

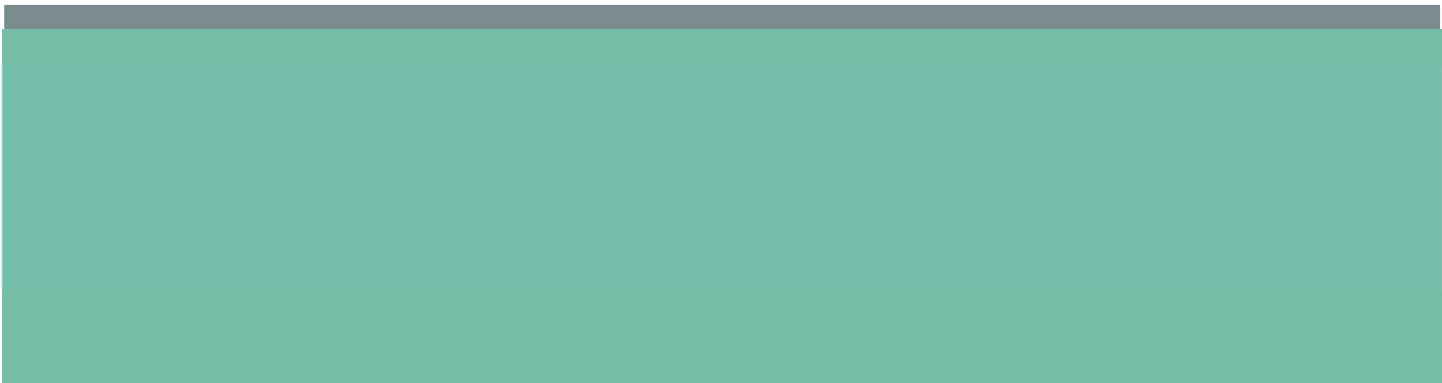
# Rural Municipality of East St. Paul Climate Change Resiliency Plan

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March 2021



RM OF EAST ST. PAUL



## TABLE OF CONTENTS

1	Executive Summary .....	4
2	Background .....	5
2.1	Objective of Each Stage .....	5
2.2	East St. Paul’s Resiliency Vision and Goals .....	6
2.3	Risk and Vulnerability Assessment .....	6
3	Method .....	7
3.1	Engagement.....	7
3.2	Analysis .....	8
4	Resiliency Plan .....	8
4.1	Achieving Visions and Goals Through Resiliency Actions .....	8
4.2	Addressing Climate Hazards Through Resiliency Actions.....	12
5	Conclusions and Recommendations .....	16
6	Key References .....	17
	Appendix A .....	20
	Appendix B.....	31
	Appendix C.....	36
	Appendix D .....	42

### Definitions

**Climate:** how the atmosphere behaves over relatively long periods of time.

**Climate Change:** A change in global or regional climate patterns, attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels

**Climate Change Plan:** The overall process encompassing the approach that the Rural Municipality of East Saint Paul has taken in identifying, planning, and responding to climate change. The Climate Change Plan is composed of the *Climate Change Risk and Vulnerability Assessment* (September, 2020), the *Climate Change Resiliency Plan* (March, 2021), and the *Climate Change Implementation Strategy* (Upcoming).

**Climate Hazards:** Weather and climate events expected to become more frequent and/or severe within the Rural Municipality of East St. Paul through 2050, as identified in the *Climate Change Risk and Vulnerability Assessment*.

**Drought:** A period of abnormally dry weather long enough to cause a serious hydrological imbalance.<sup>2</sup>

**Extreme Weather Event:** an event that is rare at a particular place and time of year.<sup>2</sup>

**Freeze-thaw cycles:** A freeze-thaw cycle occurs when the daily maximum temperature is higher than 0 °C and the daily minimum temperature is less than or equal to -1 °C. The minimum temperature of -1 °C (rather than 0 °C) is used as the threshold for freezing to raise the likelihood that water actually froze at the surface.<sup>1</sup>

**Greenhouse Gases (GHGs):** Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. Water vapor (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), methane (CH<sub>4</sub>) and ozone (O<sub>3</sub>) are the primary greenhouse gases in the Earth's atmosphere.<sup>1</sup>

**Precipitation:** The total amount of precipitation (rain, drizzle, snow, sleet, etc.) Frozen precipitation is measured according to its liquid equivalent.<sup>1</sup>

**Risk:** The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. The term risk is often used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure.<sup>2</sup>

**RM:** Rural Municipality, in this report, when use don its own, it will always refer to the Rural Municipality of East St. Paul.

**Resiliency Actions:** actions identified by the Advisory and Steering Committees which address the risks and vulnerabilities outlined in the *Climate Change Risk and Vulnerability Assessment*.

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<sup>1</sup> IPCC. 2014. Annex II: Glossary. In: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland, pp. 117-130

## Climate Change Resiliency Plan

**Resiliency Visions and Goals:** Three visions/goals outlining the desired future state of the Rural Municipality of East St. Paul from a climate change resiliency perspective. The visions/goals were developed through community consultation, and introduced in the *Climate Change Risk and Vulnerability Assessment*.

**Rural Municipality of East Saint Paul Climate Change Adaptation Steering Committee:** A body comprised of a cross-section of Rural Municipality of East Saint Paul staff members from both Administration and Operations, as well as a Council Representative.

**Rural Municipality of East Saint Paul Climate Change Advisory Committee:** A nonpolitical body of residents and business owners residing in the Rural Municipality of East Saint Paul. The advisory committee was consulted at every phase of the development of the Climate Change Plan. The Advisory Committee represents a cross-section of the community (residential, rural residential, commercial/industrial, agricultural, recreation, and youth).

**RVA:** Rural Municipality of East St. Paul Climate Change Risk and Vulnerability Assessment (September, 2020)

**Vulnerability:** With respect to climate change, refers to the degree to which a system is susceptible to, and unable to cope with, adverse effects resulting from climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its capacity to adapt.<sup>2</sup>

**Weather** - conditions of the atmosphere (temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure) over a short period of time.

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<sup>2</sup> Pacific Climate Impacts Consortium. 2020. Glossary. <https://www.pacificclimate.org/resources/glossary>

# Climate Change Resiliency Plan

## 1 Executive Summary

The RM of East Saint Paul is undergoing a process of developing a Climate Change Plan made up of three main reports. The overall Climate Change Plan directly addresses item #12 of the RM's Strategic Plan – Exemplified Climate Resiliency. The September 2020 *Climate Change Risk and Vulnerability Assessment* (RVA) was adopted by Council on December 15<sup>th</sup>, 2020, and was an important first step in laying the groundwork for the *Climate Change Resiliency Plan* (Resiliency Plan). The RVA outlined the risks that the Rural Municipality of East St. Paul (RM) would likely face with the anticipated climate changes through 2050. The risks were identified through consultation with community members, RM staff, and the Council of the RM.

The Resiliency Plan builds on the RVA with context taken from the Resiliency Vision and Goals (Appendix 2 of the RVA). Like the RVA, the Resiliency Visions and Goals were developed through multiple rounds of community, staff, and Council consultation, making them truly “Made in East St. Paul”.

The Resiliency Plan proposes short and long term practical actions that the RM can undertake to address many aspects of the risks identified in the RVA, while moving toward the Resiliency Vision and Goals. The Resiliency Actions were developed through workshops with RM community members, and RM staff and Council. The community of the RM was represented by the Rural Municipality of East Saint Paul Climate Change Advisory Committee (Advisory Committee), while RM staff and council were represented by the Rural Municipality of East Saint Paul Climate Change Adaptation Steering Committee (Steering Committee). Both committees were consulted for input in the RVA, the Resiliency Plan, and will be consulted for the upcoming *Climate Change Implementation Strategy* (Implementation Strategy). Using the risks outlined in the RVA, and with the Resiliency Visions and Goals as context, committee members proposed concrete actions which would help address these issues. Additionally, a community survey was released which provided insight as to which Climate Hazards (as identified in the RVA) were of highest concern for the community. The survey found that residents were most concerned about damage and risks to safety caused by extreme wind events, snow and ice storms, and flooding. This informed the ranking of the Resiliency Actions. Actions undertaken by other municipalities to address climate change risks were also suggested and incorporated as context.

The proposed Resiliency Actions are intended to form a clear, actionable base plan for the RM to mitigate risks outlined in the RVA. They are not intended to be a complete solution to every risk, nor are they the only actions required to reach the Resiliency Vision and Goals. It is essential that the RM engage in a regular, continuous revision process where the progress on the Resiliency Actions are evaluated. During this revision process new knowledge regarding best practices of addressing climate change, and new risks or vulnerabilities should be considered. This process will be formalized in the upcoming Implementation Strategy. The overall Climate Change Plan is intended to be a living document, with changes being made as required with evolving knowledge.

Through the analysis of this report, several actions were found to address many climate risks of high concern to the community. Some of the most impactful Resiliency Actions included the following: developing new design standards for RM infrastructure with climate change as a core consideration, conducting a land drainage study, developing plans based on the results of these studies, replacing and upgrading building components for RM buildings, and maintaining tree maintenance programs. Full consideration of the timeline, methods, and responsible parties associated with the completion of the Resiliency Actions will be presented in the upcoming Implementation Strategy.

# Climate Change Resiliency Plan

## 2 Background

The RM has framed its approach to the development of the Climate Change Plan as a three-staged activity. The first report *Climate Change Risk and Vulnerability Assessment* (September 2020) (RVA) provided a detailed overview of the risks and vulnerability assessment approach and findings.



Figure 1: Development stages of the RM's Climate Change Plan

To frame each stage, the Resiliency Vision and Goals were developed. This process established the guiding principles and ultimate vision of the RM with input from the community, RM staff, and RM Council. The community of the RM was represented by the Rural Municipality of East Saint Paul Climate Change Advisory Committee (Advisory Committee), while RM staff and council were represented by the Rural Municipality of East Saint Paul Climate Change Adaptation Steering Committee (Steering Committee). Both committees were consulted for input in the RVA the *Rural Municipality of East Saint Paul Climate Change Resiliency Plan* (Resiliency Plan), and will be consulted for the upcoming *Climate Change Implementation Strategy* (Implementation Strategy). Consultation with the general public was intended to be a cornerstone of data collection for all stages, but the COVID-19 pandemic and funding timelines impeded this.

It is important to note that the Climate Change Plan revolves around Climate Adaptation, or a set of measures which aim to reduce the vulnerability of the RM to hazards associated with climate change. Greenhouse gas (GHG) emissions reduction is addressed in a separate, and ongoing plan, the *Climate Change Local Action Plan* (2017). The Climate Change Plan directly addresses the RM's Strategic Plan item #12 – Exemplified Climate Change Resiliency.

### 2.1 Objective of Each Stage

#### 2.1.1 Risk and Vulnerability Assessment

This stage is defined by the following activities:

- Understanding and contextualizing likely trends in climate conditions over a 10 to 30-year time horizon;
- Assessing the potential impacts of changes in climate conditions on the RM; and
- Identifying risks and vulnerabilities that these changes may have on the RM and the larger region.

#### 2.1.2 Resiliency Plan

This stage is defined by the following activities:

- Reflecting on the community risks and vulnerabilities in relation to climate change; and

## Climate Change Resiliency Plan

- Identifying actions to mitigate identified risks and vulnerabilities.

These actions may include the development of policy, capital undertakings, operational measures, adjusting or developing plans or training of RM staff. It will also include raising awareness and educating residents, institutions, and businesses in the community as well as developing partnerships with surrounding communities and other levels of government. Actions identified and recommended within the Resiliency Plan are known as “Resiliency Actions”.

### 2.1.3 Implementation Strategy

This stage is defined by the following activities:

- Prioritizing actions; and
- Identifying how resiliency and adaptation measures can be implemented, including responsible parties, timelines, and budgets.

## 2.2 East St. Paul’s Resiliency Vision and Goals

The Resiliency Vision and Goals framework was co-developed with the RM’s Steering Committee and Advisory Committee, with input from Council. The visions and goals draw inference from our partners, our network, and global frameworks. In doing so they help anchor the RM’s actions with those of others building a broader framework of resiliency that reflects on us, making our community even stronger. The goals acknowledge that choices today have long-term impacts on our quality of life, the environment, and the economy. The needs and interests of the residents, businesses, and institutions of the RM were a core element in their framing. These goals also recognize our interdependencies with the natural environment and neighboring municipalities and reflect that the RM is a member of a broader provincial, national, and world community.

The Resiliency Vision and Goals provide a frame of reference to plan for the future of our community within the context of a changing climate. They provide a context from which to consider and evaluate climate risks for the community. At this stage they provide a reference for evaluating the Resiliency Actions proposed in the Resiliency Plan.

## 2.3 Risk and Vulnerability Assessment

The RM’s RVA identified potential climate changes based on peer-reviewed scientific information sources, and engaged the Steering Committee and Advisory Committee to identify interactions between potential changes and aspects and assets of the RM. The list of risks and vulnerabilities remains open for further additions based on new knowledge. Council adopted the RVA by resolution on December 15<sup>th</sup>, 2020. The RVA considered potential effects of a changing climate on the ecological, social and economic aspects of the RM. A risk assessment table was generated to consistently display and summarize the duration, magnitude, extent, and likelihood of the events. The socio-ecological context was also evaluated. The risks are to be used as informative tools for future decisions on public works and policies. The RVA identified nine Climate Hazards, or damaging weather events which are likely to become more common in East St. Paul through 2050. The Climate Hazards were used to evaluate the Resiliency Actions defined in the Resiliency Plan.

### 3 Method

The Resiliency Plan for the RM was developed with regards to the milestones and requirements as established by the funding agency, the Federation of Canadian Municipalities (FCM) as well as applicable government and industry policies, standards, and guidance. This Resiliency Plan recommends actions that the RM can undertake to address its Resiliency Visions and Goals, and mitigate risks associated with the Climate Hazards identified in the RVA.

The development of the Resiliency Plan was intended to address the following objectives:

- Engage the Advisory Committee and the Steering Committee to identify desired and practical actions to address the Resiliency Visions and Goals;
- Identify actions which help mitigate risks and vulnerabilities;
- Provide basis for the Implementation Strategy.

#### 3.1 Engagement

The Steering Committee was the primary contact for staff engagement. The committee is comprised of a cross-section of RM staff members from both Administration and Operations, as well as a Council Representative. Staff engagement also occurred with select RM individuals who were not members of the Steering Committee but may have useful knowledge on risk areas. During workshops, staff were asked to consider the Interaction Matrix (Appendix 3 of the RVA) and propose practical short and long-term actions to address these risks. Community engagement involved the Advisory Committee. The committee aided the process by providing a community view on the actions and their practicality and desirability for residents. The original engagement strategy was to provide the community an opportunity to participate through in-person workshops and open houses, but this was set aside due to the pandemic. In lieu of in-person workshops a survey entitled “Building a Resilient Community” was released to the general community on March 12<sup>th</sup>, 2021. The goal of the survey was to gauge the current resiliency of the community, and to determine how concerned residents were with each of the Climate Hazards identified in the RVA. The survey, and a summary of the key findings are found in Appendix A. Virtual meetings were also held with the established climate change committees. The dates of meetings related to the resiliency plan are provided in Table 1 below. In addition to those proposed by the Advisory and Steering Committees, adaptation actions undertaken and proposed by other municipalities across Canada were considered and integrated.

*Table 1 - Internal and External Engagement*

Steering Committee		Advisory Committee	
Meeting 5	August 27 <sup>th</sup> , 2020	Meeting 6	July 23 <sup>rd</sup> , 2020
Meeting 6	February 25 <sup>th</sup> , 2021	Meeting 7	February 16 <sup>th</sup> , 2021
		Meeting 8	March 2 <sup>nd</sup> , 2021
		Meeting 9	March 16 <sup>th</sup> , 2021



## Climate Change Resiliency Plan

### 3.2 Analysis

Resiliency Actions proposed by the Steering Committee and approved by the Advisory Committee were then considered through the lens of the established Resiliency Visions and Goals. The actions were qualitatively grouped based on the Vision and Goal that they primarily addressed, along with one other Vision and Goal which the action may address secondarily. Through this grouping, synergies between actions were identified.

Resiliency Actions were also qualitatively grouped based on the Climate Hazards that they may address or mitigate. The evaluation allowed consideration for actions to address more than one climate hazard. The responses from the March 12<sup>th</sup> “Building a Resilient Community” survey provided an understanding of which hazard were of greatest concern to the community. From this ranking of hazards, a weighting score was calculated for each. Weighting scores were determined based on the answers to a questions 11, 13, and 14 in the survey (Appendix A). The survey platform automatically calculated a rank score for each hazard based on the survey results. The rank scores were then converted to a percentage of the maximum possible rank score (eight). The percentage generated for questions 13 and 14 were then averaged with the percentage of each response in question 11 to produce the weighting score. A total score was then produced for each action by taking the sum of weighting scores of all hazards that a particular action addressed, and normalized by the total number of hazards (nine). Resiliency Actions with a total score of 25 or greater were selected as especially efficient at addressing the most concerning hazards within the RM, and are highlighted in the Section 5, Conclusions and Recommendations.

## 4 Resiliency Plan

The Resiliency Plan proposes Resiliency Actions meant to further the established Resiliency Visions and Goals and help mitigate the risks and vulnerabilities outlined in the RVA. At this stage, the actions are suggested as future possibilities. More definitive methods and timelines of their use will be outlined in the upcoming Implementation Strategy.

### 4.1 Achieving Visions and Goals Through Resiliency Actions

The Resiliency Actions are organized by the Vision/Goal (referred to here as visions), determined in the Resiliency Vision and Goals, that they primarily address. Secondary actions are those that contribute to the vision, but primarily addressed a different vision. In this way synergies were noted by observing actions which contributed to multiple visions. The actions are colour-coded to their primary vision. Some of the identified actions have begun to be implemented since they were identified, some have even been completed. Actions which have been at least started in some capacity are highlighted in **bold**. The actions are further organized by their anticipated timeline (short-term and long-term). For the sake of brevity, only short-term, (estimated 2-3 year implementation) actions are listed directly in the main text of this report. A full list of all the proposed Resiliency Actions, including the long-term or evolutionary actions are included in Appendix B, which also includes a full explanation of all the action ID’s (2Sa, 2Sb, etc...), and their association with elements of the RVA. The ID’s are comprised of the following: a leading number, indicating a general grouping of similar actions; a letter “S” for short-term, “L” for long-term, and “F” for other; and an optional letter (a, b, c, etc...) indicating progression. Appendix C contains a list of all the Resiliency Actions grouped based on their primarily addressed resiliency vision.

## Climate Change Resiliency Plan

### 4.1.1 Vision #1

“

We are proactive in our resiliency, considering the effects of a changing climate and the potential for impacts on our community, our neighbours and our families. Thus we will:

- *Help our community grow sustainably by being well-managed, taking an integrated and long-term decision-making approach that considers health, safety, the economy and the environment.*
- *Engage with our community and incentivize the behaviors of our residents and businesses to reduce exposure and vulnerability to risks and build resilient infrastructure.*
- *Continue to build strong collaborative networks with residents, business, neighbouring municipalities and other levels of government to best serve the community so we are prepared and can rebound from events and changes.”*

This vision concerns the RM’s management philosophy. It seeks to institute considerate, long-term planning. While some actions contribute directly to this vision, many other actions help bolster this type of thinking in short-term plans for the RM.

#### Proposed Primary Resiliency Actions

ID	Action	Main Risk Addressed
2Sa	Increase maintenance schedule for priority roads and paths	Damage to roads and paths caused by changing and severe weather
2Sb	Apply high building design standards to heavily used roads and paths	Damage to roads and paths caused by changing and severe weather
3Sa	<b>Ongoing inspection and repair of RM buildings</b>	Water damage to RM buildings from septic flooding and extreme weather events
3Sb	<b>System retrofit to Operations building to be able to use generator</b>	Water damage to RM buildings from septic flooding and extreme weather events
5S	<b>Enforce existing water supply by-laws, such as sprinkling during drought</b>	Water supply through droughts

#### Secondary Resiliency Actions

ID	Action	Main Risk Addressed
1S	<b>Encourage all residents to have overland flood/sewer backup insurance</b>	Property damage due to flooding

## Climate Change Resiliency Plan

### 4.1.2 Vision #2

“

Our community is more resilient when we are mentally and physically strong so we;

- *Engage and educate our residents on a changing climate to foster awareness, empower preparedness, and boost self-sufficiency.*
- *Build a strong community by supporting active recreation and mental well-being through our cultural and social networks.*
- *Curate partnerships and promote inclusivity and resourcefulness so that we are all resilient together.”*

Vision #2 relates to the RM’s interaction with the community, and seeks to help build the skills, health, and networks essential to promote resiliency in uncertain and challenging times. Not everyone in the community will be affected equally by climate change, but the more that the RM can promote community networks and build independent strength and resilience, the better off the entire community will be.

#### Proposed Primary Resiliency Actions

ID	Action	Main Risk Addressed
1S	Encourage all residents to have overland flood/sewer backup insurance	Property damage due to flooding
7Sa	Form pond advisory committees to educate and encourage community transformative behaviours	Pond water quality and flooding by maintaining community drainage capacity
7Sb	Encourage public to reduce nutrients through targeted communications	Eutrophication of local water bodies
7Sc	Encourage public to establish no-mow zones on private property	Eutrophication of local water bodies through nutrient capture
7Sd	Provide planting information and workshops to the public to support changing shoreline vegetation to native species	Eutrophication of local water bodies through nutrient capture, and bank instability through improved root zone cohesion
8Sb	Provide planting information and workshops to the public to support changing property vegetation to native species	Health of ground cover vegetation through extreme heat and precipitation events
9Sa	Provide information to private landowners with septic fields on how climate change may affect their system	Septic field failure due to extreme weather events

## Climate Change Resiliency Plan

9Sb	<b>Provide information to private landowners with wells on how climate change may affect their system</b>	Compromised water quality in private wells due to extreme weather events
10Sa	<b>Provide updated emergency preparedness information to public, including community news stories, social media updates, and how to prepare an emergency kit and plan</b>	Illness and injury related to extreme weather events
10Sb	<b>Provide residents with winter/spring home preparedness information</b>	Illness and injury related to extreme weather events by improving capacity to shelter in place

### Secondary Resiliency Actions

ID	Action	Main Risk Addressed
2Sa	Apply high building design standards to heavily used roads and paths	Damage to roads and paths from extreme weather events and increased freeze/thaw cycling
2Sb	Increase maintenance schedule for priority roads and paths	Damage to roads and paths from extreme weather events and increased freeze/thaw cycling

#### 4.1.3 Vision #3

“ Our natural environment is an important asset that can both help to reduce risks and be adversely affected by changes. To that end we will:

- Plan our community for a sustainable future by protecting and enhancing the natural ecosystems within our boundaries.
- Strategically invest in green spaces and choose our vegetation wisely so that is resilient to drought, storm and diseases.
- Leverage natural landscapes to support infrastructure capacity, recognizing that this investment also provides natural areas for our community to enjoy, quality habitat for a variety of species and other ecosystem benefits. “

The final vision addresses the RM’s relationship with the environment. It is focused on using the natural advantages the RM has and protecting the habitats and species that make it unique.

## Climate Change Resiliency Plan

### Proposed Primary Resiliency Actions

ID	Action	Main Risk Addressed
6Sa	Maintain inspections of tree canopy	Loss of tree diversity and coverage, damage from falling limbs, loss of shade and cooling
6Sb	Maintain diseased tree programs	Loss of tree diversity and coverage, damage from falling limbs, loss of shade and cooling
6Sc	Monitor for emerging risks (green ash borer) to facilitate early action	Loss of tree diversity and coverage, damage from falling limbs, loss of shade and cooling
8Sa	Reduce mowing to improve root zone and moisture retention	Fire and soil instability due to dead or unhealthy ground cover vegetation

### Secondary Resiliency Actions

ID	Action	Main Risk Addressed
2Sa	Apply high building design standards to heavily used roads and paths	Damage to roads and paths from extreme weather events and increased freeze/thaw cycling
2Sb	Increase maintenance schedule for priority roads and paths	Damage to roads and paths from extreme weather events and increased freeze/thaw cycling

## 4.2 Addressing Climate Hazards Through Resiliency Actions

Resiliency Actions were also evaluated based on the Climate Hazards that they address. A summary of the impact of each climate hazard, how the Resiliency Actions address them, and the weighting score is provided in the subsequent sections. Appendix D outlines the same data in matrix form, tallying which actions address which climate hazard. The subsequent sections are meant to be read concurrently with the tables in Appendix D.

The weighting factors span a range of 61 to 32, indicating that RM residents are broadly concerned about all the identified hazards. Residents were primarily concerned with extreme wind events, with blizzards and events leading to flooding ranked similarly. Residents were generally less concerned by drought and heatwaves. Perhaps not surprisingly, the prospect of shorter, warmer winters ranked the lowest.

### 4.2.1 High Winds/Tornados

#### Weighting Score: 60.9

Extreme wind was the climate hazard that residents consistently ranked as their highest concern, and the one which they are most exposed to. Keeping a healthy tree canopy within the RM will greatly

## Climate Change Resiliency Plan

reduce the risk of damage due to broken and fallen trees and limbs. This includes planning for tree succession since trees also help shield properties from winds. A strong communications relationship between the RM and its residents is essential to both warn and prepare people. Maintaining the RM's buildings will help reduce the risk of structural failures and ensure that staff can continue to provide a high level of service to residents during an emergency. As of 2020, the RM has installed back-up power generators to all RM buildings, allowing for continued service to residents during power outages.

### 4.2.2 Blizzards

**Weighting Score: 57.1**

Blizzards bring many challenges and dangers, chiefly decreased mobility, and power/heat outages. The RM can address mobility by building and maintaining its road infrastructure to the highest standards. The RM also plays a critical role in disseminating safety information to residents; building this relationship, and providing high-quality information is very important. Managing the tree canopy is an important part of preventing snow and ice from snapping branches and downing power lines, protecting private and commercial buildings.

### 4.2.3 Heavy Rain on Frozen Soils

**Weighting Score: 46.5**

Spring and winter flooding are a large concern with the onset of climate change. Rain events on frozen soils present a large risk as many of the factors that help mitigate flood events are not present at times of the year when soils are frozen. The main ways that the RM can address the risks of flooding in spring and winter is to diligently maintain and upgrade its infrastructure, particularly roads, water control structures, and drainage infrastructure. A critical part of understanding the priority of infrastructure repairs and upgrades will be to understand the risks that they are under. A land drainage study will greatly inform areas most at risk to flooding and highlight drainage infrastructure which is old and or inadequate. Providing emergency information for citizens and improving emergency preparedness of the RM and its buildings is also critical. Switching to native plants and creating denser vegetation buffers around water bodies will help slow down and keep water in place when frozen soils cannot.

### 4.2.4 More Annual Precipitation, Longer Dry Spells

**Weighting Score: 44.8**

Oscillation of soil moisture conditions presents a risk to certain RM infrastructure; regular inspection and maintenance is critical. Similarly, RM water infrastructure must be designed to handle higher peak flows, but also to protect water quality during long dry spells which can concentrate water contaminants in shrinking bodies of water. Natural assets such as trees, areas of native plantings, and wide riparian buffers all serve to mitigate the risks of local flooding and to help retain water in soils during dry periods. Finally, the RM must help residents prepare for flooding by promoting flood insurance and by conducting a land drainage study that assess flood risk areas.

## Climate Change Resiliency Plan

### 4.2.5 Higher Winter Temperatures

#### Weighting Score: 44.6

Higher winter temperatures increase the risk of “Heavy Rain on Frozen Soil” and “More Freeze-Thaw Cycles” type winter events and emergency, requiring similar actions. Additionally, similar to Section 4.2.8, warmer winter temperatures will reduce the likelihood of winter kill for new pests and diseases.

### 4.2.6 Drought

#### Weighting Score: 43.1

Encouraging a transition from high-demand horticultural plants to low-maintenance, drought tolerant native plants is a win-win for nearly everyone. These plants provide much more appropriate and higher quality habitat for local insects, birds, mammals, and reptiles. Native plants are much lower maintenance, beyond the initial transition period, and are generally more resistant to drought and other extreme weather conditions.

Programs which promote water efficiency within households will reduce demand for fresh water and ensure there is enough to go around while reducing the carbon footprint of the RM. Managing water quality in the ponds and streams of the RM will help reduce some of the negative impacts of a drought as well, since water quality issues become much more severe when water in ponds begins to evaporate, leaving contaminants behind. Additionally, higher temperatures promote the growth of aquatic plants, leading to eutrophication.

Droughts can drastically change soil moisture levels. The soils of the RM are dominated by clay, a material which radically changes its size, strength, and structure based on moisture. Alternating between extreme dry and extreme wet conditions can cause expansion and subsidence stress on RM infrastructure such as roads, trails, and all buildings. Higher design standards and regular maintenance will be critical in mitigating this risk.

### 4.2.7 Heatwaves

#### Weighting Score: 38.8

The main risks facing the community during heatwave scenarios are injury or death due to heat. Here, it is critical that the RM establish and maintain a trusted line of communication with residents to inform them of hazards and help them prepare their homes. The effects of a heatwave can be exacerbated by loss of power due to increased power demand from air conditioning units. The RM has an emergency plan to provide cooling centers at public facilities, such as the arena. This plan is critical for providing heat relief to those who do not or cannot air condition their homes. However, to prevent over-capacity of the cooling facilities, the RM must seek to reduce peak and off-peak power demand. This puts less strain on the energy grid, reducing the likelihood of brown or blackouts. The RM can help reduce energy demand by promoting power-saving practices and retrofits in the RM community, local businesses, and within the RM’s buildings and operations. This strategy has benefits outside of heatwave scenarios since the power savings will occur all year long.

Maintenance of the tree canopy within the RM can also mitigate the impacts of heatwaves. Trees help provide shade from the sun, but also cool the air surrounding them through evaporation and transpiration occurring naturally within the leaves.

## Climate Change Resiliency Plan

Additional risks from heatwaves include fouling of standing water with aquatic plant growth, including blue-green algae. Strategies to manage nutrient loading in ponds, increasing riparian corridors, and promoting the use of native species will help reduce the risk of water fouling.

### 4.2.8 Longer Period of Frost-Free Days / Shorter Periods of -30 Degree Days

#### **Weighting Score: 35.5**

A longer period of frost-free days represents an opportunity for local agriculture to extend growing seasons and diversify crops. To realize this opportunity, the RM must work hard to protect water quality and quantity locally, as discussed in Sections 4.2.4 and 4.2.6. The largest risks to the RM from shorter winters is the northern migration of pests and diseases. Diligent monitoring of the health of plants, especially trees will help the RM to maintain the investments it has made in its natural assets and infrastructure.

### 4.2.9 More Freeze-Thaw Cycles

#### **Weighting Score: 32.2**

Repetitive freeze-thaw cycles accelerate wear on stationary infrastructure through heaving, necessitating greater attention to repair, maintenance of roads and pathways, and building standards. Mid-winter thawing can produce significant run-off events with similar effects and magnitudes to a “Heavy Rain on Frozen Soils” event, as described in Section 4.2.3, requiring similar actions.



## 5 Conclusions and Recommendations

Based on the data presented in Appendix D, Resiliency Actions with a total score great than 25 were selected as being especially efficient at addressing concerning Climate Hazards within the RM. These actions are summarized below, with the intention of highlighting very impactful actions which efficiently address hazards that the community is concerned about. Bolded actions have at least been begun in some capacity by RM staff.

ID	Action	ID	Action
2Lb	Develop municipal standards for infrastructure design and maintenance to meet demands of a changing climate *	10Lb	Webinar series/workshop – back up power system retrofits for private residents and commercial buildings
3L	<b>Replace or upgrade municipal building components to higher standards</b>	6L	Develop a tree replacement strategy/policy
1La	<b>Land drainage study to assess capacity and gaps in response to climate change</b>	2Sb	Apply high design standards to heavily used roads and paths
1Lb	<b>Develop drainage systems upgrade and mitigation plans based on results of land drainage studies</b>	2Sa	More frequent maintenance for priority areas to maintain roads and paths
3Sa	<b>Ongoing inspection and repair of municipal buildings</b>	6Sb	<b>Maintain diseased tree removal and replacement programs</b>
6Sa	<b>Maintain inspections of tree canopy</b>	10La	Communications plan to relay emergency preparedness information on an annual basis and engage residents (i.e. – submit your plans for a chance to win)

*\* This can be achieved through several other actions such as updating development guidelines regarding stormwater and plantings with consideration for climate change (actions 5L, 6Fb, and 7Ld), developing path and roadway standards with consideration for climate change (action 2Sb), and developing vegetation standards and strategies with consideration for climate change (actions 8L and 6L)*

The Resiliency Actions introduced in this report and its Appendices are not intended to comprise the entire response of the RM to the risks of climate change. New risks and required actions will come to light as new projects are undertaken, and new funding becomes available. At the time of writing, the drainage infrastructure of the RM stands as a good example of this. The hydrology within the RM is not fully understood. However, the extent of that risk and how to address it is an “unknown unknown”. A land drainage study must be undertaken to better understand the land drainage and ecology of each catchment within the RM. Further decisions must be made based on new knowledge, from these studies and other facts that come to light over time. Critically, regular attention must be given to re-evaluation of the risks and vulnerabilities presented to the RM by climate change.

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**Appendix A**  
Community Survey



## Introduction

A survey entitled “Building a Resilient Community” was released to the residents of East St. Paul via the RM website, email, Twitter, and Facebook on Friday March 12<sup>th</sup>, 2021. The survey received 209 responses, which is a slightly higher level of engagement than is typically found with surveys released by the RM. For example, the Community Engagement survey released in August 2020 had 163 responses.

The survey asked questions regarding how prepared RM residents feel for major weather events such as extreme wind, blizzards, flooding, and heatwaves. Emphasis was given on the fact that these weather events were expected to become more likely in the future. Residents were also asked to rank their level of concern with major weather events, and what major weather events they had experienced in the last year. A blank copy of the survey is provided here.

This document briefly summarizes the findings of the survey as they relate to the *Climate Change Resiliency Plan* (Resiliency Plan). A more detailed analysis of the survey results will be prepared for Council review.

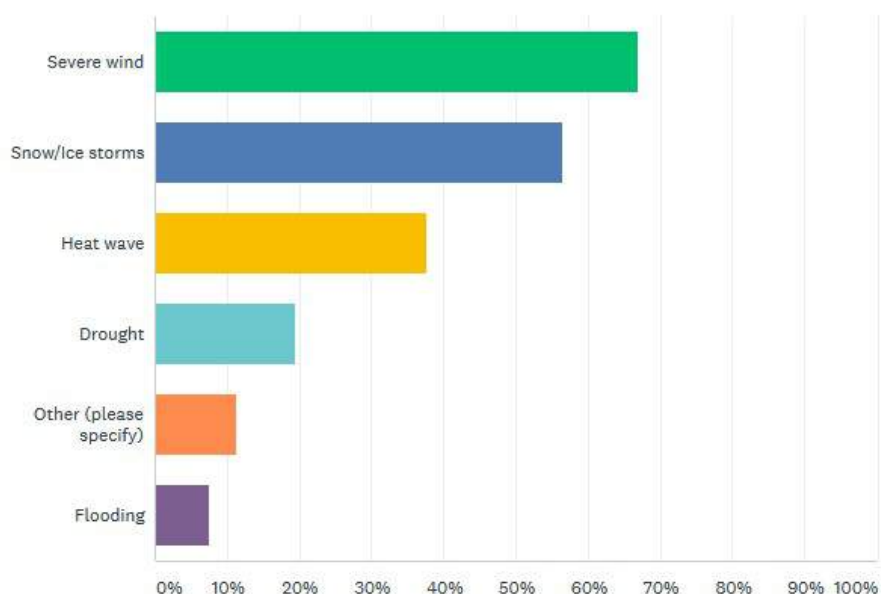
## Key Findings

### Concerns over Climate Change

When asked to rate how much they agreed with the following statement, “Climate change has me concerned about the well-being of future generations in my community” (Question 12), 46% of respondents said they strongly agreed. A further 29% agreed, and 13% neither agreed nor disagreed. A total of 12% of respondents disagreed or strongly disagreed. This question shows that the projected impacts of climate change are concerning to the current residents of East St. Paul.

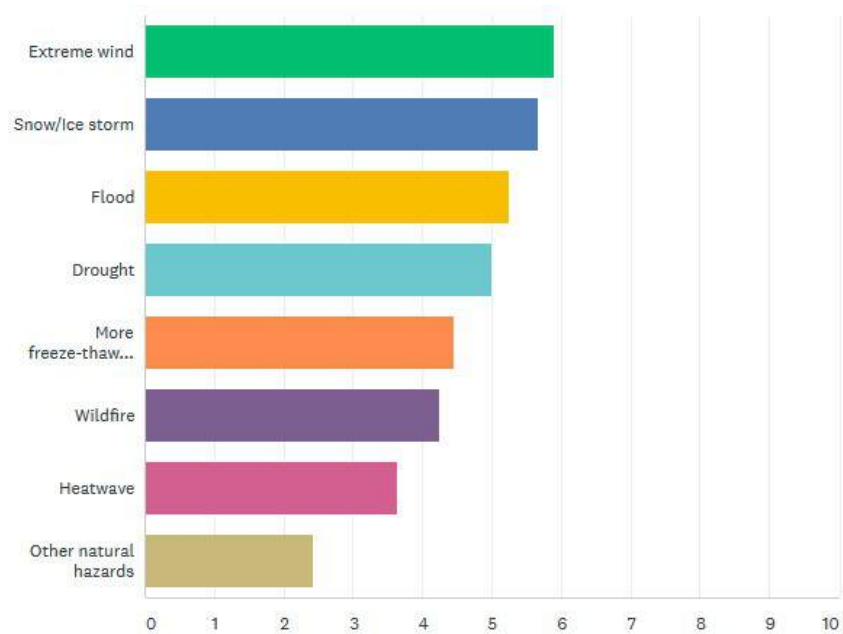
### Weather Concerns

Residents were asked to select all of the severe weather events that their home has been exposed to in the last 12 months (Question 11), with the following results.

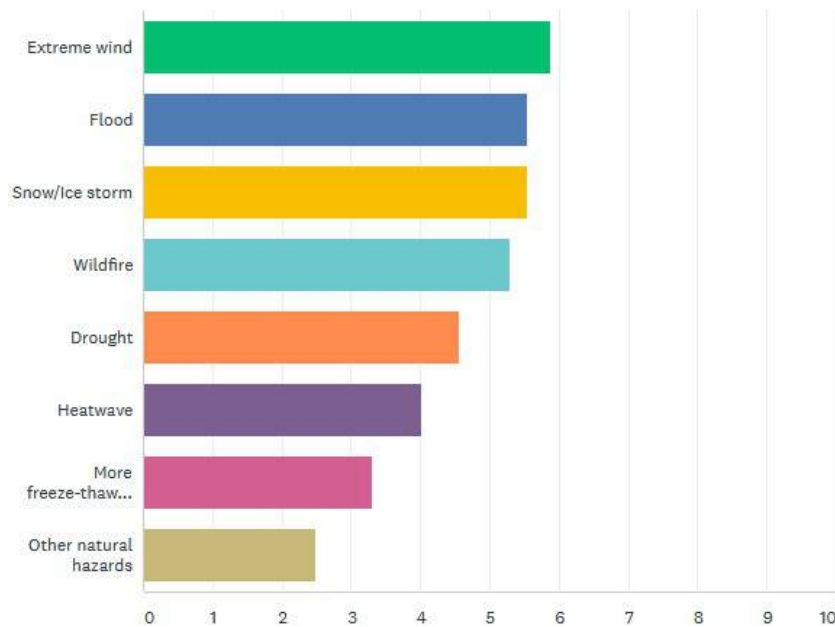


Residents were also asked to rank their concern over these severe weather events and their impacts on their homes, and the safety of their families (Questions 13 and 14), with the following results. The x-axis represents a “score” generated for each option, a larger score means that the option was ranked higher more often than other options.

**Question 13** - Please rank the climate events you believe would be most damaging to your property



**Question 14** - Please rank the climate events you believe would have the most risk to the safety of the members of your household



Severe wind events emerged as the top concern in all three questions, generally closely followed by snow/ice storms and flooding. However, there was not a large spread between most of the results, indicating that residents are broadly concerned with of the identified extreme weather events.

The results of these three questions formed the basis of the weighting produced in the Resiliency Plan.

## Blank Survey

### Tell Us About Yourself

Who am I?

(Choose any one option)

- I am a resident of East St. Paul
- I am not a resident of East St. Paul, but I am looking at purchasing or renting in the community
- I am not a resident of East St. Paul

*Answer this question only if you have chosen I am a resident of East St. Paul for Who am I?*

I have been living in East St. Paul for \_\_\_\_\_ years

*Answer this question only if you have chosen I am a resident of East St. Paul for Who am I?*

The age of my dwelling is

(Choose any one option)

- 0-10 years
- 11-20 years
- 21-30 years
- 31-40 years
- 41-50 years
- 51 years +

I own a business in East St. Paul

(Choose any one option)

- Yes
- No

*Answer this question only if you have chosen Yes for I own a business in East St. Paul*

My business has been operating in East St. Paul for \_\_\_\_\_ years



## Living Conditions

This section will ask some general questions about your living conditions and practices to help us understand your personal resiliency.

I \_\_\_\_\_ my place of residence

(Choose any one option)

- Own
- Rent

My water supply comes from

(Choose any one option)

- Municipal Water
- Well
- Other (please specify)

My sewer system is

(Choose any one option)

- Septic Tank
- Holding Field
- Municipal
- Ejector
- Low pressure sewer
- Other (please specify)

The power lines on my street/in my yard are

(Choose any one option)

- Overhead
- Underground
- Not sure

My place of residence has insurance for

(Choose all that apply)

- Overland flooding
- Sewer backup flooding
- Wind/Tornado
- Hail
- Not Sure

In the past 12 months my household has been exposed to

(Choose all that apply)

- Drought
- Flooding
- Heat Wave
- Severe Wind
- Snow/Ice Storm
- Other Natural Hazards (please specify)

### Changing Climate and Resiliency

Climate Change is occurring at an unprecedented rate, and is making the climate more variable and less predictable. Changes to precipitation patterns and temperature patterns are expected to result in more extreme weather events, and changes to the vegetation and the growing season. These questions aim to discover how resilient your household would be to certain projected climate events.

More information on the impacts of a changing climate to the RM of East St. Paul can be found [on the RM website](#).

Please select how much you agree with the following statement

	<b>Definitely agree</b>	<b>Somewhat agree</b>	<b>Neither agree nor disagree</b>	<b>Somewhat disagree</b>	<b>Definitely disagree</b>
<b>Climate change has me concerned about the well-being of future generations in my community</b>					

Please rank the climate events you believe would be most damaging to your property (1 being most concerned)

(Rank each option)

- \_\_\_\_\_ Drought
- \_\_\_\_\_ Wildfire
- \_\_\_\_\_ Flood
- \_\_\_\_\_ Extreme Wind
- \_\_\_\_\_ Snow/Ice Storm
- \_\_\_\_\_ Heatwave
- \_\_\_\_\_ Other Natural Hazards
- \_\_\_\_\_

Please rank the climate events you believe would have the most risk to the safety of the members of your household (1 being most concerned)

(Rank each option)

- \_\_\_\_\_ Drought
- \_\_\_\_\_ Wildfire
- \_\_\_\_\_ Flood
- \_\_\_\_\_ Extreme Wind
- \_\_\_\_\_ Snow/Ice Storm
- \_\_\_\_\_ Heatwave
- \_\_\_\_\_ Other Natural Hazards
- \_\_\_\_\_

### Increasing Temperature

Mean temperatures are expected to increase by an average of 2°C from 2021-2050. Higher temperatures year round will result in an increased number of frost free days, and it is likely that we will see higher temperatures earlier in the year. It is projected that the number of very hot days (+30 °C) will increase substantially, meaning there is a higher risk for heat waves and heat related health impacts such as heat stroke.

Higher temperatures will stress vegetation, those like turf grass with shallow roots will be most susceptible. In the summer months, it is likely that the potential for droughts or prolonged periods without rain will increase.

Please select how much you agree with the following statement

Questions	Definitely agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Definitely disagree
<b>If a heat wave were to occur in East St. Paul, I would be prepared</b>					

I am prepared for a prolonged heat wave because

(Choose all that apply)

- My home has air conditioning I can rely on
- I have a cool room or basement I can use
- I have fans
- My home is shaded by trees and remains cool
- I am not prepared for a long heat wave
- Other (please specify)

With increasing heat, I would consider modifying my home to implement the following measures

(Choose all that apply)

- Planting trees to shade the building
- Painting my house another color so it doesn't absorb heat
- Changing my windows to improve thermal comfort
- I have not really thought about it
- Other (please specify)

As drought becomes more frequent, I plan on doing the following

(Choose all that apply)

- Changing my landscaping to more drought resistant plants
- Getting a rain barrel(s) so that I have other watering sources to rely on
- I have not really thought about it
- Other (please specify)

**Precipitation Changes**

The average precipitation rate is expected to increase in all seasons. However, it is also anticipated that precipitation **patterns** will change, resulting in fewer, larger precipitation events rather than scattered throughout a season. As East St. Paul is already in a flood risk region, increasing precipitation especially in the spring and winter months can result in higher flooding potential. Too much precipitation at once can also result in local flooding and water stress that cumulatively can adversely affect vegetation.

Please select how much you agree with the following statements

Questions	Definitely agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Definitely disagree
<b>My property is at risk of flooding from a local stream or pond during a rain storm</b>					
<b>My property is at risk of flooding during a spring melt event</b>					
<b>My property is at risk of overland flooding during a rain storm</b>					
<b>In the event of flooding from a major summer rain storm, I am prepared</b>					

I have implemented the following measures to increase the resiliency of my property from major rain storms or sudden spring melt events

(Choose all that apply)

- Upgraded land drainage (regrading and landscaping yard to reduce runoff)
- Have a backup sewer valve installed
- Upgraded roof drainage
- Maintain downspouts regularly
- Installed a sump pump
- Install a power system for my sump pump
- Installed a sump pump monitoring system/alarm
- Installed a backup generator
- I don't know
- I don't think I need to implement any additional measures
- I've thought about it, but I haven't done any
- Other (please specify)

I do the following annual maintenance activities to ensure my house is prepared for storms and other weather related events

(Choose all that apply)

- Clean my eaves troughs and downspouts
- Check my foundation for signs of cracks and soil shifting
- Clean out debris from my window wells
- Check the condition of my sump pump
- Ensure my sump pump hose is away from my window wells
- Inspect my trees for damaged branches and disease, and remove
- Check and ensure my shingles are in good condition
- Remove dead plant material in a 30 meter radius around my home
- Other (please specify)

### Winter Storms

It is projected that we will see a decrease in blizzards/snow storms and an increase in ice storms and hail. Ice storms can damage trees and overhead power lines due to increased stress on branches and lines, creating a safety risk for nearby homes, cars and roadways. It is possible that power could be lost for extended periods of time.

Please select how much you agree with the following statement

Questions	Definitely agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Definitely disagree
In the event of a major winter storm, I am prepared					

In the event of a major winter storms, my biggest concerns are

(Choose all that apply)

- I'll lose power for a sustained duration of time, meaning no lights or furnace
- Emergency services will be unable to reach us in case of emergency
- I don't have enough food and water for 72 hours
- I have no way of cooking food
- The food in my fridge/freezer perishes
- I run out of medication
- I run out of wood for my fire place
- I am not concerned- it's a great time to hunker down and spend with family
- Other (please specify)

During a major winter storm was to occur, I am able to maintain access to my property because I have and can use

(Choose all that apply)

- Snow clearing equipment (shovels, snow blowers, etc...)
- A neighbor who will assist me
- A snow removal service
- I am not prepared for a major winter storm
- Other (please specify)

During a prolonged power outage, I am prepared because I have

(Choose all that apply)

- Flashlights
- Candles and matches
- Back-up power supply
- Spare batteries for flashlights and other battery operated electronics
- I am not prepared
- Other (please specify)

### Further Feedback

Is there something in your neighborhood that you are concerned might fail in the event of a storm or flooding event that could adversely affect you or your neighbors? Where is it located? (ex. a place where water frequently pools, a poorly placed power line, areas in which snow drifts making the road dangerous)

What ways would you like to see the RM help residents become more resilient in the face of a changing climate?

(Choose all that apply)

- Provide tips in the Community News
- Provide information on the RM website and update regularly
- Host webinars/workshops
- Help build community so neighbors are more connected
- Other (please specify)
- None of the above

If you have any further questions or concerns related to climate change and our community, or the risks not covered in this survey, please share them here.

**Appendix B**  
Resiliency Actions



RISK ASSESSMENT						RESILIENCY MEASURES		
Key Vulnerabilities	Risk	Driving Factors	Direct Effects	Residual Impacts	Affected Areas	Short Term	Long Term	Other Ideas
<b>RM owned Infrastructure</b>								
Land drainage systems	Flooding	Extreme rain events and/or high snow pack	Flooding of adjacent properties	Property damage	All RM	<b>1S Encourage all residents to have overland flood/sewer backup insurance</b>	<b>1La Land drainage study to assess capacity and gaps in response to climate change</b>	
			Bank instability due to saturation and vegetation	Stress on homeowners and businesses			<b>1Lb Develop drainage systems upgrade and mitigation plans based on results of land drainage studies</b>	
Roads, sidewalks, and paths	Heaving	Freeze/thaw	Heaving and cracking	Increased operational demands and costs	All RM	<b>2Sa More frequent maintenance for priority areas to maintain roads and paths</b>	<b>2La Investigate alternative measures to extend life of infrastructure (i.e. micro-resurfacing)</b>	
	Surface failure	Increased precipitation	Shorter lifespan	Increased frequency of repair		<b>2Sb Apply high design standards to heavily used roads and paths</b>	<b>2Lb Develop municipal standards for infrastructure design and maintenance to meet demands of a changing climate</b>	
	Foundation failure			higher costs associated with infrastructure				
Municipal buildings	Damage to structure from extreme storm events	Extreme storm events (i.e. ice, rain, high winds)	Flooding of building	Increased insurance costs and higher deductible	All municipal buildings	<b>3Sa Ongoing inspection and repair of municipal buildings</b>	<b>3L Replace or upgrade municipal building components to higher standards</b>	
			Damage to roof, siding, and HVAC equipment	Additional maintenance and repair costs				
			Damage to structure	Loss of service to residents				
Operations building	Septic flooding	Extreme rain events and/or high snow pack	Flooding of building	Increased insurance costs and higher deductible	All municipal buildings	<b>3Sa Ongoing inspection and repair of municipal buildings</b>	<b>3L Replace or upgrade municipal building components to higher standards</b>	
				Loss of service to residents				
	Resource accessibility	Extreme rain events and/or high snow pack	Loss of power to building	Access to equipment & fuel	All RM	<b>3Sb System retrofit to Operations building to be able to use generator</b>		
Waste water treatment	Plant capacity	Extreme storm events					<b>4L By-law updates and inspection to better regulate sump pump and other land drainage discharges</b>	<b>4F Low flow fixture replacement rebate to reduce rate of increase in water use and wastewater generation</b>
	Sewer line/lift station capacity	Extreme storm events or power failures				<b>1S Encourage all residents to have overland flood/sewer backup insurance</b>		
Water treatment	Water Supply	Drought/higher temperatures	Reduced water supply due to high demand	Additional operational demands and costs	Areas serviced by municipal treatment system	<b>5S Enforcement of existing water supply by-laws, such as sprinkling during drought</b>	<b>5L Implement xeriscape/native plant requirements in new developments</b>	

\* **Bolded** actions have been at least started by RM staff in some capacity

Key Vulnerabilities	Risk	RISK ASSESSMENT				RESILIENCY MEASURES			
		Driving Factors	Direct Effects	Residual Impacts	Affected Areas	Short Term	Long Term	Other Ideas	
<b>Natural Assets</b>									
Tree canopy	Loss of mature tree coverage	Drought	Greater susceptibility to pests and diseases	Loss of enjoyment, aesthetics	Parks	<b>6Sa Maintain inspections of tree canopy</b>	6L Develop a tree replacement strategy/policy	<b>6Fa Communicate tree species options to the public</b>	
			Damage to or loss of individual trees	Loss of shade increasing summer cooling costs	Boulevard Trees	<b>6Sb Maintain diseased tree removal and replacement programs</b>			
Tree canopy	Loss of tree diversity	Ice storms	Loss of habitat for wildlife	Decline in property value	River bank trees	<b>6Sc Monitor for emerging risks to facilitate early action</b>		<b>6Fb Work with developers to ensure a diversity of trees are planted in new developments</b>	
			Damage to property or impassible roads due to downed limbs or trees	Increased bank instability and erosion					
Pond and creeks	Pond Quality	High summer temperatures  Drought conditions	Extended low flow periods leading to concentration of nutrients	Odours from anaerobic decay (decay without oxygen)	Silver Springs	<b>7Sa Form pond advisory committees to educate and encourage transformative behaviours</b>	<b>7La Reduce attractiveness of ponds to geese through vegetation management</b>	<b>7F Look for funding opportunities to support actions (i.e. FCM Storm Water Quality grant, Lake Winnipeg Basin grants, Conservation Trust grants)</b>	
					Eagle Creek				<b>7Lb Comprehensive goose management plan</b>
					Southlands				<b>7Lc Draw nutrients out of pond systems by planting native vegetation in riparian zones and installing floating islands</b>
					By the Park				<b>7Ld Develop retention pond design guidelines so that new ponds are designed to reduce nutrient loading and ensure bank stability</b>
Pond and creeks	Bank stability	Extreme rain events	Flooding saturating banks	Reduced water quality and storage capacity in ponds	Countryside	<b>7Sc Encourage public to establish no-mow zones on private property</b>	<b>7Le Identify pond banks that are failing and use retaining walls or other methods to combat slumping</b>		
		Drought conditions	Loss of vegetation during drought leading to erosion		Bottomley Creek			<b>7Sd Provide planting information to the public to support changing shoreline vegetation to native species</b>	
<b>Flooding (see land drainage system)</b>									
Vegetation	Dead and drying grasses and other plants	High temperatures/extended droughts	Erosion of soils	Risk of wildfire	Parks	<b>8Sa Reduce mowing to improve root zone and moisture retention</b>	<b>8L Develop a municipal wide strategy to shift ground cover to more resilient/native species that require less water and are hardier</b>		
			Invasive weeds	Invasive weeds	Boulevards			<b>8Sb Provide planting information to the public to shift vegetation to more resilient native species on lawns</b>	
			Loss of bank stability	Reduced aesthetic	Sports grounds				
			Increased maintenance and replacement costs						

\* **Bolded** actions have been at least started by RM staff in some capacity

RISK ASSESSMENT						RESILIENCY MEASURES		
Key Vulnerabilities	Risk	Driving Factors	Direct Effects	Residual Impacts	Affected Areas	Short Term	Long Term	Other Ideas
<b>Private Landowners</b>								
Septic system	System failure	Droughts and freeze thaw cycles Flooding of septic fields	System is compromised	Increased maintenance and replacement costs	Off system properties	<b>9Sa Provide septic field owners with information on how climate change may affect them</b>	<b>9La</b> Provincial partnerships/grants to migrate septic field users to municipal waste water system	
Private wells	Water quality	Flooding Droughts Freeze/thaw cycles	Water infiltration through flooding Surface soils pulling away from well during droughts	Increased risk of collapse or failures Additional maintenance costs and resource requirements	Off system properties	<b>9Sb Provide well owners with information on how climate change may affect them</b>	<b>9Lb</b> Provincial partnerships/grants to migrate well users to municipal supply	
Agricultural businesses	Crop production	Extreme storm events (i.e. ice, rain, high winds) Drought	Unreliable growing season Damage from extreme weather events	Additional costs for watering in droughts Loss of crop yield	All agricultural producers			
Damage to residential and commercial properties	Damage to structure and property Damage to foundation Extended loss of power	Extreme storm events (i.e. ice, rain, high winds) Freeze/thaw cycles	Water damage Wind and hail damage Water damage from sump pump failure	Increased insurance rates, higher deductibles and/or difficulty in securing insurance.	All RM	<b>10Sa Provide updated emergency preparedness information to public, including community news stories, social media updates, and how to prepare an emergency kit and plan</b>	<b>10La</b> Communications plan to relay emergency preparedness information on a annual basis and engage residents (i.e. – submit your plans for a chance to win) <b>10Lb</b> Webinar series/workshop – back up power system retrofits for private residents and commercial buildings	<b>10Fa</b> Grant opportunities for homeowner retrofits
Health and safety	Illness, loss of life	Heat exposure Extreme storm events (i.e. ice, rain, high winds)	Need to shelter in place			<b>10Sa Provide updated emergency preparedness information to public, including community news stories, social media updates, and how to prepare an emergency kit and plan</b> <b>10Sb</b> Provide residents with winter/spring home preparedness information		<b>10Fb</b> Community resilience survey to assess compliance and understanding

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Driving Factor	Risk	RISK ASSESSMENT				RESILIENCY MEASURES	
		Silver Spring Ponds	Eagle Creek	Southlands, By the Park, Countryside	Bottomley Creek, Christie Drain, other ag. drains	Short Term	Long Term
<b>Risks to Specific Waterbodies</b>							
high summer temperatures and droughts	odours from anaerobic bacteria decay (decay without oxygen)	<b>Low</b> – naturally aerated by wind action	<b>Extreme</b> - extensive build up of nutrients in sediment and discharged into ponds on a regular basis	<b>High</b> - nutrients and soils beginning to build up from backyard runoff and soil erosion	<b>Low</b> – waterbodies drain and do not retain water.	<b>7Sa Form pond advisory committees to educate and encourage transformative behaviours</b> <b>7Sb Encourage public to reduce outdoor chemical fertilizer use through targeted communications</b>	<b>7La</b> Reduce attractiveness of ponds to geese through vegetation management
	Risk of flooding due to back flooding from Red River	<b>No risk</b>	<b>Medium</b> - risk of flooding downstream of Burr Oak culvert	<b>Unknown</b> - likely low to medium	<b>Low to Extreme</b> - depending on location	<b>1La Land drainage study to assess capacity and gaps in response to climate change</b>	<b>1Lb Develop drainage systems upgrade and mitigation plans based on results of land drainage studies</b> <b>1Lc Targeted flood mitigation measures for at risk properties, based on land drainage studies</b>
Extreme rain events/ spring melts	Risk of flooding due to extreme rain event (higher impact if it occurs during frozen soil conditions)	<b>Low</b> – may flood pathways and disrupt park use but no permanent damage	<b>Extreme</b> – risk of basement flooding in 10% of homes along waterbody	<b>Unknown</b> - likely low to medium	<b>Low to Extreme</b> - depending on location, some drains are not well understood	<b>1La Land drainage study to assess capacity and gaps in response to climate change</b>	<b>1Lb Develop drainage systems upgrade and mitigation plans based on results of land drainage studies</b> <b>1Lc Targeted flood mitigation measures for at risk properties, based on land drainage studies</b>
	High level of aquatic plant growth due to nutrient loading levels	<b>Medium</b> – runoff from private prop., inherent nutrients in system from previous loadings, contribution from wildlife (geese and other species)	<b>Extreme</b> – runoff from private prop., inherent nutrients in system from previous loadings, minor contributions from wildlife (geese and other species)	<b>Extreme</b> – runoff from private prop., inherent nutrients in system from previous loadings, minor contribution from wildlife (geese and other species)	<b>Medium to high</b> – runoff from private prop., minor contribution from wildlife (geese and other species)	<b>7Sa</b> Form pond advisory committees to educate and encourage transformative behaviours <b>7Sb</b> Encourage public to reduce outdoor chemical fertilizer use through targeted communications	<b>7La</b> Reduce attractiveness of ponds to geese through vegetation management

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**Appendix C**

Resiliency Actions Sorted by Primary Resiliency Vision

\* **Bolded** actions have been at least started by RM staff in some capacity

Vision #1  
 We are proactive in our resiliency, considering the effects of a changing climate and the potential for impacts on our community, our neighbours and our families. Thus we will:

- Help our community grow sustainably by being well-managed, taking an integrated and long-term decision-making approach that considers health, safety, the economy and the environment.
- Engage with our community and incentivize the behaviors of our residents and businesses to reduce exposure and vulnerability to risks and build resilient infrastructure.
- Continue to build strong collaborative networks with residents, business, neighbouring municipalities and other levels of government to best serve the community so we are prepared and can rebound from events and changes.

Primary Actions		
ID	Action	Main Risk Addressed
2Sb	Apply high building design standards to heavily used roads and paths	Damage to roads and paths
2Sa	Increase maintenance schedule for priority roads and paths	Damage to roads and paths
3Sa	Ongoing inspection and repair of RM buildings	Water damage to RM buildings from septic flooding and extreme weather events
<b>3Sb</b>	<b>System retrofit to Operations building to be able to use generator</b>	Water damage to RM buildings from septic flooding and extreme weather events
5S	Enforcement of existing water supply by-laws, such as sprinkling during drought	Water supply depletion
4L	By-law updates and inspection to better regulate sump pump and other land drainage discharges	Large storm events overwhelming Waste Water Treatment Plant capacity
<b>1La</b>	<b>Land drainage study to assess capacity and gaps in response to Climate Change</b>	Flooding/Water Quality
<b>1Lb</b>	<b>Develop upgrade and mitigation plans based on results of land drainage study</b>	Flooding
<b>3L</b>	<b>Replace and upgrade building components to build better standards for RM buildings</b>	Water damage to RM buildings from septic flooding and extreme weather events
2Lb	Develop municipal standards for infrastructure design and maintenance to meet demands of a changing climate	Damage to roads and paths
2La	Investigate alternative measures to extend life of infrastructure (i.e. micro-resurfacing)	Damage to roads and paths
9Lb	Provincial partnerships/grants to migrate well users to municipal supply	Compromised water quality in private wells
<b>1Lc</b>	<b>Targeted flood mitigation measures for at risk properties, based on land drainage studies</b>	Flooding
7F	Look for funding opportunities to support actions (i.e. FCM Storm Water Quality grant, Lake Winnipeg Basin grants, Conservation Trust grants)	Pond water quality

Secondary Actions		
ID	Action	Primary Vision Association
<b>1S</b>	<b>Encourage all residents to have overland flood/sewer backup insurance</b>	Vision #2
7Ld	Develop retention pond design guidelines so that new ponds are designed to reduce nutrient loading	Vision #3
<b>8L</b>	<b>Develop a municipal wide strategy to shift ground cover to more resilient species that require less water and are hardier</b>	Vision #3

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Vision #2

Our community is more resilient when we are mentally and physically strong so we;

- Engage and educate our residents on a changing climate to foster awareness, empower preparedness, and boost self-sufficiency.
- Build a strong community by supporting active recreation and mental well-being through our cultural and social networks.
- Curate partnerships and promote inclusivity and resourcefulness so that we are all resilient together.

Primary Actions		
ID	Action	Main Risk Addressed
1S	<b>Encourage all residents to have overland flood/sewer backup insurance</b>	Flooding
7Sb	<b>Encourage public to reduce nutrients through targeted communications</b>	Pond water quality
7Sa	<b>Form pond advisory committees to educate and encourage transformative behaviours</b>	Pond water quality
7Sc	<b>Encourage public to establish no-mow zones on private property</b>	Pond water quality
7Sd	<b>Provide planting info to encourage switch to native species on shorelines</b>	Pond water quality
8Sb	<b>Provide planting info to the public to change property plants to native species</b>	Health of ground cover vegetation
9Sa	<b>Provide information to private landowners with septic fields on how climate change may affect their system</b>	Septic field failure
9Sb	<b>Provide information to private landowners with wells on how climate change may affect their system</b>	Compromised water quality in private wells
10Sa	<b>Provide updated emergency preparedness information to public, including community news stories, social media updates, and how to prepare an emergency kit and plan</b>	Illness and injury related to extreme weather events
10Sb	<b>Provide residents with winter/spring home preparedness information</b>	Illness and injury related to extreme weather events
5L	<b>Implement xeriscape landscape requirements in new developments</b>	Water supply depletion
9La	Provincial partnerships/grants to migrate septic field users to municipal waste water system	Septic field failure
10La	Communications plan to relay emergency preparedness information on a annual basis and engage residents (i.e. submit your plans for a chance to win)	Illness and injury related to extreme weather events
10Lb	Webinar series/ workshop – back up power system retrofits	Illness and injury related to extreme weather events
4F	Low flow fixture replacement rebate to reduce rate of increase in wastewater quantity	Large storm events overwhelming Waste Water Treatment Plant capacity
6Fa	<b>Communicate tree species options to the public</b>	Loss of tree diversity and coverage
10Fa	Grant opportunities for homeowner retrofits	Illness and injury related to extreme weather events
10Fb	Community resilience survey to assess compliance and understanding	Illness and injury related to extreme weather events

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<b>Vision #2 Con't - Secondary Actions</b>		
<b>ID</b>	<b>Action</b>	<b>Primary Vision Association</b>
2Sb	Apply high building design standards to heavily used roads and paths	Vision #1
2Sa	Increase maintenance schedule for priority roads and paths	Vision #1
4L	By-law updates and inspection to better regulate sump pump and other land drainage discharges	Vision #1



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Vision #3  
 Our natural environment is an important asset that can both help to reduce risks and be adversely affected by changes. To that end we will:

- Plan our community for a sustainable future by protecting and enhancing the natural ecosystems within our boundaries.
- Strategically invest in green spaces and choose our vegetation wisely so that is resilient to drought, storm and diseases.
- Leverage natural landscapes to support infrastructure capacity, recognizing that this investment also provides natural areas for our community to enjoy, quality habitat for a variety of species and other ecosystem benefits.

Primary Actions		
ID	Action	Main Risk Addressed
6Sa	<b>Maintain inspections of tree canopy</b>	Loss of tree diversity and coverage
6Sb	<b>Maintain diseased tree programs</b>	Loss of tree diversity and coverage
6Sc	<b>Monitor for emerging risks (green ash bore) to facilitate early action</b>	Loss of tree diversity and coverage
8Sa	<b>Reduce mowing to improve root zone and moisture retention</b>	Health of ground cover vegetation
7Ld	Develop retention pond design guidelines so that new ponds are designed to reduce nutrient loading	Pond water quality
8L	<b>Develop a municipal wide strategy to shift ground cover to more resilient species that require less water and are hardier</b>	Health of ground cover vegetation
6L	Develop a tree replacement strategy/policy	Loss of tree diversity and coverage
7La	Reduce attractiveness of ponds to geese through vegetation management	Pond water quality
7Lb	Comprehensive goose management plan	Pond water quality
7Lc	<b>Draw nutrients out of the system by planting native vegetation in riparian zones and installing floating islands</b>	Pond water quality
7Le	<b>Identify areas that are failing and use retaining walls or other methods to combat slumping</b>	Pond water quality
6Fb	<b>Work with developers to ensure a diversity of trees are planted in new developments</b>	Loss of tree diversity and coverage

Secondary Actions		
ID	Action	Primary Vision Association
7Sb	<b>Encourage public to reduce nutrients through targeted communications</b>	Vision #2
7Sa	<b>Form pond advisory committees to educate and encourage transformative behaviours</b>	Vision #2
7Sc	<b>Encourage public to establish no-mow zones on private property</b>	Vision #2
7Sd	<b>Provide planting info to encourage switch to native species on shorelines</b>	Vision #2
8Sb	<b>Provide planting info to the public to change property plants to native species</b>	Vision #2
9Sa	<b>Provide information to private landowners with septic fields on how climate change may affect their system</b>	Vision #2
1La	<b>Land drainage study to assess capacity and gaps in response to Climate Change</b>	Vision #1

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Vision #3 Con't - Secondary Actions		
ID	Action	Primary Vision Association
1Lb	<b>Develop upgrade and mitigation plans based on results of land drainage study</b>	Vision #1
3L	<b>Replace and upgrade building components to build better standards for RM buildings</b>	Vision #1
5L	<b>Implement xeriscape landscape requirements in new developments</b>	Vision #2
9La	Provincial partnerships/grants to migrate septic field users to municipal waste water system	Vision #2
4F	Low flow fixture replacement rebate to reduce rate of increase in wastewater quantity	Vision #2
6Fa	<b>Communicate tree species options to the public</b>	Vision #2

**Appendix D**  
Actions and Climate Hazards Matrix



ID	Action	Climate Hazards								Score	
		Blizzard	Heatwave	Heavy Rain on frozen soils	High Winds/Tornados	Drought	More annual precip., longer dry spells	Longer period of frost free days	More freeze/thaw cycles		Higher winter temp.
	<b>Hazard Scores</b>	<b>57.1</b>	<b>38.8</b>	<b>46.5</b>	<b>60.9</b>	<b>43.1</b>	<b>44.8</b>	<b>35.5</b>	<b>32.2</b>	<b>44.6</b>	<b>/100</b>
2Lb	Develop municipal standards for infrastructure design and maintenance to meet demands of a changing climate <sup>1</sup>	X	X	X	X	X	X		X		35.9
<b>3L</b>	<b>Replace or upgrade municipal building components to higher standards</b>	X	X	X	X	X	X		X		35.9
1La	Land drainage study to assess capacity and gaps in response to climate change	X	X	X		X	X		X	X	34.1
1Lb	Develop drainage systems upgrade and mitigation plans based on results of land drainage studies	X	X	X		X	X		X	X	34.1
3Sa	Ongoing inspection and repair of municipal buildings	X	X	X	X		X		X		31.1
<b>6Sa</b>	<b>Maintain inspections of tree canopy</b>	X	X		X	X		X		X	31.0
10Lb	Webinar series/workshop – back up power system retrofits for private residents and commercial buildings	X	X	X	X	X			X		31.0
6L	Develop a tree replacement strategy/policy	X	X		X	X	X				27.2
2Sb	Apply high design standards to heavily used roads and paths	X		X	X	X			X		26.6
2Sa	More frequent maintenance for priority areas to maintain roads and paths	X		X	X	X			X		26.6
<b>6Sb</b>	<b>Maintain diseased tree removal and replacement programs</b>	X	X		X			X		X	26.3

<sup>1</sup> This can be achieved through several other actions such as updating development guidelines regarding stormwater and plantings with consideration for climate change (actions 5L, 6Fb, and 7Ld), developing path and roadway standards with consideration for climate change (action 2Sb), and developing vegetation standards and strategies with consideration for climate change (actions 8L and 6L)

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ID	Action	Climate Hazards								Score	
		Blizzard	Heatwave	Heavy Rain on frozen soils	High Winds/Tornados	Drought	More annual precip., longer dry spells	Longer period of frost free days	More freeze/thaw cycles		Higher winter temp.
<b>Hazard Scores</b>		<b>57.1</b>	<b>38.8</b>	<b>46.5</b>	<b>60.9</b>	<b>43.1</b>	<b>44.8</b>	<b>35.5</b>	<b>32.2</b>	<b>44.6</b>	<b>/100</b>
10La	Communications plan to relay emergency preparedness information on an annual basis and engage residents (i.e. – submit your plans for a chance to win)	X	X	X	X				X		26.2
<b>7Sa</b>	<b>Form pond advisory committees to educate and encourage transformative behaviours</b>		X	X		X	X			X	24.2
6Fa	Communicate tree species options to the public		X			X	X	X		X	23.0
7Sc	Encourage public to establish no-mow zones on private property		X	X		X	X		X		22.8
7Sd	Provide planting information to the public to support changing shoreline vegetation to native species		X	X		X	X		X		22.8
8Sb	Provide planting information to the public to shift vegetation to more resilient native species on lawns		X	X		X	X		X		22.8
4L	By-law updates and inspection to better regulate sump pump and other land drainage discharges		X	X		X	X		X		22.8
10Sa	Provide updated emergency preparedness information to public, including community news stories, social media updates, and how to prepare an emergency kit and plan	X	X	X	X						22.6
3Sb	System retrofit to Operations building to be able to use generator	X	X	X	X						22.6

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ID	Action	Climate Hazards									Score
		Blizzard	Heatwave	Heavy Rain on frozen soils	High Winds/Tornados	Drought	More annual precip., longer dry spells	Longer period of frost free days	More freeze/thaw cycles	Higher winter temp.	
Hazard Scores		57.1	38.8	46.5	60.9	43.1	44.8	35.5	32.2	44.6	/100
6Sc	Monitor for emerging risks to trees to facilitate early action	X			X			X		X	22.0
10Sb	Provide residents with winter/spring home preparedness information	X		X	X				X		21.9
8Sa	Reduce mowing to improve root zone and moisture retention		X	X		X	X				19.2
9Lb	Provincial partnerships/grants to migrate well users to municipal supply		X	X		X			X		17.8
10Fa	Grant opportunities for homeowner retrofits	X	X			X					15.5
1S	Encourage all residents to have overland flood/sewer backup insurance			X			X			X	15.1
1Lc	Targeted flood mitigation measures for at risk properties, based on land drainage studies			X			X			X	15.1
9Sb	Provide well owners with information on how climate change may affect them			X		X	X				15.0
5L	Implement xeriscape/native plant requirements in new developments		X			X	X				14.1
7Sb	Encourage public to reduce outdoor chemical fertilizer use through targeted communications		X			X	X				14.1

\* **Bolded** actions have been at least started by RM staff in some capacity

ID	Action	Climate Hazards									Score
		Blizzard	Heatwave	Heavy Rain on frozen soils	High Winds/Tornados	Drought	More annual precip., longer dry spells	Longer period of frost free days	More freeze/thaw cycles	Higher winter temp.	
<b>Hazard Scores</b>		<b>57.1</b>	<b>38.8</b>	<b>46.5</b>	<b>60.9</b>	<b>43.1</b>	<b>44.8</b>	<b>35.5</b>	<b>32.2</b>	<b>44.6</b>	<b>/100</b>
7Ld	Develop retention pond design guidelines so that new ponds are designed to reduce nutrient loading and ensure bank stability		X			X	X				14.1
8L	<b>Develop a municipal wide strategy to shift ground cover to more resilient/native species that require less water and are hardier</b>		X			X	X				14.1
7Le	<b>Identify pond banks that are failing and use retaining walls or other methods to combat slumping</b>		X	X					X		13.1
2La	Investigate alternative measures to extend life of infrastructure (i.e. micro-resurfacing)	X							X		9.9
5S	Enforcement of existing water supply by-laws, such as sprinkling during drought					X	X				9.8
6Fb	<b>Work with developers to ensure a diversity of trees are planted in new developments</b>		X			X					9.1
7Lb	Comprehensive goose management plan		X			X					9.1
7Lc	<b>Draw nutrients out of pond systems by planting native vegetation in riparian zones and installing floating islands</b>		X			X					9.1
7La	Reduce attractiveness of ponds to geese through vegetation management		X			X					9.1

\* **Bolded** actions have been at least started by RM staff in some capacity

ID	Action	Climate Hazards									Score
		Blizzard	Heatwave	Heavy Rain on frozen soils	High Winds/Tornados	Drought	More annual precip., longer dry spells	Longer period of frost free days	More freeze/thaw cycles	Higher winter temp.	
<b>Hazard Scores</b>		<b>57.1</b>	<b>38.8</b>	<b>46.5</b>	<b>60.9</b>	<b>43.1</b>	<b>44.8</b>	<b>35.5</b>	<b>32.2</b>	<b>44.6</b>	<b>/100</b>
9La	Provincial partnerships/grants to migrate septic field users to municipal waste water system			X					X		8.8
<b>9Sa</b>	<b>Provide septic field owners with information on how climate change may affect them</b>						X		X		8.6
4F	Low flow fixture replacement rebate to reduce rate of increase in water use and wastewater generation					X					4.8
7F	Look for funding opportunities to support actions (i.e. FCM Storm Water Quality grant, Lake Winnipeg Basin grants, Conservation Trust grants)										None, but important for other actions
10Fb	Community resilience survey to assess compliance and understanding										

\* **Bolded** actions have been at least started by RM staff in some capacity