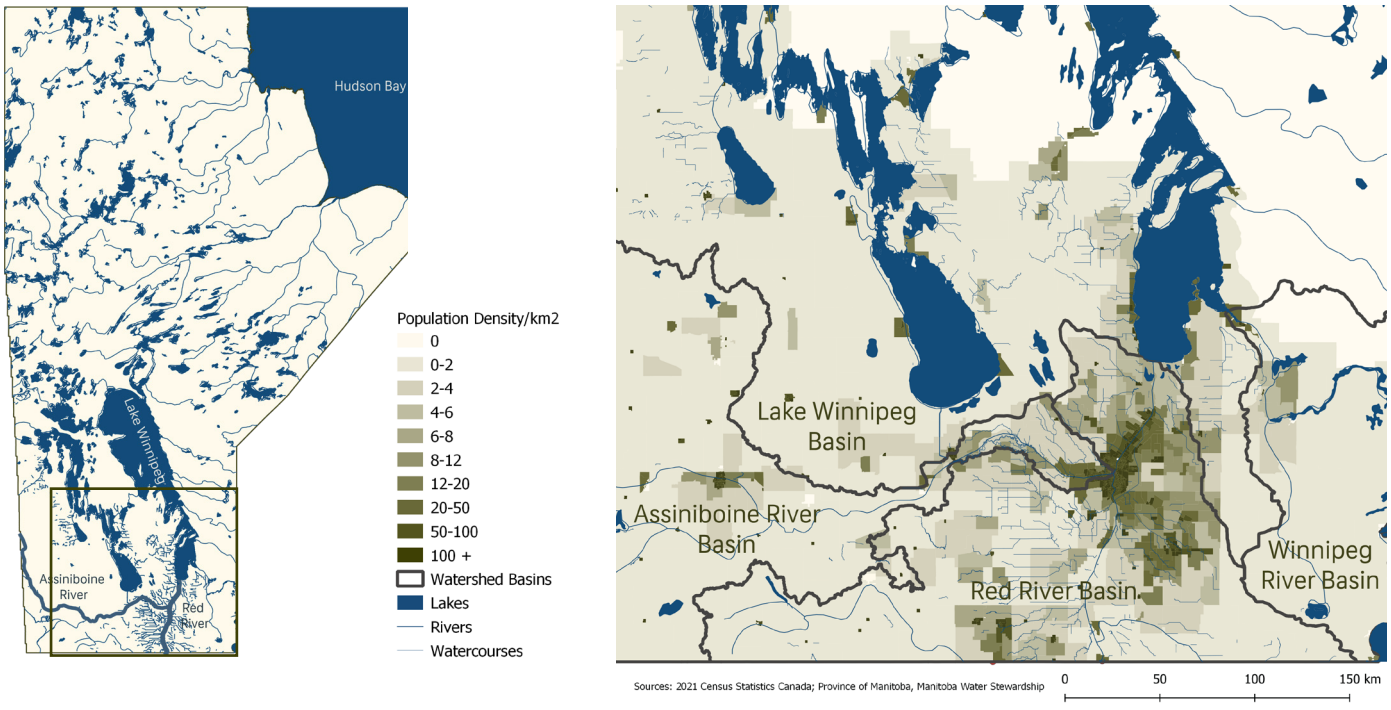


Figure 2: Population Density of watershed districts in Manitoba

and decision-making mechanisms across sectors and scales. Efficient and legitimate governance arrangements and interactions are necessary for effective FRM (Dordi et al., 2022).

In Manitoba, most of the FRM responses have been driven by the provincial government following severe flood events. The historically favoured engineered and structural interventions protect many communities across the province today. Dams, diversions, and ring dikes offer protection from flooding to many communities today. Over time, there has been a noticeable shift from this approach the provincial government has included more actors and diversified their responses. The involvement of Watershed Districts and Emergency Management Organization (EMO), along with the adoption of policies such as flood zoning indicates that FRM is diversifying, however, it remains to be seen whether these changes are effectively addressing flood risk management.

To date, much of the literature related to FRM has been focused on the technical tools to assess, track, and manage flood risk but there has been much less research on frameworks and tools that could help in FRM decision-making and implementation (Dordi et al., 2022; Morrison et al., 2018a; Driessen et al., 2016). In terms of geographic contexts, most research focuses on the Global North, especially European countries; and primarily concentrates on urban contexts (Dordi et al., 2022, Hegger et al., 2014). There have been studies related to FRM done in Manitoba, seeking how various disaster management institutions and policies in the province have changed over the years, and comparing FRM policies and instruments across the prairie provinces (Haque et al., 2019; Morrison et al., 2018b). Flood research in Manitoba has also focused on understanding flood risk perceptions, identifying flood risk communication gaps, encouraging bottom-up activity, and community case studies (Stewart and Rashid, 2011; Olczyk, 2005, Haque et al., 2022; Haque et al., 2023).

My report aims to supplement the research on technical tools and European urban contexts by focusing on FRM decision-making frameworks and tools in rural Manitoba. (Dordi et al., 2022, Hegger et al., 2014). This report will contribute to the body of work on Manitoban flood research by providing an analysis of FRM in rural Manitoba and investigating efforts by the province, municipalities, and watershed districts.

Municipalities play a crucial role in FRM as they are directly confronted with the impacts of floods. Understanding how municipalities manage and adapt to flood risks, and the challenges they face is essential for developing effective and resilient FRM at the local level. Although this study will be focused on Manitoba, findings in this report may be relevant to rural municipalities facing flood risk and seeking to reduce harm.

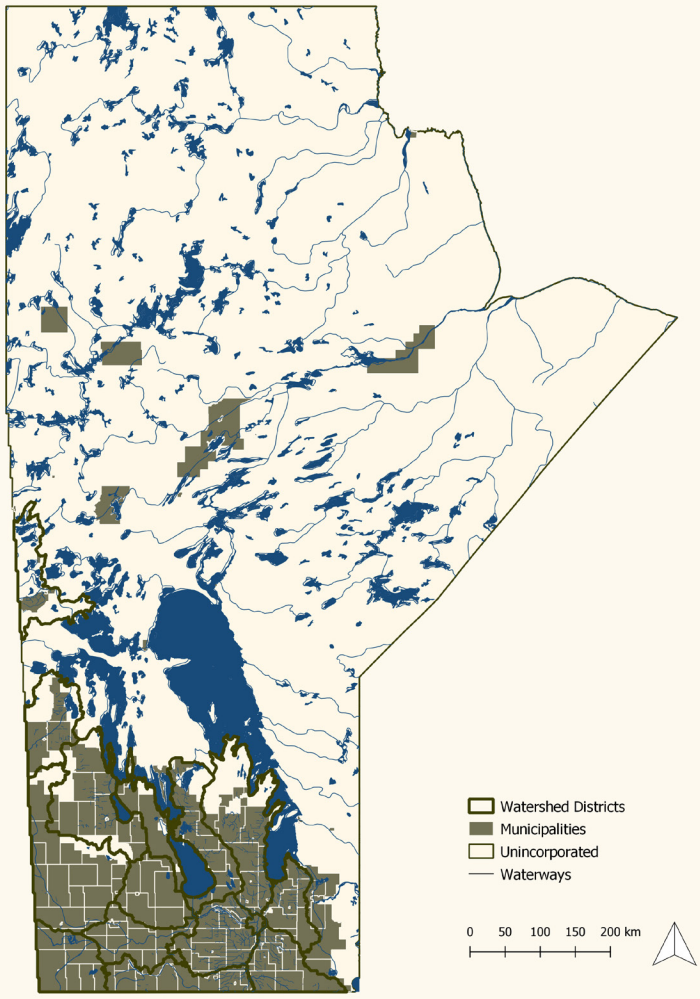


Figure 3: FRM focus in rural Manitoba: Watershed Districts, muncipalities, and provincial.

CHAPTER 2

SCOPE AND PURPOSE

2.1 RESEARCH OBJECTIVES

The objective of this report is to understand the FRM in the province, by critically assessing FRM efforts across Manitoban municipalities, and to provide planners and policy makers with key takeaways on FRM. Specifically, the objectives are to (1) understand how flood impacts and costs have evolved over time, (2) understand who the critical actors and stakeholders in FRM are, (3) critically assess the barriers and opportunities in implementing FRM efforts, and (4) outline pathways forward for successful implementation of these efforts. Policy instruments are reviewed, local planning and policy-making officials are interviewed as key informants, and investments into FRM are evaluated.

2.2 RESEARCH QUESTIONS

How have flood impacts and costs evolved over time?

What are the critical contributing factors?

What is the state of flood risk management efforts?

What investments are being made, what projects are being planned, where are these taking place, and what are they addressing?

What are the barriers? How might these challenges be overcome?

How has planning, policy, and decision-making evolved in relation to flood risk governance management?

Who are the critical actors and stakeholders? What are their roles and responsibilities? How are efforts being coordinated, or not?

Who does what, why, how, when? What are the areas of conflict?

2.3 METHODOLOGY

This investigation takes a mixed methods approach to understand how relationships, decision-making, and power structures interact between municipal, watershed, and provincial levels to determine and implement flood risk management in Manitoba. It addresses the arrangement of institutions, actors, systems of rules, decision-making procedures, and programs to assess how responsibilities and roles are assigned and how FRM has materialized in practice. While institutions can be formal or informal (Næss et al., 2005), this investigation focuses on formal institutions relevant to flood risk management in flood-prone areas, particularly planning and water management institutions at the municipal and provincial level of governance in Manitoba. Combining a review of FRM literature, thematic analyses of policy instruments, interviews with key informants, and geospatial mapping, this report will present the state of flood risk governance management efforts, and how planning, policy, and decision-making have evolved.

2.3.1 Literature and Historic Precedent Review

A survey of academic and non-academic literature was used to provide a solid foundation for key concepts discussed throughout the report. The literature review informed and ensured all analysis was grounded in the field of flood risk management. This review begins with the history of flood events in Manitoba and the resulting actions and policies. Concepts related to FRM are presented using academic research articles, as well as non-academic work by organizations working with flood risk management such as the International Panel on Climate Change, International Institute for Sustainable Development, and the Prairie Climate Centre. The literature review informed the framework and criteria used for coding policies and interviews which were presented and analyzed in the report.

2.3.2 Policy Instrument Analysis

An analysis of policy instruments identified actors, patterns, themes, and trends in FRM to better understand the governance and management of flood risk. Drawing on concepts from the literature review on FRM, data from the review of policy instruments from watershed districts, provincial, and municipal government departments was coded to organize the current approaches into types of policy instruments, FRGM strategies, roles, and responsibilities.

For the purposes of this report, 'policy instruments' are any tools used to influence the practice of

FRM, including legislative requirements and acts, regulations, by-laws, infrastructure or land-use zoning, funding programs for flood mitigation, preparedness, disaster recovery, and guidance documents on flood preparation or risk management. The policy instruments that were examined were current as of July 2024. The review of policy instruments did not include any instruments that could be considered technical aspects of water management, due to the focus on governance.

Policy instruments were categorized and coded into strategies, legislation, programs, and guidance/information as defined by Morrison et al., (2018b). Each policy instrument was then categorized based on its primary focus, using the five FRM approaches described by Hegger et al. (2014), (1) prevention; (2) defense; (3) mitigation; (4) preparation and response; and (5) recovery.

2.3.3 Key Informant Interviews

This project received ethics approval (McGill University REB 24-01-067) to conduct interviews with planning and decision-making professionals in Manitoba. A series of semi-structured interviews with key informants were conducted to complement the analysis of the policy instruments. The semi-structured interviews were based on key themes in the FRM literature (Morrison et al., 2018a; Hegger et al., 2014; Thistlethwaite and Henstra 2017; Dordi et al., 2022), and elicited the perspectives of professionals working in different areas of flood risk management.

The key informants include three government and municipal officials, two community planners, an emergency management coordinator, and a watershed district manager. The purpose of the interviews is to understand how flood impacts and costs have evolved, the relationships between professionals, future FRM intentions, and the opportunities and barriers faced. Interviews were transcribed and coded thematically, using Taguette software, initially based on the structured interview topics (Corbin and Strauss, 2008). Within each topic, results were analyzed and coded to identify themes in the qualitative data, then used to develop and share statements describing the experiences and perspectives of FRM professionals.

2.3.4 GIS Analysis

To add a spatial element to the research and analysis, geospatial analysis using GIS tools was conducted to visualize and analyze the range of policy instruments, and to show where interventions are taking place. Mapping FRM revealed relationships between where flood events have happened, where FRM investments are distributed, and what FRM priorities are. This entailed mapping the distribution of the Mitigation Preparedness Program investments, integrated watershed management plans that incorporated flood risk prevention and mitigation, and the range of measures taken to reduce flood risk through land use planning in municipal zoning bylaws.

CHAPTER 3

LITERATURE & HISTORIC PRECEDENT REVIEW

3.1 The history and influence of flood events in Manitoba

Flood disaster events have propelled government intervention through policies, investments, and changes to the management of flood risk across the province of Manitoba. From 1904-2024, the province experienced a total of 33 flood-disaster events (Public Safety Canada, 2022b). While formal government intervention began in the 1950s, historic events have significantly shaped flood responses to date.

The 1826 Red River flood is the largest recorded flood in Manitoba's history, the flood covered an area forty percent greater than the 1997 Red River flood (St. George & Rannie, 2003). The flood had catastrophic impacts on the city of Winnipeg, wiping out a significant part of the population and forcing mass relocation to higher settlements. The scale of this event influenced the level of flood protection to strive for in future years.

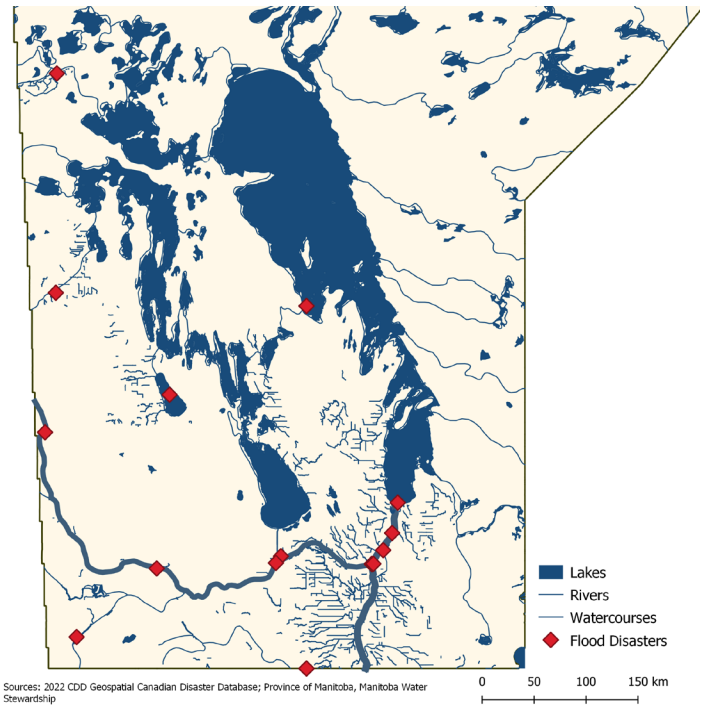
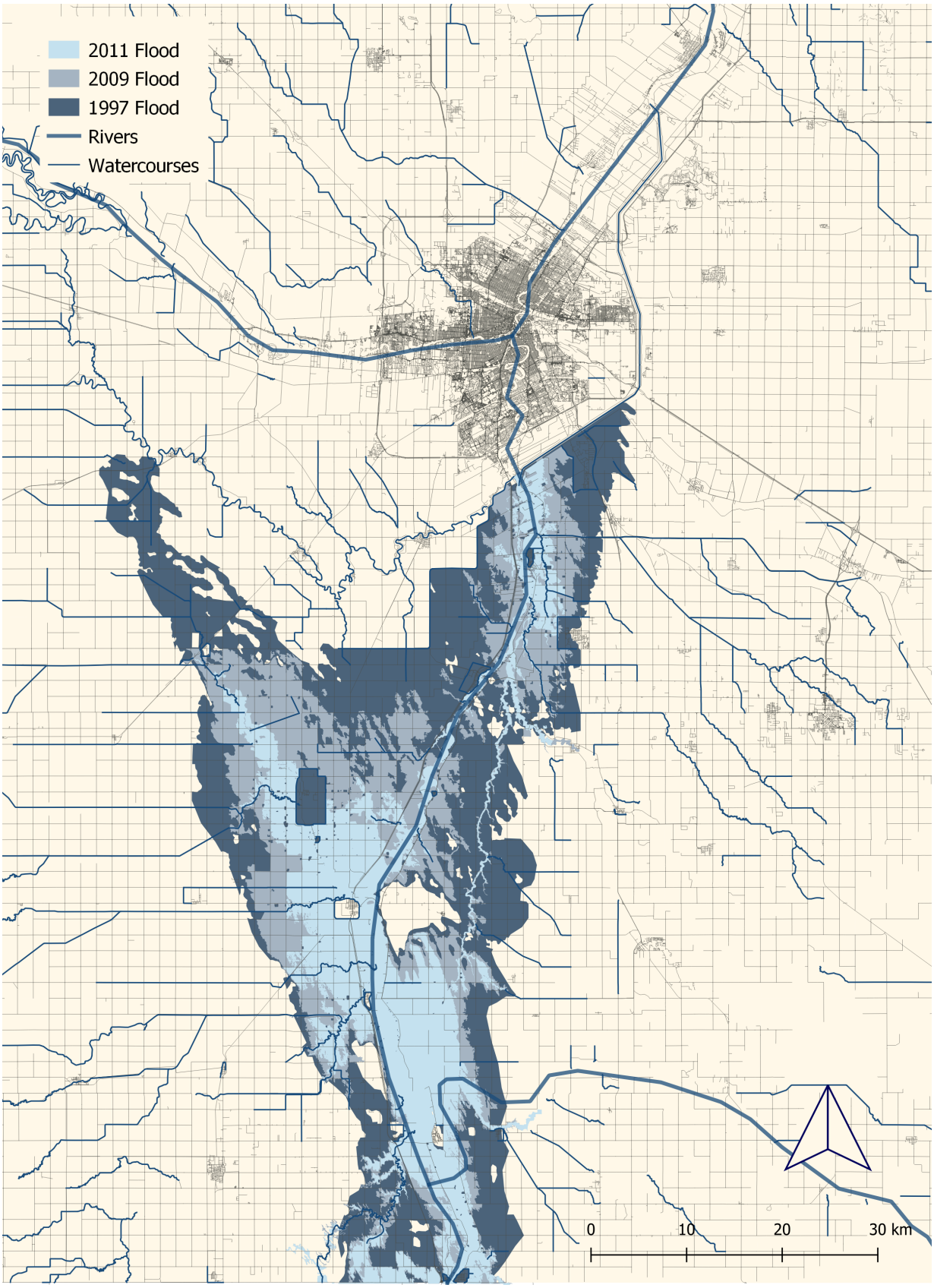


Figure 4: CDD record of flood disaster events (1904 – 2014)

In 1950, Winnipeg once again felt the devastating impacts of a major flood in the Red River Valley, resulting in 100,000 evacuations (Haque et al., 2019; R. Halliday & Associates, 2017). A range of investments and interventions followed this massive flood based on recommendations from the Royal Commission Report (Blais et al., 2016). There were three major infrastructural projects built after 1950: the Red River Floodway, the Portage Diversion, and the Shellmouth Dam and Reservoir, to protect residents from future events. The Emergency Measures Act was adopted in 1951, which was an important first step in developing emergency response legislation in Manitoba (Haque et al., 2019).

In 1966, flooding in the Red River basin revealed the vulnerabilities of communities outside of the protection of the Floodway (Blais et al., 2016). The government subsequently intervened by building ring dikes that offered protection to the 1950 flood level around eight communities.

Figure 5: Recent major flood event extents



The first flood that put the Red River Floodway to the test following its construction was in 1979, which was similar to the magnitude of the 1950 flood. While Winnipeg was kept safe, communities along the Red River outside of the floodway were not as fortunate. The 1979 flood led to an increase of the protection levels of the ring dikes, and the establishment of a program to flood-proof individual homes and businesses to the flood-of-record level, in some cases, buildings were relocated (Blais et al., 2016).

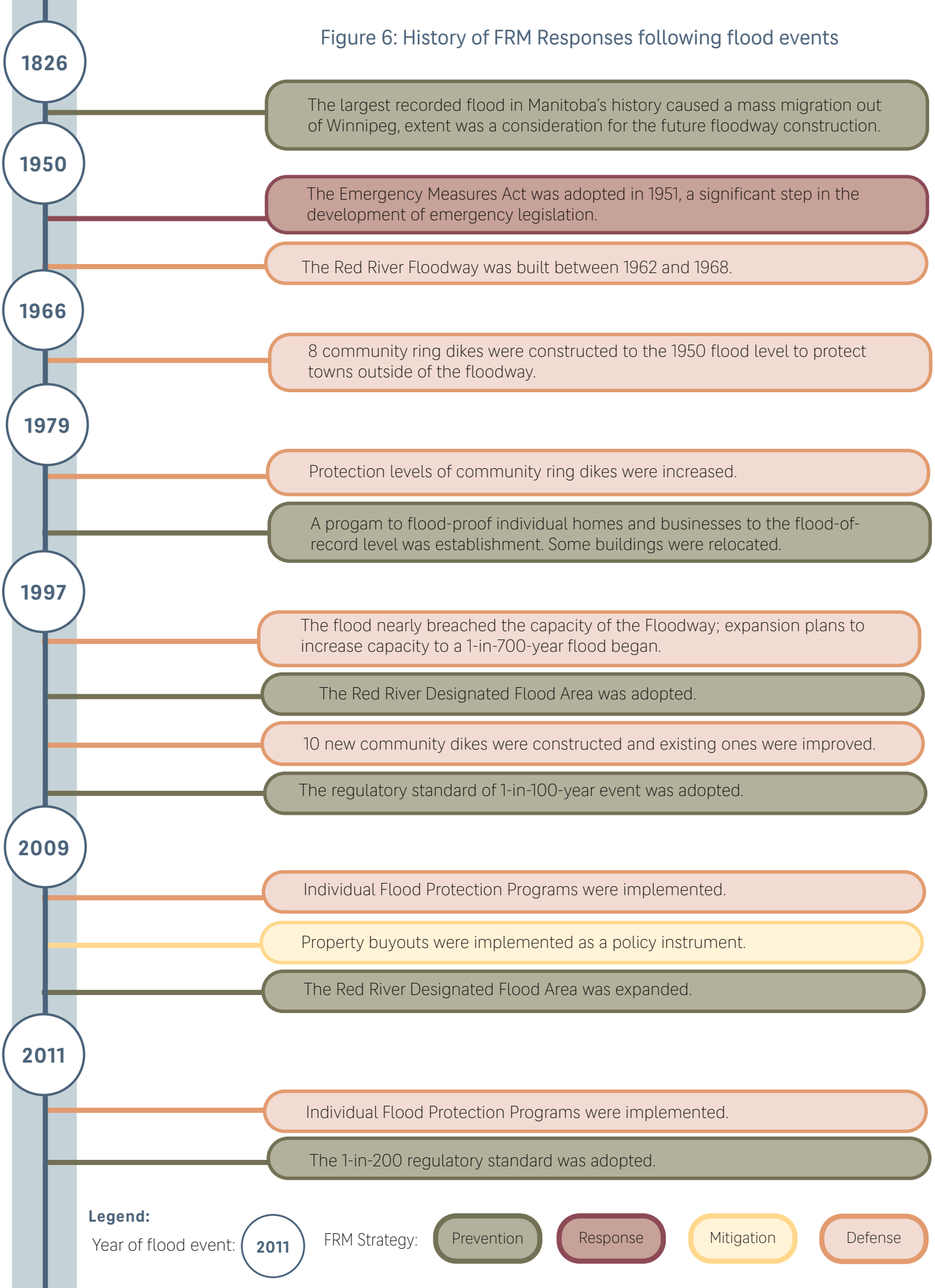
In 1997, Manitoba experienced a flood so massive it was considered the flood of the century. While the city of Winnipeg was once again protected by the Red River Floodway, the floodway was put to the test and reached its capacity. Unfortunately, the same could not be said for the rest of the province; the military was deployed to relocate 25,450 evacuees from outside the capital (Haque et al., 2019). The flood of the century revealed the vulnerability of the floodway and an expansion to increase its capacity was prioritized. As of 2014, the floodway now offers protection for a 1-in-700-year event. The 1997 flood also revealed the vulnerabilities of settlements outside of the protection of the Floodway. In response, the province built more ring dikes and increased existing ring dike capacity around communities that are in the flood zone. Furthermore, the spread of the flood was mapped as a flood zone and adopted by the province as a Designated Flood Risk Area (DFRA)[1]. The DFRA has restrictions to regulate any new proposed developments to reduce flood vulnerability.

In 2009, the Red River had another significant flood event, in which ice jams revealed the vulnerabilities north of Winnipeg by flooding many settlements. The province responded by expanding the zone of the DFRA to include the newly revealed flood-prone areas. The province also identified properties that were deemed high-risk and initiated a buyout program.

In 2011, the Assiniboine River experienced a massive flood; considered to be a 1-in-330-year event. On May 9, 2011, the government of Manitoba declared a provincial state of emergency and evacuated several municipalities along the Assiniboine River. The 200-year regulatory standard, which is the level of flood protection that any new construction must meet, was adopted across the province following the 2011 flood. For a comprehensive overview of when flood responses were adopted, please refer to Figure 1. The figure shows the major flood events and when they were adopted, as well as categorizing each response into the type of FRM approach.

1. The province of Manitoba uses the term "Designated Flood Zone". However, to avoid confusion with the Disaster Financial Assistance (DFA) program, this report will refer to designated flood zone as DFRA.

Figure 6: History of FRM Responses following flood events



Sources: Haque. et al, 2019; St. George & Rannie, 2003; R. Halliday & Associates, 2017; Blais et al., 2016.

3.2 FLOOD RISK MANAGEMENT

Flood risk management involves a collaboration among actors, to reduce the impacts of floods through a diversity of instruments, actions, and decisions (Hegger et al., 2014; Cutter et al., 2013; Hecker et al., 2009). While the overarching goal of FRM approaches is to reduce the impacts of floods, FRM can be categorized into two types of strategies: resistance-based and adaptive-based.

The goal of resistance-based strategies is to remove flood threats as much as possible to reduce impacts on society (Morrison et al., 2018a; Thistlethwaite and Henstra, 2017). Resistance-based strategies determine the level of protection needed based on the probability of a hazard occurring. Traditionally FRM efforts have favored resistance-based strategies, by aiming to control floodwaters and defend areas from floods, through engineered and structural measures.

On the other hand, adaptive-based strategies exist with the risk of flooding and focus on mitigating, coping with, and recovering from flood events using a diverse set of policy instruments (Morrison et al., 2018b). Adaptive strategies prioritize considering the consequences of flood events by incorporating exposure and vulnerability considerations (Thistlethwaite and Henstra, 2017; Morrison et al., 2018a; Jongman, 2018).

There has been discourse since the 1970s emphasizing the limitations of a resistance-based approach. The National Disaster Risk Reduction Program highlighted the need to diversify strategies and adopt an adaptive-based approach (FDRP, 1978). Over time there has been a shift in the approach to FRM, the focus on controlling and fighting floods is shifting towards an attitude of living with flood events (Morrison et al., 2018a). An important tool for adaptation is policy instruments, which enable actors to plan and implement actions to achieve their objectives (IPCC, 2014; Henstra, 2016).

FRM is a continuous process that can be divided into three stages; pre-flood, flood event, and post-flood, with various actors involved at different times (Schanze, 2006). The pre-flood stage focuses on long-term risk reduction and includes any actions taken to address flood events before they occur. The flood event stage is characterized by the magnitude of the flood event and includes actions related to preparing for and responding to the event. The post-flood stage refers to actions taken after a flood event subsides and focuses on the recovery from losses and damages (Shanze 2006; Zbigniew & Samuels 1997; Morrison et al., 2017).

Actors involved in FRM can take actions using policy instruments which can be categorized into five strategies: prevention, defense, mitigation, preparation response, and recovery (Hegger et al., 2014). Flood risk prevention aims to reduce the consequences of flooding by decreasing the exposure of people and property in areas in areas at risk. Flood defense seeks to lower the probability of flooding through structural measures such as dikes, levees, and dams. Flood risk mitigation focuses on reducing the scale and impacts of flooding in vulnerable areas, through measures such as water retention or storage, and flood-proof building practices. Flood preparation and response includes actions taken leading up to, and during a flood event to manage the event, such as developing flood warning systems, disaster management, and evacuation plans. Flood recovery responds to damages and losses inflicted by floods and includes reconstruction and rebuilding efforts.

3.3 POLICY INSTRUMENTS

Policy Instruments are tools of governance that use authority and resources to shape the behavior of individuals or groups to reach strategic public objectives (Howlett, 2005; Thistlethwaite and Henstra, 2019). For managing flood risk, the provincial government has traditionally favored structural instruments such as the floodway and community dikes; however, these approaches have significant upfront costs and have limits to the protection they offer.

There are shifts towards incorporating more non-structural instruments that aim to reduce the vulnerability of people and the exposure of assets by influencing social behaviors (Raikes et al., 2023; Morrison et al., 2018a). Non-structural policy instruments can share flood risks and responsibilities by involving more actors, however, it is important to leverage the strengths and capacities of all actors involved for effective FRM (Thistlethwaite and Henstra, 2017). Examples of non-structural instruments can include flood maps, risk assessments, regulations, flood insurance, and disaster assistance.

Morrison et al., (2018b) identify 4 types of policy instruments used in FRM: strategies, programs, legislation, and guidance or information. Strategies outline a set of principles, set broad objectives, and provide a framework for a coordinated set of FRM programs and actions. Legislation officiates FRM principles, making them legally binding, assigning responsibilities and providing a framework for enforcement of those principles. Programs consist of distributing funding for actions and activities to address clear and defined aspects of FRM, such as erosion control, community

defense, or relocation programs. Finally, guidance and information provide a framework for FRM approaches. Guidance can be both technical and general in scope. Guidance can pertain to flood mapping, building design or emergency planning, and can include public messaging related to flood preparation and recovery. Information includes data that informs and assists FRM such as flood maps, hydrological measurements and other data (Morrison et al., 2018b).

3.4 FLOOD VULNERABILITY

When thinking about flood risk, it is not enough to only consider the area of land covered by a flood, the impacts felt must also be considered. Flood risk is generally understood as the product of three variables; the flood hazard, the exposure of people and assets, and the vulnerability of people and assets to flood impacts (Chakraborty et al., 2022; Cutter et al., 2013; Armenakis et al., 2017; Thistlethwaite and Henstra, 2017; Aerts et al., 2018). Exposure refers to the amount of people, property, infrastructure and activity that is in contact with the flood hazard risks (Dordi et al., 2022; Sayers et al. 2013; Aerts et al., 2018). Vulnerability refers to the capacity of people, property, infrastructure and activity to anticipate, cope with, resist, and recover from a flood hazard event (Chakraborty et al., 2022; Cutter et al. 2003; Wisner, 2004). It is important to incorporate exposure and vulnerability into discussions surrounding flood risk management because people do not have the same capacity to deal with flood events.

Social vulnerability refers to the factors and characteristics of a person or group that shape their susceptibility to harm and ability to respond (Cutter et al., 2003; Cutter et al., 2013). Factors such as socioeconomic status, age, gender, race, ethnicity, and employment sector can influence the impacts of flood events (Cutter et al., 2013). Assessing social vulnerabilities spatially is key to accurately identifying flood risks and is critical to prioritize limited FRM investments to protect those most at risk (Chakraborty et al., 2022).

A common decision-making tool for distributing flood risk management investments involves hydrological modeling and cost-benefit analyses (CBAs) (Paauw et al.,2023). Using CBAs to justify decisions has many limitations, one being that a major consideration is based on preventing property damages. Using property values focuses on the economic values of the property, rather than considering the social impacts, like the capacity of people to recover (Cutter et al., 2013). People with less means will generally live in areas that have lower property values. These approaches fail to consider social vulnerabilities meaningfully and account for the capacities of people to respond to events.

3.5 The distribution of flood risk management in Manitoba

In Canada, the responsibilities for managing flood risk are divided between three levels of government (Golnaraghi et al. 2020). While the federal level has delegated most FRGM responsibilities to the provincial government, it provides significant support by generating geospatial data for flood mapping, providing economic resources to mitigate and recover from flood risk, and developing broad policy frameworks (Raikes et al., 2023). The provincial governments have control over key policy tools such as land use planning and building standards. Manitoba, as a provincial government, adopts legislation such as setting regulatory standards for land use planning through The Planning Act; builds and maintains major infrastructure projects through Manitoba Infrastructure (MI); ensures preparedness for flood disasters through the Emergency Management Organization (EMO); and provides disaster financial assistance for post-flood recovery (Bill 33, 2005).

The province of Manitoba designated Watershed Districts as the Water Planning Authorities in 2020, replacing former Conservation Districts, marking a shift towards integrated water management (IWM) across the province. IWM refers to an ongoing process that manages human activities and ecosystems at the watershed scale to protect and manage water. The responsibilities of watershed districts are to create integrated watershed management plans (IWMP). IWMPs are meant to be a tool to help residents, stakeholders and all levels of government make responsible decisions regarding the management of water, development of land, and allocation of financial resources.
Watershed Districts are effective in their role of IWMP efforts thanks to their local grass-roots leadership connections, ability to integrate stakeholder interests, and connections to provincial support (Cuvelier & Greenfield, 2016). The watershed-based approach for water and land-management activities is one way to improve coordination among actors and to foster a more integrated approach to land use planning and water management.

Municipalities are given powers by provincial legislation and are largely responsible for the enforcement and implementation of FRM. Municipalities oversee the implementation of provincial legislation on land use, investment in structural defenses, and enforcement of standards for the design and maintenance of buildings and infrastructure (Golnaraghi et al., 2020). Despite

being given significant responsibilities, the financial capacity and resources of municipalities are limited due to their dependence on property taxes for revenue. Dealing with challenges as complex as flood risk management is difficult with limited resources, so municipalities rely heavily on the province concerning FRM.

In Manitoba, the complexity of FRM is compounded by the fact that many municipalities are rural, cover a large land area, and have a very small population. These characteristics mean that many municipalities do not have the resources to have designated planners. In this case, two or more adjoining municipalities can form a Planning District. By creating planning Districts, municipalities can work together to coordinate resources and policy instruments relating to land use and development. The province also provides support through community planning branches. There are 9 branch offices located throughout the province to provide professional and technical services to municipalities and planning districts. (Gov MB, n.d.-a).

CHAPTER 4

ANALYSIS OF POLICY INSTRUMENTS

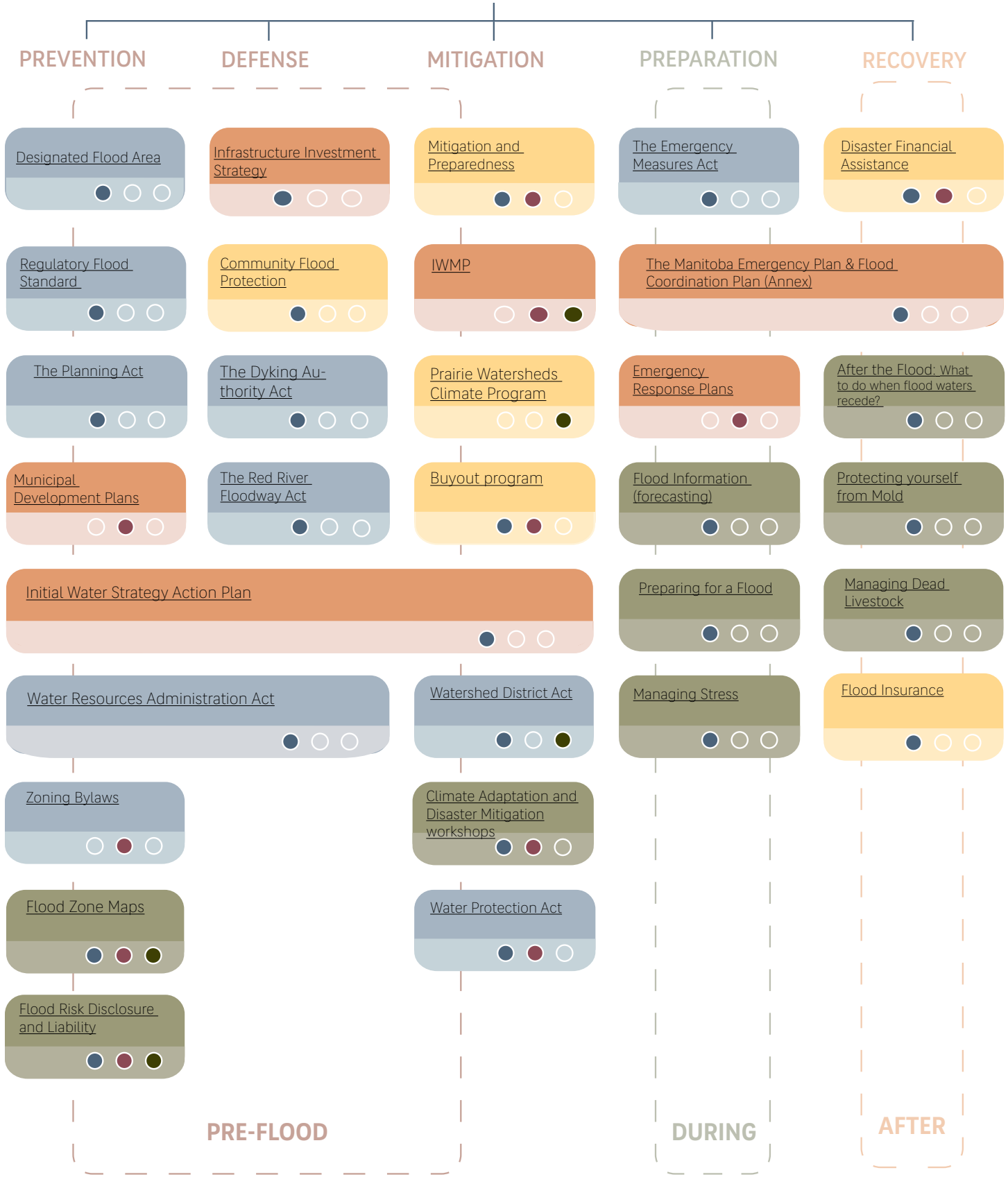
4.1 FRM POLICY INSTRUMENTS

I investigated policy instruments at three levels of governance: the watershed district level, the provincial level, and the municipal level. All the instruments were categorized based on the FRM approach, the type of policy instrument, and the types of actors involved (Hegger et al.,2014; Morrison et al., 2018b). Each policy instrument is described based on which actors are involved and how it relates to FRM. See Figure 6 for the overview of the policy instruments.

There were 32 FRM policy instruments that were identified in Manitoba. 21% of policy instruments are strategies, 32% are legislative instruments, 18% are programs, and 29% are guidance and information documents. Of the five FRM categories identified by Hegger et al. (2014), the distribution of the policy instruments found was similar: prevention instruments were the most common (25%), followed by defense, mitigation, preparation instruments (20%), and recovery (15%).

The province is a critical FRM actor, heavily involved in each stage through all types of policy instruments. Municipalities are involved throughout the FRM process, at every stage except for flood defense. Municipalities have an important role in prevention through instruments related to land use planning. Watershed Districts are involved in the pre-flood stage through mitigation and prevention measures. It is important to consider each FRM stage, and the subsequent sections will present the instrument and actors involved in each approach.

Figure 7: FRM Policy Instruments in Manitoba



Guidance/ Info n = 9

Legislation n = 10

Programmes n = 6

Strategies n = 6

Types of Actors

Province

Watershed

Municipality

Adapted from: Morrison et al., 2018 & Hegger et al., 2014, Zbigniew & Samuels 1997.

4.1.1 FRM Prevention Instruments

Policy instruments related to prevention aim to avoid the negative consequences of flooding by building outside of areas that are prone to flooding (Hegger et al., 2014). Land use policies and spatial planning can keep people and assets out of flood-prone areas and away from water (Dyca et al., 2024; Chakraborty et al., 2022). Most of the policy instruments that are involved in flood prevention are legislative (55%) and stem from the provincial level. Many of the preventive policy instruments that were reviewed guide, inform or affect land use planning and management and are described below.

One of the specific policy instruments used in FRM prevention is flood zone maps which show the geographic extent of flood events based on historical events or modeling (Raikes et al., 2023). Flood zone maps are primarily created by the provincial government in Manitoba; however, municipalities and watershed districts are also able to map flood zones if they have the resources to do so. Flood zone maps are used to inform planning and land use management, emergency planning, and public communication of flood risks. Interviews with community planners and municipal officials revealed that many municipalities do not have their own flood zone mapping, relying on the province for this information (Interviews 2,3,5,6,7).

The province has flood zone maps based on historic floods, such as the ones mentioned in chapter 3, however, this information is not publicly available. A study by Babei (2017), revealed that that many of the flood risk maps currently in use by the province of Manitoba were created between 1970-1980 and are based on past flood extents. The problem with this approach is it fails to consider land use changes, activities, urbanization, all which can play a significant role in contributing to flood risk. Maps of the 1997 and 2011 floods zones are used to define the provincial Designated Flood Risk Areas (DFRA) (Gov MB, n.d.-a).

The DFRA is a provincial zoning classification requiring a secondary permit for any new construction or development. This permit is to ensure that any proposed developments are flood-proofed, to provincial standards. The DFRA zones are based on two historic floods, rather than all flood-prone areas in the province. Outside of DFRAs, Manitoba sets a regulatory flood standard; referring to the “return period of a flood” which is included in provincial legislation (MB Infrastructure, n.d.-a; Bill 33, 2005; Bill 22, 2004). See Figure 7 for a map of the DFRA zones.

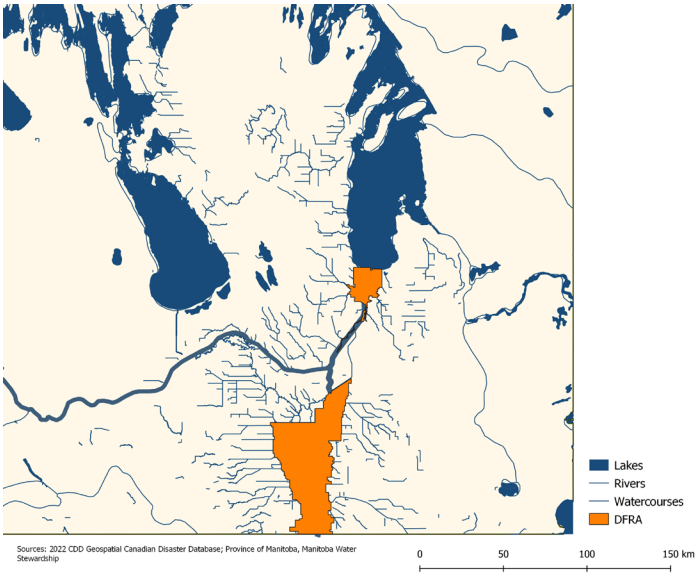


Figure 8: Map of DFRA zones

The 1-in-200-year event is used for the regulatory standard, meant to guide municipalities to regulate development in flood-prone areas and inform land use planning, public infrastructure protection, and flood protection design. Unfortunately, while the 1-in-200-year event standard is progressive, implementation is a challenge because mapping for this level is not completed across the province. Until mapping is made available, areas that are prone to 1-in-200-year events are and will continue to be at risk of being developed.

Local planning authorities, such as planning districts and municipalities, are responsible for the development of land and resources in their designated planning areas (Municipal and Northern Relations, n.d.). Using provincial legislation as a framework, local authorities prepare development plans to use as strategies to guide future land use and development activity. Development plans are opportunities for municipalities and regions to create plans reflecting development goals based on set physical, environmental, social, and economic objectives.

To ensure that the strategies and goals identified in development plans are met, local authorities pass zoning by-laws to regulate activities. A major challenge to regulating development comes from waterfront properties having high economic values, despite being more flood-prone than inland properties. This creates pressure from developers and land speculators who push for approvals to subdivide and develop these flood-prone areas.

"As planners we use the 1-in-200-year standard to approve or reject proposals, but not everything is updated yet. I had a developer appeal a subdivision rejection once, in the RM of Macdonald, because the 200-year flood event of that area is not known, but they (the province) are working on it" (Interview 3).

The appeal process is a recent update and allows developers to appeal rejected applications for subdivisions.

"Now, anything that gets rejected can be appealable and goes to the municipal board, who is extremely busy with all the appeals" (Interview 3).

Available flood data could alleviate the development pressure by providing a clear justification for rejections and approvals.

The final tool examined was Flood Risk Disclosure and Liability, which mandates the release of a property's flood history and its current risk to potential buyers (Raikes et al., 2023). Currently, the Manitoba Real Estate Association (MREA) strongly recommends conducting a title search for the prospective property. A title search can be done in person at a Land Titles Office and provides publicly available information about the property that may impact its value. Title searches can provide information such as taxes, special assessments or local improvement levies, development plans, and flood risk and protection requirements (MREA, 2023). If a property is located inside the floodway, community ring dike, or within an identified flood zone, this would appear on a title search. As mentioned previously, because updated flood mapping is not available across the province information for properties outside of identified flood-prone areas is limited. Disclosing flood risks is not mandated by the province, simply recommended by the MREA, however, the province does take other measures.

An interview with the Community Planning Branch of the province revealed that new subdivisions and developments in a flood-prone area, must create their own development agreements (Interview 2). Development agreements require lots and buildings to be built to a certain level, with floodproofing measures. These agreements are registered on the property title to ensure compliance.

In sum, there is clear legislation in place to guide flood prevention measures across the province, however, crucial data to properly enforce the legislation is missing. Flood zone maps are not available for all areas, and many of the existing maps are out of date and do not reflect contemporary flood challenges. Updating the flood mapping to provide adequate data is critical to ensure the success of all actors in flood risk prevention.

4.1.2 FRM Defense Policy Instruments

Flood defense approaches are based on the probability of flooding and use structural measures to keep flood waters away from people and assets (Hegger et al., 2014). Examples of structural measures include dikes, dams, embankments, weirs, and upstream retention areas. Defense approaches are primarily a tool used by the provincial government and are mostly legislative and strategical.

A significant part of the defense approach stems from Manitoba's historic investments into infrastructure such as the Red River Floodway, the Portage Diversion, and the community ring-dikes along the Red River. Today, Manitoba Infrastructure (MI) is responsible for these projects, managing flood forecasting, operating flood control works, and monitoring water flows.

The Dyking Authority Act and the Red River Floodway Act authorize the operations of flood control structures during flood events. The structures have protected communities, people, and assets from devastating losses. Despite the high vulnerability to flooding, the Red River Basin is one of the most densely populated areas of the province. Refer to Figure 2 for a map of the population density.

The Community and Individual Flood Protection (CFIP) program was introduced to fund measures that provide protection for people and communities outside of provincial structural measures. 667 individual properties have funded flood protection measures such as raising buildings and building dikes thanks to the CIFP (MB Infrastructure, n.d.-b).

Funding individual flood protection can allow people to stay in their home. When the resources and support needed to relocate are lacking, CFIP provides an important lifeline. An interview with an emergency coordinator revealed that people stay in flood-prone areas because they are unable to relocate due to the unaffordability of moving.

"The trend that we are seeing is that folks are staying put longer, living in homes because they can't find affordable housing, there isn't enough social support to help these people" (Interview 2).

While the community and individual flood program may encourage staying in a vulnerable area, it does protect people by reducing the flood risk, and is an important social support for people that are unable to move. It is important to note that the program also provides financial assistance for cottage owners. Providing funding for individual flood protections for both primary residences and cottages suggests that social vulnerabilities are not incorporated into funding criteria. The province should consider including an assessment of vulnerabilities to ensure funding helps people that are most at risk.

The province has two major strategies guiding investments related to infrastructure and water management. The Infrastructure Investment Strategy is a five-year plan detailing Manitoba Transportation and Infrastructure's (MTI) strategic investments in new and existing infrastructure and assets. MTI specifies that investments will focus on flood protection and climate resiliency (MB Transportation and Infrastructure, 2023). The list

of investments in the five-year plan includes dams, flood protection ring dikes, linear dikes, diversions, and water control structures. The program is responsible for moving water effectively through a network of water-related infrastructure. The largest investment is into the Lake Manitoba – Lake St. Martin outlet channel, which includes building two separate flood control channels and their associated structures.

The 2023 Integrated Water Strategy brings together various actors to manage water and establishes FRM investments. The IWS reveals continued provincial infrastructure investment and key projects include 20 dam structure replacement or rehabilitation projects, 7 pump station replacement or rehabilitation projects, 11 dike rehabilitation projects, 3 flood protection enhancement projects, 40 structure rehabilitation projects, 104 culvert improvement projects, and 27 flood restoration projects for structures, dams, drains, and culverts (IWS, 2023).

Manitoba's investment strategies reflect an ongoing focus on a resistance-based approach. While the planned infrastructure will offer protection against flooding, it is important to note that the projects have a limit to their protection. A weakness of this approach was voiced by a provincial official in an interview.

"I think the misconception is that engineered solutions solve our problems, but they don't adapt to climate change and the continued impact of landscape change from urbanization" (Interview 4).

Flood events are changing across the province, they are becoming more frequent, and occurring at different times of the year, including summer for which infrastructure like the Red River Floodway was not originally designed (Interview 4).

Structural infrastructure can encourage risky development in flood-prone areas due to a sense of safety from the engineered protection. There is always renewed development interest following upgrades to flood protection infrastructure. An interview with a planner described development pressure after the city upgraded its community flood protection infrastructure following a near breach due to a large flood.

"There was a renewed interest in the area, because there is a level of protection now, there should be some development allowed" (Interview 5).

It is important to remember that while flood defense structures protect property, there are limits to the protection offered. An interview with a flood-prone municipality talked about how extensive investments following the 1997 flood ensured that all properties were either raised or ring-diked. This approach does not eliminate flood impacts. The interviewee noted,

"We don't lose any residential or commercial buildings during floods, the only damage that we get now is to our road networks and municipal infrastructure. This results in evacuations because the road network goes out and people are stranded" (Interview 6).

If Manitoba continues to make significant investment in permanent infrastructure, it should be diligent in ensuring these investments reduce the exposure and vulnerability of people.

4.1.3 FRM Mitigation Policy Instruments

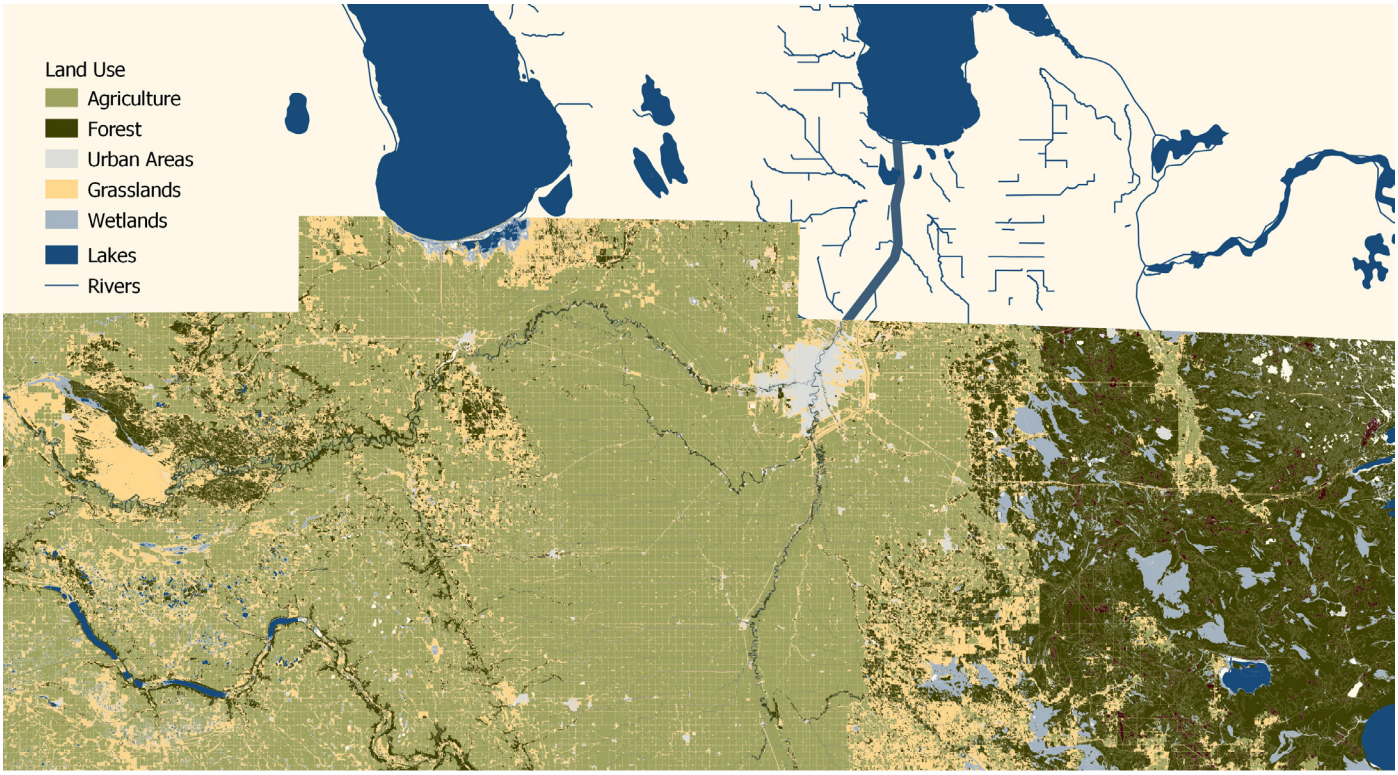
The approach of flood risk mitigation recognizes that floods will continue to occur and focuses efforts on reducing the consequences of floods through interventions in flood-prone areas (Hegger et al., 2014). Manitoba employs a range of policy instruments for flood mitigation, including legislation, strategies, programs, information and guidance. Various actors are involved in mitigation, from the provincial and municipal government levels to watershed districts.

The Water Protection Act recognizes the importance of using scientific information for water-related decision-making processes and supports integrated watershed management planning (IWMP). IWMP is a cooperative effort by watershed residents, governments, and other stakeholders to create a long-term plan to manage land, water, and related resources on a watershed basis (Bill 22, 2004).

Watershed districts, established under the Watershed Districts Act, develop and implement programming to improve watershed health (Environment and Climate Change, n.d.). Currently, there are twenty-six integrated watershed management plans (IWMP) in various stages of completion and one plan under renewal in Manitoba, these are analyzed in greater detail in section 4.2.

The Prairie Watershed Climate Program (PWCP), led by the Manitoba Association of Watersheds and delivered by the Watershed Districts, offers funding incentives to agricultural producers for implementing beneficial management practices (BMP). These practices enhance farm resilience to flooding and drought, reduce greenhouse gas emissions, improve soil health, and benefit the environment (MB Association of Watersheds, n.d.). The PWCP is a program that addresses issues identified in IWMP and works with private landowners to work towards watershed goals. It has funded various projects including water retention and has been a success in overcoming some of the challenges related to flooding that are exacerbated by the agricultural sector. This approach has great potential because agriculture is such a significant economic industry in the province. Refer to Figure 8 for a map of land use.

The Mitigation and Preparedness Program (MPP) was established in 2020 as a measure to mitigate future disasters by building local capacity. It



Sources: Province of Manitoba, Manitoba Water Stewardship; Land Inventory

Figure 9: Land Use in southern Manitoba

develops new funding sources, assists municipalities in accessing existing funds for mitigation projects, facilitates information sharing, and conducts research (Interview 7). The MPP projects are analyzed in more detail in section 4.3.

A priority of the Mitigation Preparedness program is knowledge sharing. In 2024, the MPP partnered with Environment and Climate Change Manitoba to deliver climate adaptation and disaster mitigation workshops to municipalities across the province. As part of these workshops, the province mapped disaster sites for each municipality, marking all the areas that had suffered damage, which was powerful to see.

"Locally, people know where their problems are, they also have access to the information in an excel spreadsheet, but when you see it on a map, it's super impactful. It gives people a moment of pause and they can reflect and realize, ok, we are seeing clusters of impacts" (Interview 7).

The climate adaptation and disaster mitigation workshops provided an opportunity for municipalities to voice their hopes, dreams, and goals for disaster risk reduction in the municipalities, as well as the barriers and challenges for implementing these projects (Interview 7). Despite being a recent program, the MPP has been successful in bringing municipal concerns to the provincial level and facilitating knowledge and resource sharing.

Property buyouts are a policy instrument that involve relocating people out of high-risk areas through the public purchase of properties (Raikes et al., 2023). While highly effective at reducing flood risk, buyouts often face opposition from property owners that are unwilling to participate due to their attachment to place, economic prospects, and belief that the compensation is unfair (Binder and Greer, 2016). Buyouts were identified as an action in some IWMPs; the Dauphin Lake IWMP proposed a buyout program to be in place by 2020 (ICD and TRCD, n.d.). The Arrow Oak River IWMP proposed establishing a natural reserve by buying land prone to flooding and providing incentives to convert flood-prone land from agricultural production to permanent grasslands from 2015 to 2019 (LSRCD & UARCD, 2011, p.26). For both mentioned proposals, I was unable to verify whether these actions had been realized. One confirmed case of property buyouts took place in Selkirk following the 2009 flood, where $4.4 million was spent in buying out flood prone properties near Breezy Point, St. Andrews, and St. Clement (Wazney & Clark, 2016).

The final identified policy instrument that falls under mitigation (as well as prevention and defense) is the Initial Water Strategy Action Plan (IWS).

The IWS provides a comprehensive and integrated approach to water management in Manitoba (Gov MB, 2023). The plan focuses on sustainable water use, protecting ecosystems, enhancing climate resilience, and addressing infrastructure challenges. The FRM strategies emphasize the need for Indigenous inclusion, coordinated watershed management, improved data, and public engagement. Specific actions include updating data portals, digitizing maps, and undertaking and updating flood hazard mapping to improve available information and flood knowledge sharing. (Gov MB, 2023). The IWS recognizes some of the gaps in the province related to managing flood risk and outlines a strategy to overcome them. If the province successfully achieves all identified actions, Manitoba will be very well positioned to manage flood disasters.

The recent adoption of mitigative policy instruments, especially compared to the defense policy instruments, reflects that there is a shift in the approach to flood management in Manitoba. A combination of legislation, strategies, programs and guidance documents reveal the intention to accommodate living with floods, by improving the ability of people and assets to cope with floods. Actors from all levels: provincial, municipal, and watershed districts are involved and given a role in mitigating flood risk.

4.1.4 FRM Preparation and Response Policy Instruments

The preparation and response approach refers to actions that prepare people and areas for flood events and reduce potential impacts through protection during the event (Hegger et al., 2014; Morrison et al., 2018b). There are six identified policy instruments in Manitoba categorized as preparation and response strategies, this stage is heavily led by the province and supported by municipal participation on the ground. Flood preparation and response are primarily managed by two departments under the Ministry of Transportation and Infrastructure (MTI): the Emergency Management Organization (EMO) and the Hydrologic Forecast Centre (HFC).

The HFC prepares for floods by closely monitoring river flows and drainage networks, using historical data to predict when and where infrastructure interventions are needed. When flood levels reach certain thresholds, proactive measures such as cutting roads are taken to facilitate water drainage and reduce infrastructure damage. Monitoring efforts are disseminated through the Manitoba Emergency Coordination Centre (MECC), which coordinates real-time information and resources among actors during emergencies.

The MECC is staffed based on the scale of the emergency; during flood events, regular update meetings are held, often daily, involving representatives from affected municipalities and various provincial departments such as water resources, infrastructure, social services, and EMO. These meetings enable everyone involved to share real-time information, coordinate actions, and request resources, such as additional pumps (Interview 6).

The EMO coordinates flood preparedness and response based on its mission to work continuously with partners to mitigate, prepare for, respond to, and recover from hazards and disasters (MB Transportation and Infrastructure, n.d.-a). Per the Emergency Preparedness Act, EMO creates the Manitoba Emergency Plan (MEP), which provides a comprehensive strategy to guide and coordinate emergency responses across the province.

EMO provides support and offers leadership during emergency events while emphasizing the importance of building local capacity to respond to events. Each municipality has a Municipal Emergency Coordinator, and an annually updated local emergency response management plan, tailored to the unique characteristics and challenges of the municipality. Municipalities must include a hazard risk vulnerability assessment (HRVA) as part of their emergency plan (Interview 7).

The province is undergoing a process to update the HRVA criteria, to provide guidance and standardize the way hazards, vulnerabilities, and risks are identified and assessed. During flood events, municipalities implement their plans, supported by the provincial government when needed. If a scenario extends beyond the capacity of a municipality, the province provides information and support as needed as well as equipment and other resources on a priority basis. The availability of physical resources such as sandbags, pumps, and earth-moving equipment is communicated, and the protocols and procedures to mobilize these resources when needed are clear.

The effectiveness of local emergency management is exemplified by various municipalities' successes. For example, Selkirk's emergency response to flooding is structured around a detailed flood map with 32 action points, corresponding to specific mitigation measures. These measures include actions such as closing valves to prevent river water from backing up into the city's drainage system and constructing permanent dikes to protect key areas. The flood map is updated to reflect infrastructure changes,

including detailed sheets for each action point with photos, GPS coordinates, flood height triggers, and time estimates for completion. This comprehensive approach ensures all actions are documented and integrated into the city's emergency plan, which is approved by the Council. The plan also serves as a public communication tool to justify necessary measures and enhance community safety (Interview 2).

Lastly, the province provides general information to any residents facing flood risk through a comprehensive flood preparation resource list (Gov MB, n.d.-c). This includes steps for preparing homes and properties, such as installing a sump pump, plugging drains, disconnecting eaves troughs, and turning off the furnace, gas, and electricity in the event of an evacuation. The list also provides evacuation checklists, insurance information, securing hazardous materials, preparing agricultural operations for floods, and constructing sandbag dikes.

Recognizing the stress and anxiety that flood events can cause, the province has compiled resources to provide support to residents in managing stress. Support services include Shared Health's Mental Health and Wellness Resource Finder, Health Links-Info Santé, Manitoba Farm Rural and Northern Support Services, and Klinic Community Health Centre. These services help locate support systems, provide resources, counseling, and maintain a 24-hour crisis line (Gov MB, n.d.-b). There are also targeted guides for supporting volunteers, and caring for seniors, children, youth, and students.

Flood preparedness and response is a strength across the province. There is a clear coordinated approach that is responsive to the scale of the disaster. By providing training and establishing a municipal emergency coordinator in every municipality the province has created a provincial network that can respond to events on the ground. The review of the HRVA criteria required for emergency plans presents an opportunity to incorporate measures of social vulnerability.

4.1.5 FRM Recovery Instruments

The recovery stage of FRGM refers to actions taken after a flood event to restore things to pre-flood conditions. This stage can be drastically different depending on the scale and magnitude of the event but generally involves re-entry operations, clean-up, restoration of utilities, flood damage estimation, claims for financial assistance, rebuilding roads, and repairing damaged buildings.

Under the Manitoba Emergency Plan, the Manitoba Flood Coordination Plan annex provides detailed actions with corresponding actors to facilitate the recovery process (EMO, 2019). The MECC, in partnership with utilities, local authorities, and relevant provincial ministries prepares for municipal re-entry. This includes inspecting critical institutions, ensuring water levels are safe, confirming the safety of transportation networks, and re-opening community dikes. Once deemed safe, the re-entry process begins. This involves monitoring programs, addressing unsanitary conditions, providing expertise on inspection, disinfection, resuming farming activities, and assessing the need for psychosocial support for affected communities.

The province determines the need for a Disaster Financial Assistance (DFA) program and EMO opens flood recovery offices as required to help with applications. Flood damages and impacts are documented, inspected, and assessed, and DFA claims are submitted and processed. Depending on the scale of the damages, the province may request Disaster Financial Assistance Arrangements (DFAA) from the federal government. For smaller-scale events that do not warrant the opening of the MECC, the province provides guidance and information to assist residents with the recovery process. The "After the Flood" booklet provides detailed instructions, recommendations, and offers support contacts (Gov MB, 2022a).

The Disaster Financial Assistance (DFA) program is a significant recovery tool in Manitoba, which provides funds to eligible individuals and organizations to facilitate recovery after a flood disaster. DFA funds are the first to be made available to citizens and municipalities in the aftermath of a flood, covering emergency expenses, and repair or replacement costs to a basic standard. If costs exceed a population-based threshold, federal disaster assistance is made available.

The DFA offers crucial resources enabling municipalities to manage flood events effectively. For example, in 2022 the Rural Municipality of Montcalm, with a population of 1278, faced a flood leading to 285 DFA claims, and $20 million in incurred damages (Interview 6). Without

provincial DFA support, this event could have been catastrophic. Instead, the municipality paid a $11,000 deductible, which was reimbursed on the condition that the money would be invested into mitigation measures. The Disaster Financial Assistance (DFA) program allows communities to rebuild following a disaster.

There are currently no stipulations to access the DFA funding across the province, however, the current funding framework only covers costs related to recovery. While relocation is an option covered by the DFA program, it is rarely sought by victims. The preference in Manitoba is clearly to rebuild, even in highly vulnerable areas. An interview with an official from a flood-prone municipality revealed the nature of recurring events and impacts.

"Generally, if people are going to be evacuated, it's the same homes every year that get evacuated" (Interview 6).

The DFA program's focus on restoring flood-affected areas to pre-flood conditions warrants attention. If the same locations are being rebuilt after every flood event, perhaps the funding should cover relocation instead. While relocation is an option by the DFA program, it is rarely sought by victims. Manitoba has historically and continues to prioritize rebuilding in flood recovery.

Residential flood insurance is seen as an essential non-structural tool for FRM, offering an effective way to finance household recovery and share risks beyond government support (Raikes et al., 2023). Some Canadian insurers provide overland flood coverage, but its purchase is voluntary, and availability varies. The existence of DFA presents a barrier to insurance because the incentives for property owners to purchase coverage are reduced. Another important barrier to purchasing insurance coverage is a lack of flood risk awareness. If people are not aware that they live in a flood-prone area, they will likely not purchase insurance against floods (Thistlethwaite et al., 2020). The IWS has set a goal to partner with the federal government in providing support to high-risk properties through either an insurance program or a relocation strategy, but such a program is not in place yet (Gov MB, 2023).

Manitoba's comprehensive approach to flood recovery ensures that communities can rebuild effectively, leveraging provincial and federal resources while empowering residents. While the DFA program plays a vital role in enabling swift recovery, it should evaluate whether it is encouraging rebuilding in vulnerable areas. A gap in the DFA program is its focus on recovery rather than preventive and mitigative measures that could reduce recovery costs. One example is that the DFA program will cover the cost of cleaning

sedimentation and debris out of ditches following a flood but will not fund seeding the ditches. Seeding ditches can prevent sedimentation and noxious weed growth. Simply funding the cleaning leads to a cycle where cleared ditches are regularly compromised by flood events due to the lack of rooted grasses. A pilot project for reseeding the ditch highlights the potential for incorporating mitigation efforts into funding programs, reducing future recovery costs and increasing resilience (Interview 6).

4.1.6 Summary of FRM Policy Instruments

The analysis of the policy instruments revealed a complex diverse approach to FRM across Manitoba. There is strong legislation to guide flood prevention measures but a gap in adequate data prevents proper implementation and enforcement. Manitoba's extensive flood defense structures have saved people, communities, and the province a lot of money over the years. The high cost of building and maintaining flood defense infrastructure warrants a more careful assessment ensuring that social vulnerabilities and climate risks are incorporated to protect the most vulnerable people and assets. The policy instruments used for FRM mitigation are more recent, reflecting a shift towards adaptation. Manitoba is working to address gaps in information and resources, to help improve the ability of people to cope with floods. Emergency Management delivers a clear, coordinated, and extensive approach to flood preparation in Manitoba. There is an opportunity to incorporate more accurate measures of social vulnerability into HVRA mapping. Lastly, the recovery approach in Manitoba focuses on a return to pre-flood conditions. The DFA provides swift assistance to individuals and municipalities following a flood but should consider adding criteria so that the program does not rebuild in hazardous areas.

4.2 WATERSHED DISTRICT FRM: IWMP

IWMPs provide insights into how watershed districts are approaching FRM at the watershed scale. It is important to note that IWMPs focus on water management, not just flood events. The plans were analyzed to identify if flooding was an issue identified by the watershed and to evaluate the objectives, policies, and recommendations related to FRGM based on the framework of Hegger et al. (2014).

There are twenty-six IWMPs in various stages of completion by the 14 watershed districts. Twenty plans were located, reviewed, and coded. See Table 1 for coded IWMP plans. While all the plans followed the same structure of identifying watershed issues, setting objectives, defining actions to address issues, linking actions to land use planning, and proposing a timeline - the level of detail varied significantly. This variation may be in part due to the publication dates of the plans, which range from 2006 to 2020.

The coding of the IWMPs revealed that every single plan had a surface water management strategy. Surface water management aims to prevent or reduce flooding of agricultural, industrial, and residential land using tools such as low-level dams, stream channelization, and drainage systems to quickly remove water off the land. Removing water quickly off land was frequently referenced in

Plan	Plan Name	Watershed District	SWMP	FRM	Prevention	Mitigation	Defense	Preparation	Recovery
1	Carrot-Saskatchewan River	Kelsey	x				x		
2	Swan Lake	Swan Lake	x	x			x		
3	East Duck	Inter-Mountain	x	x	x		x		
4	Shell River	Assiniboine West	x	x			x		
5	Dauphin Lake	Inter-Mountain	x	x	x	x	x		
6	Assiniboine-Birdtail	Assiniboine West	x						
7	Arrow Oak River	Assiniboine West	x	x	x	x	x		
8	West Souris	Souris River	x	x	x	x			
9	East Souris River	Souris River	x						
10	Central Assinboine & Lower Souris	Central Assiniboine	x	x	x	x			
11	Pembina River	Pembina Valley	x						
12	La Salle River	Redboine	x	x			x		
13	Roseau River	Seine Rat Roseau	x	x		x	x		
14	Rat-Marsh	Seine Rat Roseau	x	x		x	x		
15	Cooks-Devils Creek	Northeast Red	x	x	x	x			
16	Southwest Interlake	West Interlake	x	x			x		x
17	Netley-Grassmere	East Interlake	x	x	x				
18	Icelandic River and Washow Bay	East Interlake	x	x			x		
19	Fisher River	East Interlake	x	x	x				
20	willow creek	East Interlake	x	x			x		
n = 20			n = 20	n = 16	n = 8	n = 7	n = 12	n = 0	n = 1

Table 1: IWMPs coded for FRM strategies

relation to farming practices, to limit interruptions to agricultural livelihoods (ICD and TRCD, n.d.). This focus indicates a prioritization of agricultural productivity over directly addressing the broader flood risk vulnerabilities reflecting the significance of agriculture to the Manitoban economy.

Despite commonalities, each plan is tailored to its specific watershed. Although flooding impacts nearly every watershed, each district takes an individual approach to address the challenges, in part due to the varying geographic characteristics. Some watersheds have significant elevation changes and face a lot of problems surrounding erosion, while others are nearly flat and face overland flooding challenges such as standing pools of water. 10% of plans did not address flood risk management at all which is significant because IWMPs are meant to guide land use planning by providing technical recommendations. In omitting FRM from the plans, Watershed Districts miss out on an important opportunity to bridge municipal knowledge gaps.

The IWMP coding identified several proposed policy instruments to manage flood risk. For example, The Dauphin Lake IWMP proposed developing a buy-out program to purchase flood-prone agricultural land surrounding Dauphin Lake (ICD and TRCD, n.d.). Land protection programs were common recommendations with a variety of policy instruments such as conservation agreements, taxation easements, and ecological goods and services programs. Land protection programs aim to convert flood-prone land from annual crop production to permanent cover, maintaining its natural state. This policy instrument responds to the agricultural reality of the province and may be more feasible than property buyouts. The Roseau River IWMP even defined a specific target, to enroll 10 acres of privately owned flood-prone riparian zones in the Seine Rat River Watershed Districts ecological goods and services program (SRRWD, 2021).

Many of the plans that identified flooding as a priority recommend updating development criteria to reduce flood impacts, in collaboration with either the municipalities or the province. A third of the plans identified high-risk flood areas and suggested that municipalities designate these areas as floodplain zones in their development plans. The level of detail in managing flood risk varied, reflecting differences in plan age and data availability. Watersheds with access to detailed data such as LIDAR, could incorporate flood risks into the recommendations, while others, such as Assiniboine-Birdtail IWMP, defined flood mapping as a recommendation. Flood

mapping is a critical component in understanding flood risks (Assiniboine-Birdtail WPA, n.d.).

Watershed Districts receive funding to invest in projects that achieve their objectives and goals. The large scale of watersheds requires a prioritization method when distributing funding for projects. Some of the IWMPs outlined the priority process, and most used a cost-benefit approach that relates to the property value. CBAs require that a monetary value be assigned to each cost and benefit, however, social effects can be difficult to quantify and monetize (Cutter et al., 2013). The CBA method limits the inclusion of socio-economic factors affecting the exposure and vulnerability of residents. As the projects often focus on privately owned land, the effectiveness of this approach also depends on strong local relationships. An interview with a watershed district manager emphasized the importance of these relationships:

"We work very closely with the public, we get money to spend on local projects so that's our whole bread and butter, working with local agriculture producers and trying to get out there in the community and get the public involved" (Interview 1).

IWMPs define values, identify watershed problems and concerns, and make recommendations with actions to address the issues. The IWMP is a document that reflects a yearslong process, meant to guide ongoing work in the watershed districts, however, it is a planning document reflecting the planning stage. Watershed Districts are responsible for the implementation of IWMPs, but it is difficult to understand the status due to a lack of progress reports. Publishing progress reports requires monitoring, measuring, and documenting outlined actions. A watershed district manager revealed that limited staff resources made monitoring and measuring progress challenging:

"Balancing project implementation with the need for ongoing monitoring is difficult, making it one of the trickiest aspects, especially in assessing cumulative effects over time" (Interview 1).

The preference to focus limited resources on funding and implementing projects is understandable, however, monitoring should be allocated resources as well.

The IWMPs are grounded in the planning frameworks of both municipal and provincial levels. IWMPs link water management goals to specific land use planning policies and provincial

regulations. This connection facilitates the adoption of IWMP goals into development plans or other planning instruments. For example, the West Souris IWMP defines a floodplain area and encourages the incorporation of Provincial Planning Regulations 5.1.3. The plan goes on to specify "Land within this area should be recognized as an area that floods. Land use practices within the floodplain zone should be able to withstand periodic flooding impacts and residents should understand limitations to development" (West Souris River WPA, 2012. 36.)

Although watershed districts set goals related to water management and land use, they lack the ability to implement these decisions.

"We have no actual authority on anything within the watershed districts, we can provide funding and work with people who want to work with us, we can make recommendations, but that's as far as we go" (Interview 1).

Watershed Districts can share their knowledge with municipalities; however, the council has no obligation to incorporate the findings into their decision-making. The success of Watershed Districts in achieving their goals relies on good relationships with their stakeholders and municipalities.

An interview with a watershed district revealed how the effort in maintaining good relationships is paying off.

"A lot of them (municipalities) are starting to work better with us, it seems like we have a lot of information that they just don't have about how water flows. So, we've sent them our flood maps, so they know where maybe not to build a house or put a basement in" (Interview 1).

The value of watershed districts lies in their ability to foster collaboration, share critical information, and support sustainable land and water management practices despite their lack of regulatory authority. The IWMPs promote a bottom-up governance approach led by Watershed Districts, fostering engagement and sharing knowledge between local stakeholders, and municipal, and provincial governments. The watershed staff and resource limitations, and lack of political authority, hinder the success of IWMPs. Despite the challenges, watershed districts are continuing to cultivate relationships with municipalities and agricultural producers to expand their programming and influence.

4.3 PROVINCIAL FRM: MITIGATION AND PREPAREDNESS PROGRAM

The Mitigation and Preparedness (MPP) program offers an opportunity for municipalities to build resilience against natural disasters, extreme weather events, and the impacts of climate change by funding capacity-building projects. To be eligible for MPP, municipalities must have received "Disaster Financial Assistance". Since its inception in 2020, the program distributed $3,363,169.92 to support 107 projects across 91 municipalities, towns, villages, and cities (MB Transportation and Infrastructure, n.d.-b).

Drawing on the FRM strategy framework outlined by Hegger et al. (2014), the funded projects are coded and categorized to distinguish between those that focus on flood defense, addressing the consequences of flooding through mitigation, prevention, and preparation, or recovery. This analysis aims to reveal insights into municipal priorities, the challenges they are facing, and the types of FRM strategies that are being implemented. Refer to Table 2 for the results of the analysis.

Of the 107 municipalities that received funding, 36 specified their funding would be used as an investment into a reserve fund. These investments can be used by municipalities for any projects that mitigate the impacts of emergencies and disasters for a total of ($ 1,152,922.57). As the specific investment intentions could not be distinguished, these projects were not considered in the coding. The remaining $2,210,247.35 was distributed among 56 municipalities.

A clear priority among municipalities was building knowledge, to better understand flood event scenarios. Knowledge-building includes projects focused on mapping flood risks, modeling high water levels, and conducting drainage studies. Among these initiatives, six specifically aim to develop flood maps to identify where the existing flood risks are or for relocation projects. This type of map can reveal vulnerabilities and lead to moving infrastructure or assets out of areas that are at risk of flooding. Projects that build knowledge received a total of $448,043.90, accounting for 20% of the funding.

Intense and heavy rain events can result in large amounts of water and overwhelm the drainage infrastructure. When stormwater infrastructure is too full, excess water can cause sewage to come out of drainage systems in cities, and in homes. This is an obvious challenge that many municipalities are dealing with based on the projects funded. Most of the funding (64%) is allocated towards investments

aimed at preventing sewer back-ups and improving the flow of water by drainage and culvert upgrades. 18 projects focus on preventing sewer backups through increasing sewer pipe capacity, purchasing extra pumps for lift stations, and installing alarm systems. 31 municipalities invested in drainage improvement and culvert projects to manage surface water flows by channeling water away from and protecting roads and infrastructure. These efforts reveal the vulnerabilities municipalities face due to pluvial events and highlight the critical need for improved stormwater infrastructure.

Overall, there is a high uptake in this program with 90 percent of municipal participation (Interview 7). The MPP bridges the gap that municipalities face when responding to a disaster, shifting the focus from mere recovery to mitigation and prevention approaches, to prevent these types of events in the future or lessen their impacts (Interview 7). This proactive approach demonstrates a commitment to building capacity in municipal FRM efforts.

Table 2: Distribution and Coding of MPP (part 1 of 2)

Project #	Mun_No	Name	Amount	Mitigation	Prevention	Defense	Response	Recovery	Investment
1	114	Clanwilliam-Erickson	$ 7,075.28	x					
2	127	Emerson-Franklin	$ 20,632.15				x		
3	155	North Cypress-Langfor	$ 22,324.71						x
4	443	Riverdale	$ 17,346.62				x		
5	353	Rossburn	$ 7,937.32				x		
6	159	Minto-Odanah	$ 9,669.54	x					
7	151	Montcalm	$ 10,237.50						x
8	107	Oakview	$ 13,233.45	x			x		
9	170	Rosedale	$ 13,597.54			x			
10	183	Yellowhead	$ 7,289.07						x
11	431	Minnedosa	$ 19,916.49			x			
12	437	Neepawa	$ 37,482.69		x				
13	500	Brandon	$ 397,346.00	x					
14	116	Cornwallis	$ 31,132.94						x
15	124	Elton	$ 10,352.67			x			
16	609	Harrison Park	$ 13,190.92						
17	165	Ritchot	$ 52,788.96						x
18	200	Westlake-Gladstone	$ 25,626.25			x			
19	127	Emerson-Franklin	$ 20,629.21	x			x		
20	151	Montcalm	$ 10,818.27						x
21	165	Ritchot	$ 63,225.09						x
22	114	Clanwilliam-Erickson	$ 8,566.58			x			
23	116	Cornwallis	$ 38,668.12		x				
24	609	Harrison Park	$ 15,677.18	x			x		
25	431	Minnedosa	$ 23,202.57	x	x				
26	159	Minto-Odanah	$ 9,489.27	x					
27	617	Mountain	$ 8,295.70						x
28	437	Neepawa	$ 48,123.53		x			x	
29	170	Rosedale	$ 12,900.66				x		
30	202	Whitehead	$ 14,212.74			x	x		
31	183	Yellowhead	$ 15,584.07			x			
32	433	Morden	$ 84,048.99	x					
33	600	Alexander	$ 32,624.00		x				
34	121	East St. Paul	$ 82,322.13	x	x				
35	138	La Broquerie	$ 56,927.13				x		
36	145	Louise	$ 17,141.63			x			
37	152	Morris	$ 25,809.79			x			
38	610	Piney	$ 15,601.00			x			
39	163	Portage la Prairie	$ 58,306.92						x
40	164	Rhineland	$ 49,257.84				x		
41	357	St-Pierre-Jolys	$ 11,046.83	x					
42	560	Thompson	$ 12,849.87	x					
43	206	Woodlands	$ 32,141.61		x				
44	400	Altona	$ 36,120.16			x			
45	449	Souris-Glenwood	$ 21,560.36			x			x
46	447	Selkirk	$ 88,916.36		x				
47	102	Argyle	$ 8,414.21						x
48	185	West Interlake	$ 18,860.02						x
49	133	Grey	$ 21,306.41						x
50	363	Teulon	$ 10,124.14				x		
51	120	Dufferin	$ 21,526.50			x			
52	606	Grahamdale	$ 10,818.27	x					
53	101	Ellice-Archie	$ 7,034.42						x
54	190	Stanley	$ 76,024.17				x		
55	177	St. Francois Xavier	$ 12,265.79			x			
56	154	Mossey River	$ 12,274.25			x			
57	188	Norfolk Treherne	$ 14,983.05		x				
58	187	Glenboro-South Cypre	$ 9,506.20				x		
59	115	Coldwell	$ 11,114.55	x		x			
60	129	Gimli	$ 55,606.59				x		

Table 2: Distribution and Coding of MPP (part 2 of 2)

Project #	Mun_No	Name	Amount	Mitigation	Prevention	Defense	Response	Recovery	Investment
61	323	Gilbert Plains	$ 12,020.30						x
62	169	Roland	$ 9,692.43			x			
63	602	Armstrong	$ 16,650.66				x		
64	135	Hanover	$ 145,733.44				x		
65	197	Victoria	$ 10,056.42	x		x			
66	156	North Norfolk	$ 33,140.48						x
67	168	Rockwood	$ 71,444.60						
68	105	Bifrost-Riverton	$ 28,103.80				x		
69	347	Powerview-Pine Falls	$ 10,488.14						x
70	181	Riding Mountain West	$ 12,206.53						x
71	193	Swan Valley West	$ 23,354.94						x
72	149	Minitonas-Bowsman	$ 13,433.96			x			x
73	126	Ethelbert	$ 5,485.32			x			
74	119	De Salaberry	$ 33,165.87						x
75	142	Glenella-Lansdowne	$ 9,590.85						x
76	311	Dunnottar	$ 8,371.89						x
77	174	St. Andrews	$ 99,235.20					x	x
78	205	Deloraine-Winchester	$ 12,511.27						x
79	198	Victoria Beach	$ 5,832.39					x	
80	139	Lac du Bonnet	$ 30,160.80						x
81	411	Dauphin	$ 70,835.12						x
82	110	Brokenhead	$ 45,829.51	x					
83	157	Oakland-Wawanesa	$ 14,881.47			x			x
84	182	Roblin	$ 26,148.39				x		
85	118	Dauphin	$ 18,081.24			x			x
86	143	Lakeshore	$ 10,039.49						x
87	203	Whitemouth	$ 13,797.95			x			
88	403	Prairie View	$ 18,292.87						x
89	147	McCreary	$ 6,331.82			x	x	x	x
90	161	Pembina	$ 20,366.79			x			
91	601	Alonsa	$ 10,242.65	x			x		
92	111	Grassland	$ 13,400.10				x		
93	353	Rossburn	$ 8,236.45				x		
94	112	Cartier	$ 28,306.96				x		x
95	201	West St. Paul	$ 56,563.13	x		x			
96	146	MacDonald	$ 68,735.80	x	x				
97	208	Headingley	$ 36,661.92						x
98	189	Springfield	$ 136,642.03						x
99	359	Ste Rose	$ 13,467.82						x
100	175	Ste. Anne	$ 47,268.56	x		x			
101	167	Cartwright-Roblin	$ 11,309.24						x
102	107	Oakview	$ 16,320.52	x					
103	178	St. Laurent	$ 13,053.03						x
104	176	St. Clements	$ 98,075.49	x					x
105	155	North Cypress-Langfor	$ 25,488.12			x			x
106	465	Winnipeg Beach	$ 12,181.14						x
107	300	Arborg	$ 10,826.74				x	x	
			$ 3,363,169.92	n= 20	n=9	n=27	n=21	n=5	n=36

4.4 MUNICIPAL FRM: ZONING BYLAWS

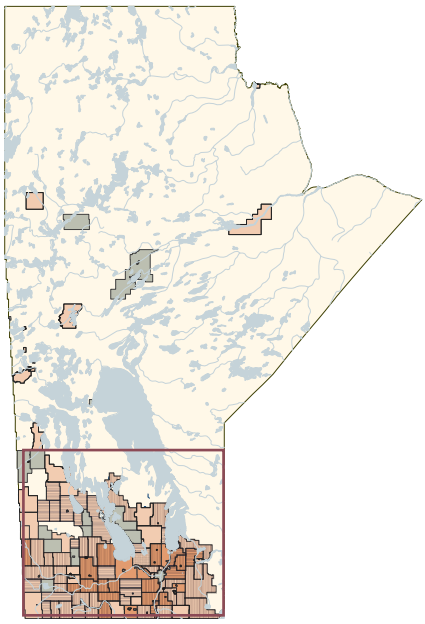
While most of the resources for FRM are concentrated among the federal and provincial levels of the governments in Canada, municipalities have several tools available to them. Land use planning and management is one of the most effective policy instruments for flood prevention in FRM, as an instrument to mitigate ever-increasing flood risk (Dyca et al., 2024). To reiterate, flood prevention as an FRM approach aims to keep people and assets away from flood-prone areas. There are many flood prevention tools available in land use planning and management such as zoning flood risk areas, conservation easements, using a regulatory standard, and requiring floodproof building techniques.

The process of municipal land use planning and management begins by adopting a development plan. Development plans are prepared by local planning authorities, to guide future land use and activity. If preventing or mitigating flood events is a priority for the municipality it is included in the development plan. Based on the priorities, the municipality regulates activities to ensure that they abide by the development plan through zoning bylaws.

There are 137 municipalities in the province of Manitoba and the zoning bylaws for 118 of them were found and reviewed for this analysis. The remaining municipalities did not have bylaws available for review, often because they had recently been amalgamated or split up and had not yet drafted their new bylaws. See Figure 9 for a map of the municipal zoning analysis.

Despite the widespread challenge of flooding, as revealed by the popularity of the MPP program, few municipalities incorporate flood prevention measures into their zoning bylaws. Of the 118 municipal bylaws reviewed, only 32 had zoning related to designating floodplains or land that was unsuitable for development. While this accounts for flood-prone lands outside of the provincial DFRA only 27% of municipalities use this as a policy tool. This may in part be because most municipalities rely on the province to assess and quantify flood risks and flood zone maps are not available across the entire province yet.

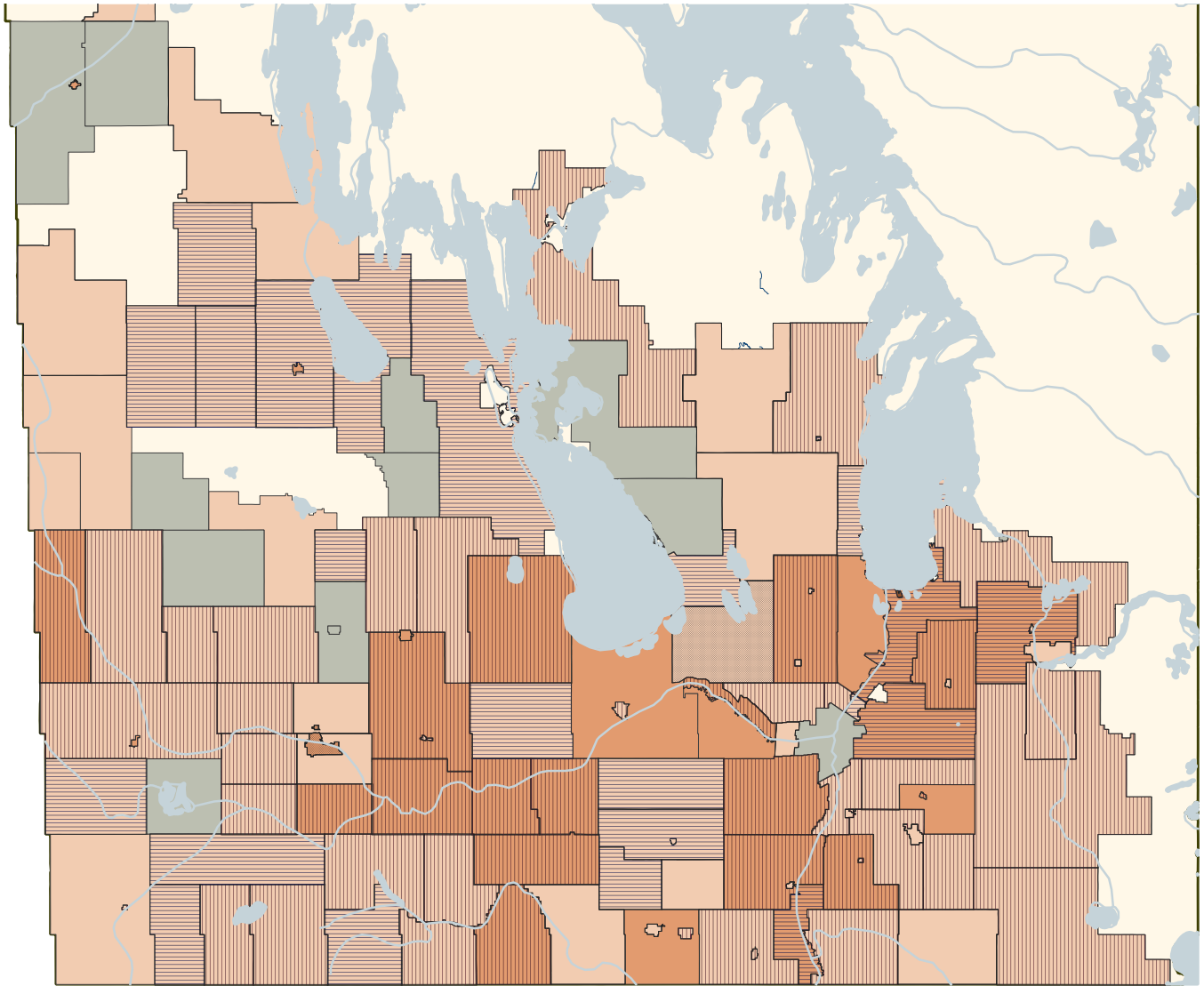
Figure 10: Zoning Bylaws as a Flood Prevention policy instrument in municipalities



Designated Flood Zoning
- Yes
- No
- n/a
- Rivers
- lakes and water

Regulatory Standard
- 100
- 200
- 300
- n/a

Sources: Government of Manitoba, 2024; MB Municipalities, Zoning Bylaws



0 25 50 75 100 km

A provincial official highlighted that updating zoning bylaws can be a time-consuming process, often beyond the capacity of municipalities.

"I find that sometimes, people in municipalities just don't have time, so we are looking at the feasibility of developing climate resiliency bylaws that could be easily adapted for municipalities to adopt" (Interview 7).

The proposed climate resilience bylaw toolkit could greatly simplify the adoption of effective climate adaptation measures, providing municipalities with standardized guidelines for interventions such as permeable pavement and bioswales. The province recognizes the constraints faced by municipalities and responds by helping facilitate the integration of sustainable practices into local planning.

Only 14% of municipalities have included a flood zone map in their zoning bylaws. Interestingly, each one of these municipalities has incorporated flooding considerations into their zoning regulations by designating identified land as "Hazard Land, Sensitive Lands, Open Space, or Flood Risk Area". Despite the different names, these areas have all been deemed unsuitable for development due to their flood risk.

Having information about flood zones and risks is crucial for municipalities, as it provides a foundation for informed decision-making and proactive planning. Many municipalities do not have updated flood zone data which limits their ability to incorporate flood prevention measures into zoning bylaws. The province is aware of this gap and emphasizes the importance of accurate information in planning decisions

"Land use and development control is a big opportunity for flood mitigation, we are working closely with our Municipal and Northern Relations folks, just to ensure that the most accurate and up-to-date information is being included in land-use planning decisions and developments" (Interview 7).

There is an inconsistency in adopting the regulatory standard that is set by the province to guide municipal planning. While the current adopted regulatory standard is the 1-in-200-year flood or flood-of-record, there is a delay in municipal adoption. The majority of municipalities have adopted the 1-in-200-year event (44%), however, many municipalities still use the 1-in-100-year event, and a third of municipalities do not reference a particular event at all.

The data and information gap is a factor once again because the level of the adopted regulatory standard is not known in every area in Manitoba, however, the province is working to update the regulatory standard mapping (Interview 3). It is also important to note that many of the bylaws reviewed were older and had been adopted by municipalities before the regulatory standards were established by the province.

The disparity between the provincial regulation and local implementation reveals a significant challenge in land use planning for floodplains.

"We allow exceptions. Policies around floodplain hazard management, mapping, and planning, you know, it's nice that they exist, but they need to be implemented" (Interview 4).

Regulations can only be successful in preventing risky behavior if they are carried out and enforced. The province can set strict regulations, but if municipalities do not have the necessary data and information, it makes it impossible to accurately enforce regulations. Currently, any available flood zone mapping is based on the recurrence of notable events, such as the 1997 Red River flood or the 2011 Assiniboine River flood. The limitation of this approach is that these foods do not consider land use changes, population densities, or even incorporate vulnerabilities of people. Addressing these gaps is essential for developing more effective flood risk management strategies at the municipal level.

4.5 KEY INFORMANT INTERVIEWS

To complement the analysis of policy instruments, professionals across Manitoba who work in FRM were interviewed. 7 semi-structured interviews were conducted among provincial policy officials, community planners, watershed district managers, and emergency response coordinators. The key themes below present the interview findings and takeaways based on the coding.

4.5.1 Changing Flood Events

A challenge that is felt across the province and sectors is the increased pluvial flood events. Heavy rains cause damage when stormwater management systems are overwhelmed.

"One of our biggest vulnerabilities is high intensity rainstorms; communities do and will continue to see a lot of damages from these types of events. Our infrastructure just isn't built to withstand that type of heavy rain and water flowing off the landscape" (Interview 7).

The timing of flood events, when they are occurring, is changing as well. Manitoba is well prepared to handle the spring flooding along the rivers, however changing weather patterns are creating different types of events in summer and fall.

"We get more summertime events in general, but lately it has even been autumn events. We just see more high precipitation events, so you get these short intense periods of rain, out of the blue" (Interview 1).

"Obviously, we're seeing a different kind of flooding, overland flooding has increased throughout my career" (Interview 2).

Changing events reveal different risks, that traditional structural defenses were not designed to protect against.

"We learned of some of our weaknesses, our sewer network is incredibly vulnerable to heavy rain events, some roads get washed out and we lose access to certain areas in the community" (Interview 5).

4.5.2 Knowledge gap

There is a disconnect between the provincial expectations for municipalities in managing flood risk and the information they are given. A common challenge identified in the interviews is that most municipalities do not have proper flood mapping to understand the flood risks.

"One of the best things I've seen is when you have accurate data around flooding hazards, which comes from LIDAR,. It's amazing how much more development you can support, and there are less arguments because you can point and say this is the floodplain" (Interview 4).

Cities and municipalities that do not have flood mapping data rely on the province to undertake this mapping. This can significantly slow down the planning process depending on the wait times (Interview 5). The provincial branch of water management and planning provides comments and recommendations based on flood data they have. The branch does not share access to the data with municipalities (Interview 3). The watershed districts have begun to bridge the data gap and provide valuable information to municipalities.

"We do flood mapping, so we have LIDAR for the whole district and then we work with a company who helped us take a culvert inventory of every culvert within Watershed District. We can hydro condition the whole district. From that, we can make larger maps to show what a 25-year flood event would look like, or a 100-year flood event. It's really helped us visualize what happens and target certain areas" (Interview 1).

The provincial government has recognized the municipal reliance on the province to assess flood risks and is working to address it.

"We have flagged better information sharing; we are working to develop a more comprehensive website to get that information up and available to the public" (Interview 7).

4.5.3 Monitoring and Measuring Progress

Monitoring and measuring the progress of goals and the effectiveness of policies and interventions is crucial to understanding if the FRM approach is working. Measuring progress is challenging

because it can be very time-consuming and resource intensive to gather the necessary data.

One example is a municipality that received a large multi-million-dollar investment to upgrade a road as a flood mitigation project. While the project was nearing completion, the municipality did not have a clear way to evaluate the success of the project.

"We don't really have all those metrics set up yet, but there will be some studies to do. We will see how many days people were evacuated in comparison with how high the water was. We can also compare the dollar value of damage that is incurred along the road" (Interview 6).

The province may consider providing guidelines to evaluate their projects to ensure investment in projects that successfully manage flood risk.

The province relies on the Disaster Financial Assistance claims and municipal HRVAs as data for assessing flood risks (Interview 7). The DFA provides metrics related to the level of damage and the types of assets being impacted. The current framework to assess HRVA weights the vulnerability of property twice as much as the vulnerability of people. To calculate the vulnerability of people only density is considered. Socio-economic factors that can contribute to vulnerability such as income, housing quality, and demographics, are not used to assess vulnerability. This is a significant limitation to an assessment meant to determine vulnerability. The province is beginning the process of updating the HRVA assessment framework.

"We have been doing a lot of work to develop a new HRVA, to standardize everything making it clear how people should be assessing their risk and vulnerabilities, which will be a great resource" (Interview 7).

The update of the HRVA framework presents an opportunity to rethink the parameters of vulnerability and include social vulnerability measures and factors.

Watershed districts struggle with monitoring and measuring progress due to resource challenges.

"We don't have the staff power to monitor everything. There's a fine line between trying to implement projects and getting everything in the ground, and then still needing to do all the monitoring, and we only have so much staff, so sometimes getting that monitoring part done is the trickiest" (Interview 1).

As actors work to refine their approaches to measuring and monitoring, it is critical that a more comprehensive framework is developed, to ensure that efforts, investments, and initiatives effectively manage flood risks and protect vulnerable communities.

4.5.4 Succession planning for governance stability

The interviews reveal some of the indirect impacts of the current FRGM approach. One is that in the current arrangement, the provincial government plays a tremendous role in managing flood risk, from distributing resources to making decisions. This hampers the long-term planning and sustainability that flood risk management requires because funding is driven by election cycles.

"The reality is you have one year after an election, to figure out what you are doing. And then you have one year before the next election to talk about what you have done. We really have two years to do anything. That goes against every long-term planning principle that exists" (Interview 4).

The turnover challenges associated with elections affect municipal levels as well. Local governments often lack adequate funding, planning capacity, training, and management skills to handle complex issues like flood risk management, making long-term sustainable funding crucial to their success. High turnover can result in knowledge loss if there is not a way to share the knowledge.

"When I started, everyone in had been in their positions for a long time, and they had a really good understanding of what the risks were. There has been so much change over the years, that I think maybe it is not the flood risks that have changed so much, but that baseline, cultural, knowledge - it just does not exist anymore" (Interview 2).

Aligning efforts clearly among actors is crucial, along with allocating long-term funding, and ensuring that there are knowledge-sharing mechanisms to alleviate challenges caused by frequent turnover.

4.5.5 External Pressures

Municipalities and provincial governments face immense pressure from the public. Municipal revenues rely primarily on property taxes, so it is in their interest to ensure that the tax base grows. Land values along waterways are generally higher than inland areas despite being more flood-prone.

"We see landowners and agricultural producers pushing as hard as they can to get what they want as opposed to what's good for the basin or for the community. Land values have increased, therefore, the economic pressure to keep allowing whatever landowners would like to see happen will continue" (Interview 4).

This is compounded by the fact that in rural Manitoba, municipalities are typically represented by elected landowners, most of whom are farmers (Interview 4). Developers also feel the pressure of higher land prices along waterways. When parcels of land are valued high, developers must subdivide land into more lots to make a profit. In a flood-prone area, increasing density increases flood risk, because more people and buildings are exposed to the impacts. Community planners often receive requests to allow more development in flood-prone areas (Interview 2). Accurate up-to-date information can help both the province and municipalities educate and inform stakeholders on why development should not happen in flood-prone areas and what zones should be excluded from development (Interview 7). Educating stakeholders and enforcing zoning regulations will prioritize long-term safety over short-term economic gains.

4.5.6 Challenges of current FRM approaches

As flood events become more frequent and severe due to climate change, some constraints of the current FRM approach come to light. The existing FRM framework is very reactive and puts a lot of focus on response and recovery rather than prevention and mitigation. Municipalities that want to implement preventive and mitigative strategies have little ability to do so.

"There's not a lot of money to put into flood mitigation, whereas we get money from the province to do the recovery" (Interview 6).

Inappropriate land use in flood-prone areas also poses a significant challenge. While many land use decisions were made in the past, there is extensive legislation and regulations in place to avoid further construction and development in flood-prone areas (Interview 4 & 7).

"I think that floodplain areas need to have appropriate land uses which are golf courses and parks, not commercial and residential development" (Interview 4).

Implementing and enforcing the existing legislation, and not continuing to rebuild in flood-prone areas will ensure land is used appropriately.

There is a consensus among interviewees that the growing frequency of flood events requires a strategy to prepare communities for large-magnitude events.

"Floods are becoming more frequent, and while we haven't experienced another event as severe as the 1997 flood, historical patterns suggest we may soon face another major flood" (Interview 6).

It's important to incorporate future climate risks rather than relying on past events. The province has emphasized the need for a pragmatic approach to flood protection. This involves critically evaluating the practicality of building extensive flood protection infrastructure for individual houses in flood-prone areas and acknowledging that some past decisions need reassessment. This is particularly relevant given Manitoba's infrastructure deficit, where the rising costs of building, maintaining, repairing, and replacing infrastructure pose significant challenges (Interview 4).

4.5.7 Key Takeaways

Overall, the interviews revealed some important gaps and challenges in Manitoba's FRM approach. The changing nature of flood events poses new risks and creates new vulnerabilities. There is a lack of accurate up-to-date information of flood risks available to municipalities, hindering their ability to manage land-use and planning. The ongoing work of the watershed districts and the province to update and share information will be critical. The challenge of measuring and monitoring both risks and progress of interventions is made more difficult due to resource limitations and insufficient vulnerability assessments. Constant political changes undermine sustainable flood risk management. The short-term agendas created by the election cycle do not align with long-term planning and continuous action. Economic pressures significantly influence decision-makers, however counter flood risk management efforts in flood-prone areas. Climate change exacerbates the frequency and severity of flood events, revealing some limitations in the current FRM approach.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The policy instruments used in Manitoba's flood risk management demonstrate a comprehensive and multi-layered approach that includes actors at the watershed district, provincial, and municipal levels. The analysis of policy instruments shows a balanced distribution of flood risk management, including prevention, defense, mitigation, preparation, and recovery, highlighting a well-rounded strategy to tackle flood risks. Despite the success of various instruments, flood risk management is a complex continuous challenge. The key findings and themes below present important considerations for effective future flood risk management.

5.1 KEY FINDINGS & THEMES

5.1.1 Strengthening knowledge and enhancing data availability

Increasing knowledge and enhancing data availability is crucial for bridging gaps in flood risk management and promoting sustainable and resilient development across Manitoba. The lack of comprehensive flood data prevents municipalities from effectively regulating land use and development in flood prone areas. The efforts of the province to improve flood mapping will lead to more informed decision-making. The province is also stepping in through other programs. The success of the MPP exemplifies how targeted funding can make local adaptation possible. The proposed climate resilience bylaw toolkit will help make updating municipal bylaws less daunting. The combination of these approaches demonstrates a shift embracing more mitigative measures that move away from traditional flood defense strategies. Gaps remain with the rigidness of some programs, such as the DFA. Expanding preventive and mitigative measures can reduce recovery costs in the future. Overall, by increasing data availability, supporting local adaptation efforts, and refining funding mechanisms, Manitoba can bridge gaps in flood risk management and advance towards a more sustainable and resilient future.

5.1.2 Aligning watershed knowledge and regulatory standards

Successful flood risk management depends on effective collaboration across all governance levels and Manitoba excels in multi-level coordination in some areas. Emergency management and response exemplify coordination as the province prepares each municipality extensively to ensure the local level is well-prepared to respond to emergencies.

Despite the success of the emergency and response coordination, challenges persist in integrating flood risk management strategies.

While the Watershed Districts promote a bottom-up governance approach, many external pressures are undermining the effective integration of IWMPs into land use planning. Watershed districts work diligently to create plans and build knowledge, yet many municipalities fall short in applying these recommendations. Economic pressures from the agricultural and development sectors, inconsistent land-use regulations, and underutilized measures like buyouts and relocations counter IWMP efforts and hinder effective flood risk management. Enhanced collaboration between the DFA, or a new provincial funding program focused on prevention and mitigation, could improve the management of high-risk areas.

The inconsistency in municipal land use regulations and poor implementation of flood-plain hazard policies threaten sustainable development. Aligning municipal zoning with technical expertise from watershed districts and adhering to provincial standards is crucial for flood risk prevention. Initiatives like the IWS signal a positive step towards better coordination among FRM actors. The true measure of success, however, will depend on the effective implementation of the actions and the realization of collaborative efforts.

5.1.3 Monitoring and Measuring Progress

Ongoing monitoring and progress measuring efforts are essential to ensure that FRM practices are continuously improved and adapted to changing conditions. This requires watershed districts to have the capacity to carry out monitoring and sharing these results making progress more transparent. It is important to have an evaluation framework to assess FRM investments and ensure that interventions are managing flood risk.

A pragmatic approach to flood risk management requires reconsidering interventions such as building extensive flood protection infrastructure for a small number of houses and considering a relocation strategy. Given Manitoba's infrastructure deficit and the misconception that engineered solutions offer permanent protection, choosing these approaches should be clearly justified. Another area warranting reconsideration is the current framework of the DFA program. The province should evaluate whether the program enables risky reconstruction and incorporate relocation as an alternative.

Ongoing monitoring and measuring should incorporate new data and research findings into policy updates. Incorporating these continuous improvements and pragmatic approaches can enhance the resilience and effectiveness of flood

risk management strategies, ensuring communities are better prepared for future flood events.

5.1.4 A holistic approach to flood risk

There is a need to critically assess how flood risk is measured, accounting for the various types of events, and how risk is understood. The interviewed officials confirmed that the types of events leading to floods are changing. Intense rain events are becoming more common and pose significant challenges to all municipalities. The MPP is a promising initiative that addresses gaps in municipal capacity and provides financial resources for flood mitigation. The eligibility criteria for the program are open-ended; municipalities must simply link the funding to a vulnerability identified in their emergency management plan. This broad approach allows MPP to respond to the various challenges municipalities face and allows them to fund needed interventions.

Although flood defense measures successfully prevent physical damage to private property, this does not mean the overall vulnerability and exposure of the community is meaningfully reduced. Flood risks are not only related to the geographic extent of flood hazards but comprised of community impacts caused by floods. The loss of road networks can cause significant impacts such as the inability to effectively implement evacuations and loss of accessibility and services, without necessarily causing physical damages to private property.

Given that the province is working to update its standards for assessing hazards and vulnerabilities, it should consider incorporating factors that affect exposure and vulnerabilities such as socio-economic factors and measuring impacts of road network losses. Incorporating detailed risk and vulnerability assessments into planning can help municipalities better understand and address the broader impacts of flood events, leading to more comprehensive and effective flood risk management strategies.

5.2 Conclusion

In conclusion, Manitoba's FRM policy framework exemplifies a comprehensive, integrated, and multi-level governance approach. By leveraging legislative instruments, strategic planning, infrastructure investment, and community-based programs, Manitoba is well-positioned to manage and mitigate flood risks effectively. The ongoing collaboration between provincial, municipal, and watershed district levels, along with the active involvement of stakeholders and communities, is crucial for building a resilient and adaptive flood management system that can respond to current and future challenges.

5.3 Limitations

While this study provides valuable insights into the state of flood risk management efforts across Manitoba, it is essential to highlight its limitations. First, due to the scope of this project, only three types of actors and their instruments were analyzed: the province, municipalities, and watershed districts. There are more actors involved including non-governmental groups, the federal government, and private groups; however, I chose to limit the scope to the three mentioned actors due to the focus of rural efforts. The policy instruments that were reviewed were ones I could find, and that were available to review online. There may be policy instruments that were missed which could reveal different priorities. This study focused on the social science aspect of flood risk governance and management and chose to focus on policy instruments. Instruments that focused more on natural science or related to technical aspects of FRM were not reviewed as this was outside of my expertise.

For the interview component, I was not able to recruit as many interviewees as I was hoping to. For example, only one watershed district manager was able to meet with me. No interviews were secured with either the provincial flood planning or flood forecasting departments. These interviews would have provided further insight into flood mapping and how flood risk is measured. This presents a gap in understanding how the province conceptualizes and measures vulnerabilities.

For the review of integrated watershed plans and municipal zoning bylaws, only the ones that were publicly available were coded. This means 77% of IWMPs and 86% of zoning bylaws were coded. While these make up the majority it is important to note that they are not the full picture. Additionally, cities, towns, and municipalities have other policy instruments that can guide land use and planning such as city plans, climate action plans, and development plans which were not analyzed in this study.

5.4 Future research recommendations

Future research could explore the effectiveness of various policy tools to see which ones are achieving their intended goals. For example, the designated flood zone risk areas seem like an excellent policy tool, but it would be enlightening to know whether they have been implemented. Have DFRAs actually prevented development in flood-prone areas? Researchers could look at the trends of population growth and development compared to areas outside DFRAs providing valuable insights into the effectiveness of the DFRA as a policy tool. Future research could also investigate the

barriers to buy-out programs and relocation strategies. Interviews with watershed districts and municipalities that have proposed buyout initiatives would reveal the progress of these efforts. Further, it would be helpful to understand the perspectives of people who are reconstructing and recovering properties multiple times to understand why they choose not to relocate. The scope of this project was limited given the amount of watershed districts and municipalities. A more focused approach could provide valuable insights into how to implement relocation as a policy instrument.

The watershed districts and their integrated watershed management plans are an innovative approach to the complex nature of managing water. While the plans set timelines using metrics to measure progress, many of the dates and deadlines mentioned had passed. Exploring the progress made by watershed districts could provide fruitful results and potentially reveal opportunities and challenges facing these local stakeholder groups.

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APPENDIX

APPENDIX 1: ETHICS APPROVAL

McGill University
Research Ethics Board Office
www.mcgill.ca/research/research/human

CERTIFICATE OF ETHICS APPROVAL

REB File Number:	24-01-067
Project Title:	Navigating Floodwaters: Analyzing Manitoba's Planning Strategies for Flood Adaptation
Faculty Principal Investigator:	Annetta Fruehauf
Department:	Urban Planning, School of
Sponsor/Funding Agency (if applicable):	
Research Team (if applicable):	

Name	**Affiliation**

Approval Period:

FROM	**TO**
03-Apr-2024	02-Apr-2025

The *REB-1* reviewed and approved this project by Delegated review in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Participants and the Tri-Council Policy Statement: Ethical Conduct For Research Involving Humans.

* Approval is granted only for the research and purposes described.
* The PI must inform the REB if there is a termination or interruption of their affiliation with the University. The McGill REB approval is no longer valid once the PI is no longer a student or employee.
* An **Amendment** form must be used to submit any proposed modifications to the approved research. Modifications to the approved research must be reviewed and approved by the REB before they can be implemented. Changes to funding or adding new funding to a previously unfunded study must be submitted as an Amendment.
* A **Continuing Review** form must be submitted before the above expiry date. Research cannot be conducted without a current ethics approval. Submit 2-3 weeks ahead of the expiry date.
A total of 5 renewals are permitted after which time a new application will need to be submitted.
* A **Termination** form must be submitted to inform the REB when a project has been completed or terminated.
* A **Reportable New Information** form must be submitted to report any unanticipated issues that may increase the risk level to participants or that may have other ethical implications or to report any protocol deviations that did not receive prior REB approval.
* The REB must be promptly notified of any new information that may affect the welfare or consent of participants.
* The REB must be notified of any suspension or cancellation imposed by a funding agency or regulatory body that is related to this study.
* The REB must be notified of any findings that may have ethical implications or may affect the decision of the REB.

APPENDIX 2: INTERVIEW GUIDE

Can you describe your role as the .....?
How do you view the role of the ..... in managing flood risk?
Can you talk through the role of your department related to flood events and planning?
What are the primary challenges your department faces when it comes to flooding?
In your experience, what are some common misconceptions people have about flood risks and events?
How would you say flood risks have evolved over the course of your career?
What do you attribute those risks to?
What data or metrics does your department use to measure flood risks, impacts, costs?
What strategies or measures does ..... have in place to mitigate flood risks?
Are there specific infrastructure or critical facilities that are particularly vulnerable to flooding in your jurisdiction?
What measures are in place to protect or mitigate against potential damage?
How does the municipality assess the economic and social costs of flooding?
What is your working relationship with the local watershed districts and other municipalities/watershed districts?
Can you walk through the relationship between the development plans and the Integrated watershed management plan?
What recent changes have occurred in the municipality's flood risk management policies and regulations?
How does the municipality incorporate climate change projections into its flood risk management planning?
Can you describe any recent initiatives or partnerships aimed at improving flood resilience and adaptation in the .....?
How does the ..... engage with stakeholders, including residents, businesses, and environmental organizations, in the decision-making process for flood risk management?
Can you describe any successful examples where community-based organizations or grassroots initiatives have played a significant role in supporting your department's flood-related activities?
In your experience, what are some of the most effective strategies for reducing vulnerabilities and increasing resilience to flooding at the community level?
Looking ahead, what do you see as the most pressing challenges or emerging vulnerabilities that your department will need to address in the coming years in relation to flooding.
Are there any flood risk management strategies from other municipal/provincial or international contexts that you find novel or inspiring?
What might opportunities or challenges be encountered in implementing this type of response in Manitoba?
Is there anything I haven't asked about flood protection or mitigation measures that you think would be important to share?
Are there any other people you think I should talk to regarding this issue?