Climate Change Adaptation Plan 2021-2026

Plan Summary

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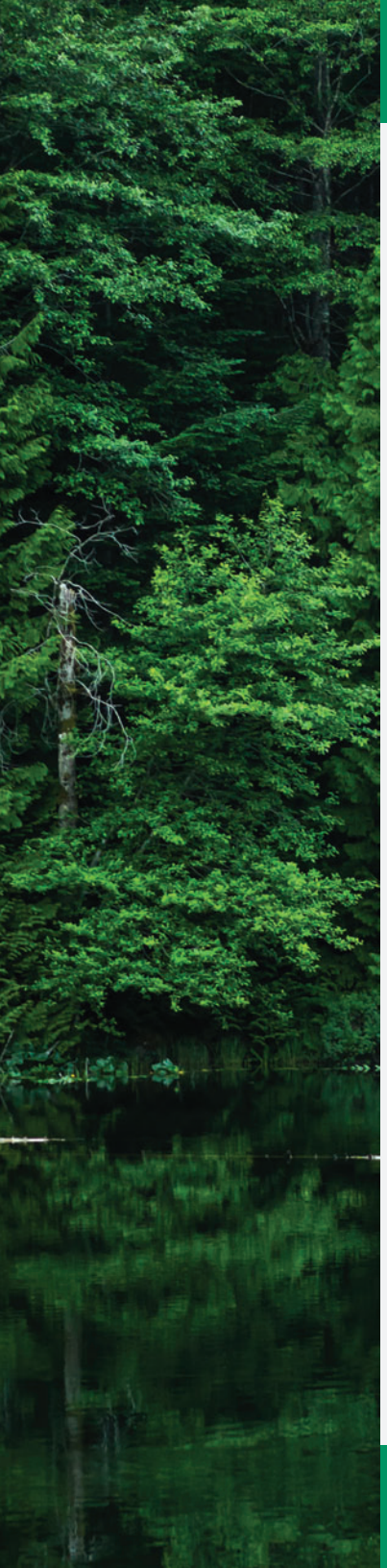


Why a Climate Change Adaptation Plan?

The development of this plan stems first and foremost from the Municipality of Chelsea's desire to adapt to the effects that climate change may have on its municipal services and infrastructures. It was achieved through the Municipality's membership in the Federation of Canadian municipalities (FCM) with the Municipalities for Climate innovation program.

In recent years, Chelsea's territory has seen an increase in climatic events that have caused a great deal of damage, sometimes requiring the implementation of emergency measures. Increasingly frequent heavy rains and floods have made de Municipality aware of the vulnerability of its rainwater management infrastructures and desires to be better prepared for the potential consequences of climate change.

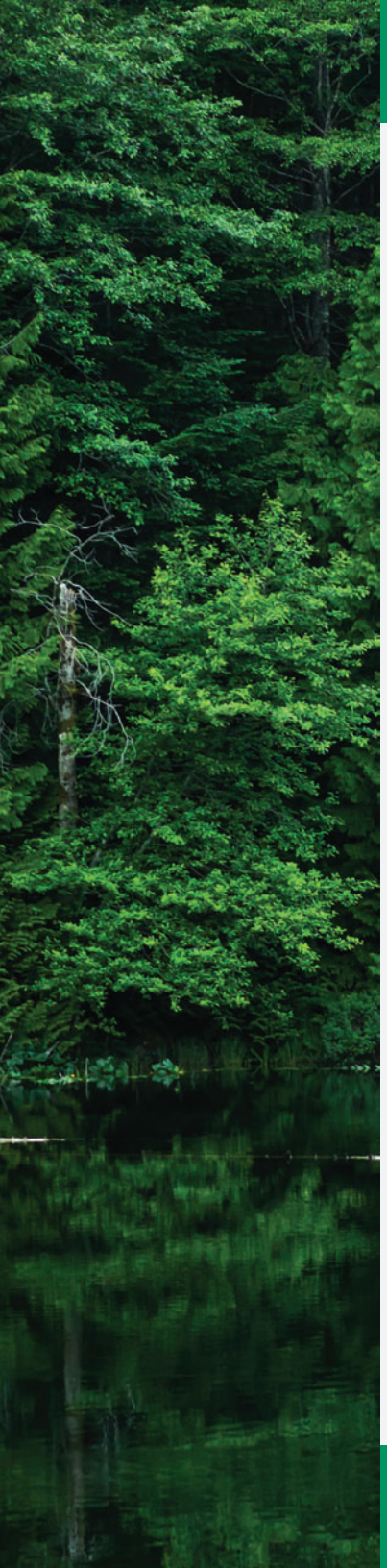
The objective of the Adaptation Plan is to guide the Municipality towards implementing operational and institutional changes that will ensure long-term adaptation to climate change by integrating climate factors into decision-making processes for the built, social, and environmental system. The Municipality wants to reduce the risks associated with specific issues, including the vulnerability of its rainwater management infrastructure to flooding and increasingly frequent torrential rain events.

Vision

The Municipality of Chelsea wants to be aware of the changes in its environment, accentuated by climate change, and to be able to continuously adapt to them by applying the necessary measures and monitoring to ensure the safety of its residents and the protection of its ecosystems in the face of projected climate events.

Plans and policies related to climate change

Over the years, the Municipality of Chelsea had become aware of the importance of environmental and climate change issues and has included them in its land use planning and municipal bylaws. The Municipality's desire to protect its biodiversity, its green spaces and its drinking water aquifer has led to the creation and adjustment of certain bylaws, such as the establishment of wetlands and watercourses protection strips, a tree cutting bylaw, a bylaw protecting the aquifer, etc. These values have also allowed the creation of certain policies and action plans, which also mention, directly and indirectly, climate change.



1 Master Plan

The vision of the Master Plan 635-05 is centered on the development of the territory and the quality of life of residents in the long term, including the principles of sustainable development. In this Plan, the environment and its protection are primary concerns for the Municipality, and it is according to them that the major development orientations are established. More specifically, development orientation number 2 provided for principles and actions to implement adaptation to climate change. The Master Plan also includes and Environmental Plan.

2 Environmental Plan

The Environmental Plan, which is part of the Master Plan 635-05, includes the principles of sustainable development and adaptation to climate change, as well as environmental issues and objectives. The issues that have been identified are water, natural and forest environments, residual materials, and climate change.

The current revision of the Master Plan and the planning bylaws will allow for the integration of the adaptation measures proposed in the Climate Change Adaption Plan 2021-2026.

3 Active Transportation Master Plan

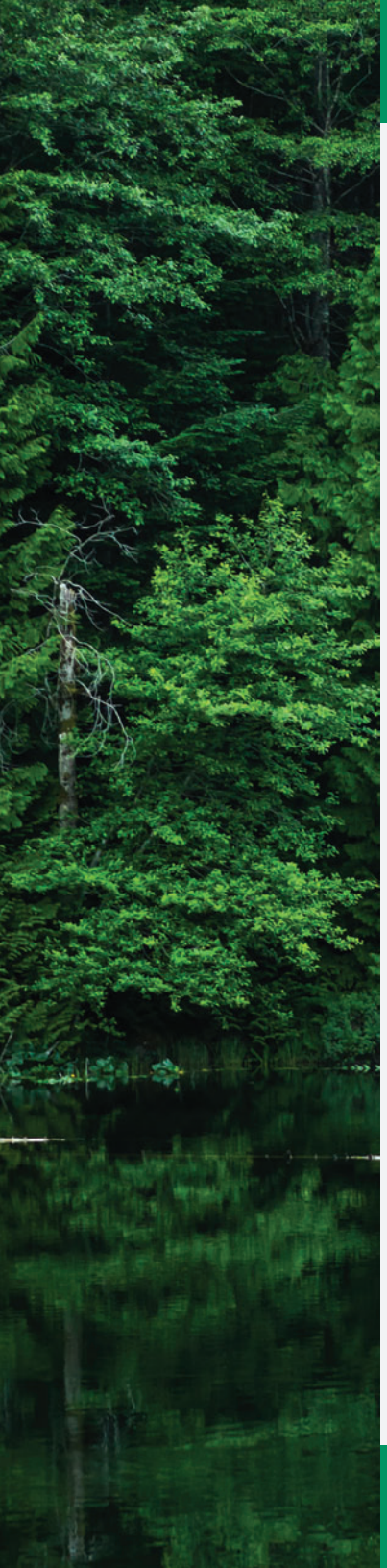
The purpose of the 2021 Active Transportation Master Plan is to support the Municipality in the development of an active transportation network, both recreational and utilitarian, to encourage healthy lifestyles and thus improve the quality of life of residents. With this Plan, the Municipality of Chelsea encourages residents to use active transportation as an alternative to the automobile for their utilitarian travels. This increase in non-motorized travel will contribute to reduce greenhouse gas emissions on the territory.

4 Sustainable Development Action Plan

The vision of the Sustainable Development Action Plan 2018-2021 focuses on innovation in sustainable development and on engaging the community in the change management process. With this Plan, the Municipality of Chelsea presents its environmental awareness to its population in a concrete way. An update of the Plan is planned for 2021, which will include the proposed measures of the Climate Change Adaptation Plan 2021-2026.

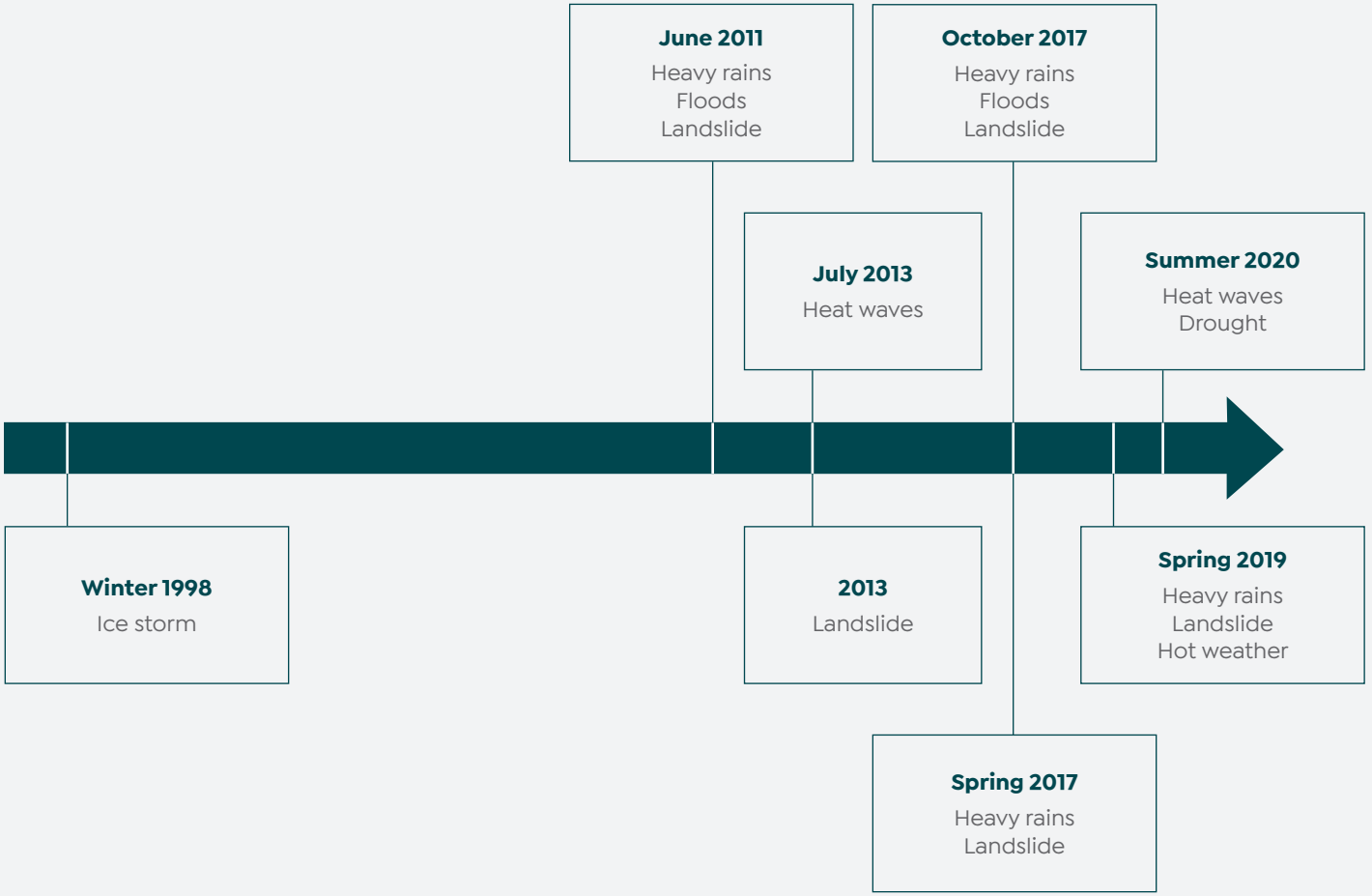
5 Climate Change Adaptation Plan

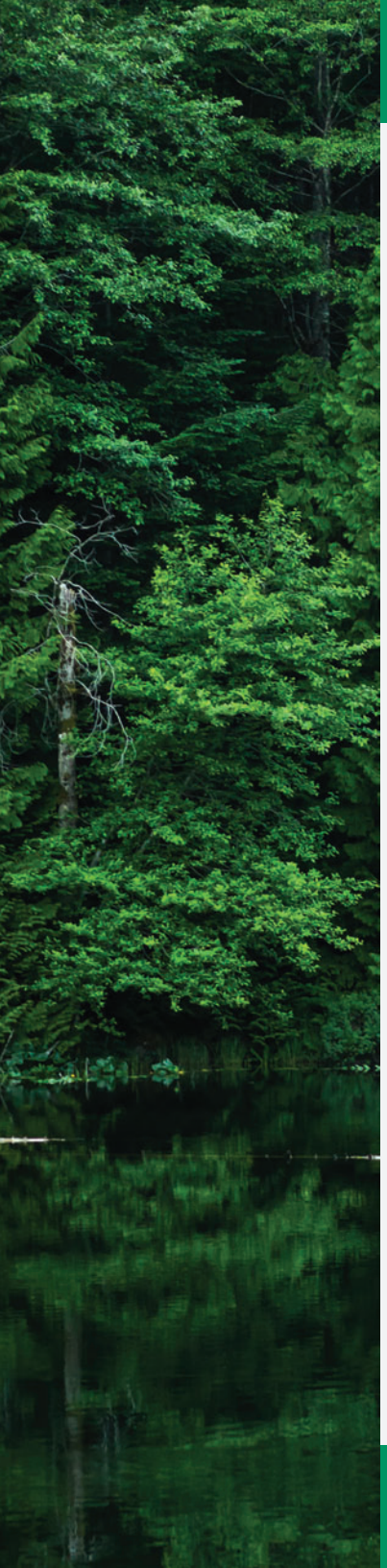
Finally, the main objective of the Climate Change Adaptation Plan 2021-2026 is to offer solutions to the main risks affecting the territory of the municipality, by integrating the principles of climate change into decision-making processes.



Portrait of the current situation

The current climate can have several influences, both positive and negative, on natural and urbanized environments. The climatic events of recent years have changed the way the Municipality responds and adapts to them. The effects of climate affect buildings, infrastructures, municipal services, and the environment. These climatic events are a good indication of what the Municipality of Chelsea can expect in the future. The territory could see these events intensify according to the defined climate projections. Here are some of the most significant weather events in Chelsea in recent years.





Climate projections for Chelsea

With the rising greenhouse gas concentrations, the climatic consequences vary from place to place, but affect both urbanized and natural environments. Climate trends in the coming years are already the subject of several international studies, including those of the Intergovernmental Panel on Climate Change (IPCC). The projections are all similar, ranging from an evolution of the intensity to the frequency of extreme climatic events. Global warming, being one of the elements at the basis of climate change, will influence future risks by its rate, its maximum intensity, and its duration of warming. Here are the climate projections for the Municipality of Chelsea.

Temperatures

Compared to past data (1976-2005), the territory of Chelsea will experience by 2050:

- An increase of 14.5 days at +30 °C
- Almost 3 times more heat waves
- An increase of 2.3 °C of the warmest maximum temperature
- An increase of 2.2 °C in average seasonal temperatures

- An increase of 3.8 °C of the coldest maximum temperature
- A decrease of 21.7 days of frost
- A decrease of 2.6 days at -30 °C

Precipitations

Compared to past data (1976-2005), the territory of Chelsea will experience by 2050:

- An increase of 61 mm of rain/snow annually

Extreme events

The territory of Chelsea will also experience an increase in the following **combinations** of weather events:

Freeze/thaw cycles

Larger variations in freeze/thaw cycles

Storms

More frquent storms, lighting and thunderstorms

Ice and hail

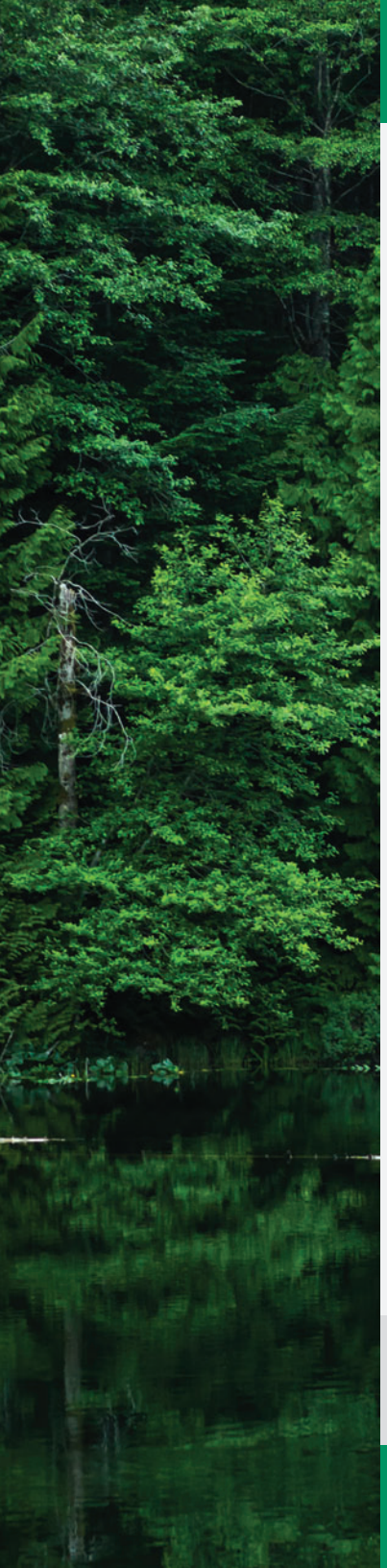
More intense and frequent ice and hail events

Modified wind regime

Possible reduction in average wind speeds and increase in periods of high winds

In summary

These projections show that, on the territory of the Municipality of Chelsea, summers will be hotter and drier, winters will be milder, annual precipitations will increase in intensity and frequency and extreme weather events will become more frequent.



Impacts of climate change on the territory

To assess the impacts of climate change affecting or potentially affecting the territory of the Municipality of Chelsea, it is necessary to first determine the risks related to the three priority meteorological elements, i.e., the increase in average temperatures, the increase in precipitation and the extreme climatic events. These were established based on the evaluation of climatic events in recent years on the territory as well as future climate projections.

These three meteorological elements were then subdivided into climatic hazards, which will be evaluated according to their probability and severity. The climatic hazards selected are the following:

Increase in average temperatures

- Heat waves
- Droughts
- Winter thaw

Increase in precipitation

- Heavy rains
- Snow storm

Extreme climatic events

- Storms, lightning and thunderstorms
- Strong winds and tornadoes
- Hail and ice storms

To produce a comprehensive study and assessment of climate hazards in Chelsea, all municipal departments were consulted and the risks for each of these hazards were assessed under three systems:

Built system

- Buildings
- Transportation infrastructures and roads
- Drinking water supply system
- Rainwater and wastewater collection system

Social system

- Municipal services
- Public health
- Quality of life

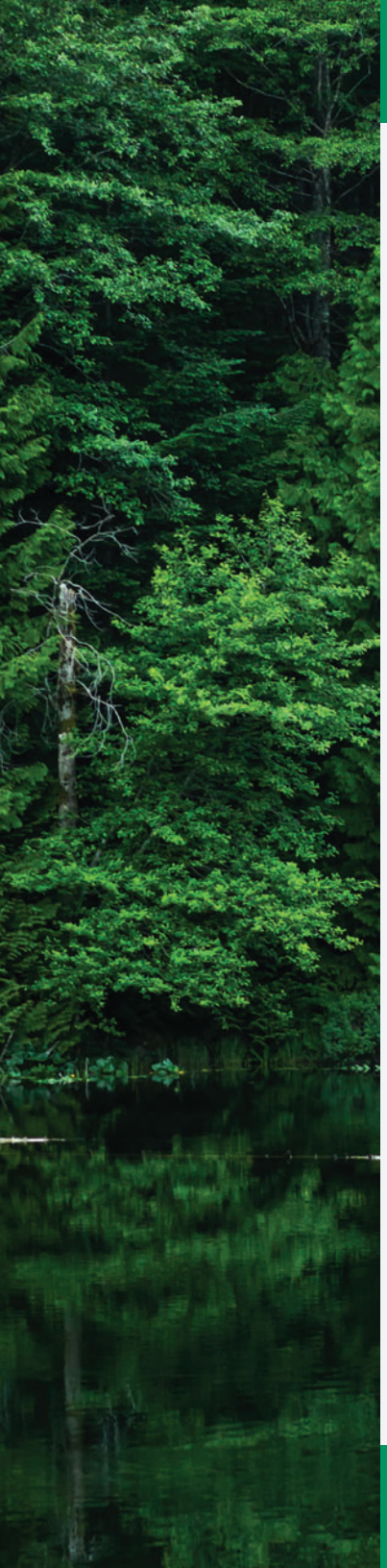
Environmental system

- Water and soil
- Fauna and flora

The assessment of climate hazards' risks on each system showed that heat waves and droughts events would affect Chelsea's territory the most. Therefore, the increase in temperatures hazard is considered a medium-high risk for the Municipality. The increase in precipitation and the extreme events will also have several impacts, however, these were determined to be medium risks.

To see the detailed impacts of climate change on the three systems, click on one of the following rectangles:

Inscrease in temperatures	Increase in precipitation	Extreme climatic events



Adaptation measures

The risks assessment is an important step in determining the priority adaptation actions to be implemented within the Municipality. For Chelsea, 39 adaptation measures were determined according to the climate risk assigned. They are presented in the form of fact sheets including a summary of the action, an estimate of the costs and timetable, the responsible department(s), as well as actions and monitoring indicators for their implementation.

Several of the monitoring indicators require feasibility studies. These studies would determine the proper costs and benefits of actions for each measure. Investing in climate adaptation remains less costly than repairing the damage once the event has passes.

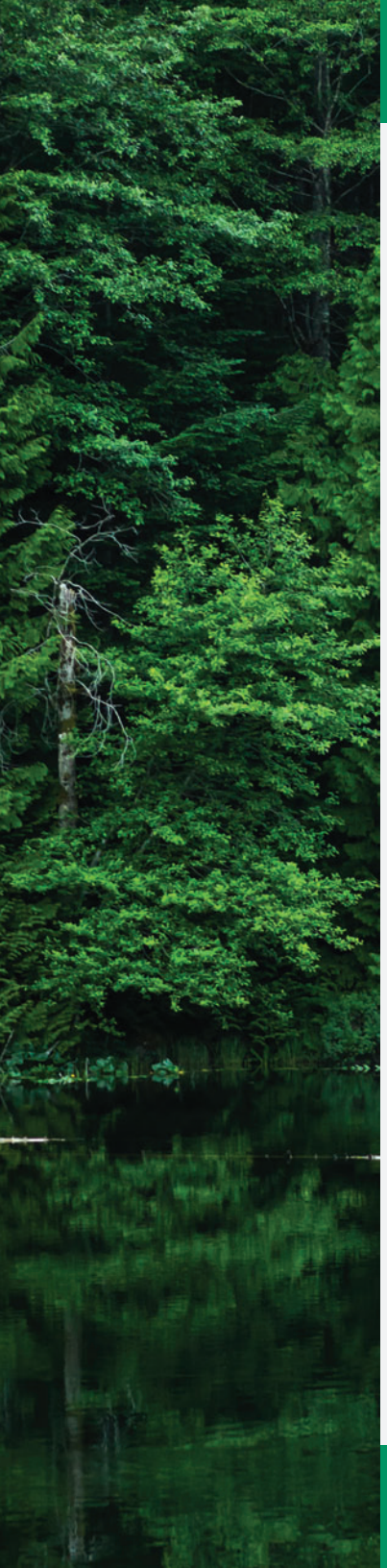
As the results of the risk assessment show, rising temperatures are a particularly high risk for the Municipality of Chelsea. Therefore, there are more adaptation measures for the hazards. Of course, this does not mean that other measures, which are equally important, should be neglected.

All municipal departments are affected by these adaptation measures. However, the Planning and Sustainable Development Department is the most affected, with 43% of the measures attributed to it, followed by the Publics Works and Infrastructures Department, with 21%.

The following table provides a summary of the 39 adaptation measures.

Increase in temperatures

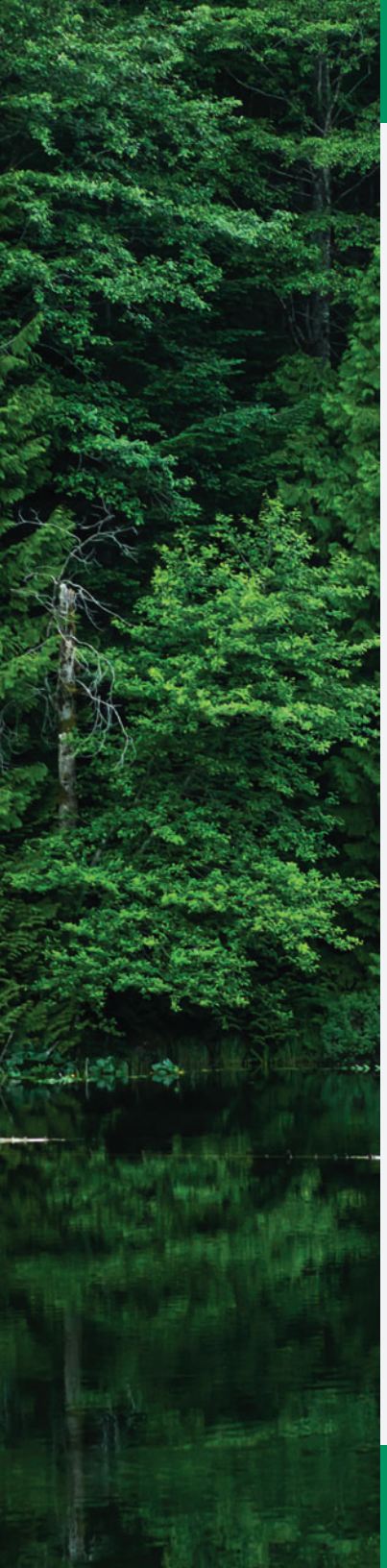
1.1	Awareness program for heat waves and extreme heat events	Communications
1.2	Adapting work contracts to extreme temperatures	Human resources
1.3	Adapting municipal social, cultural, and sporting events	Recreation
1.4	Provide access to refreshment facilities	Recreation Publics Works and Infrastructures
1.5	Enhancement of green infrastructures on Chelsea's territory	Publics Works and Infrastructures Planning and sustainable development
1.6	Maintain green spaces, sports fields and parks and adapt them to extreme temperature variations	Publics Works and Infrastructures Planning and sustainable development
1.7	Greening of parking areas	Publics Works and Infrastructures Planning and sustainable development



1.8	Increase the resilience of infrastructures to the freeze-thaw cycles	Publics Works and Infrastructures Planning and sustainable development
1.9	Create an action pan to adapt the municipality to high summer temperatures	Recreation Planning and sustainable development
1.10	Adopting the use of high solar reflectance materials in new construction	Planning and sustainable development
1.11	Update the Golder report on Chelsea's aquifer	Planning and sustainable development
1.12	Increase and preserve the vegetation cover on the municipal territory	Planning and sustainable development
1.13	Fight against invasive exotic species	Publics Works and Infrastructures Planning and sustainable development
1.14	Installation of washing stations for watercrafts	Publics Works and Infrastructures Planning and sustainable development
1.15	Retain or collect rainwater	Planning and sustainable development
1.16	Ensuring water quality and quantity	Planning and sustainable development

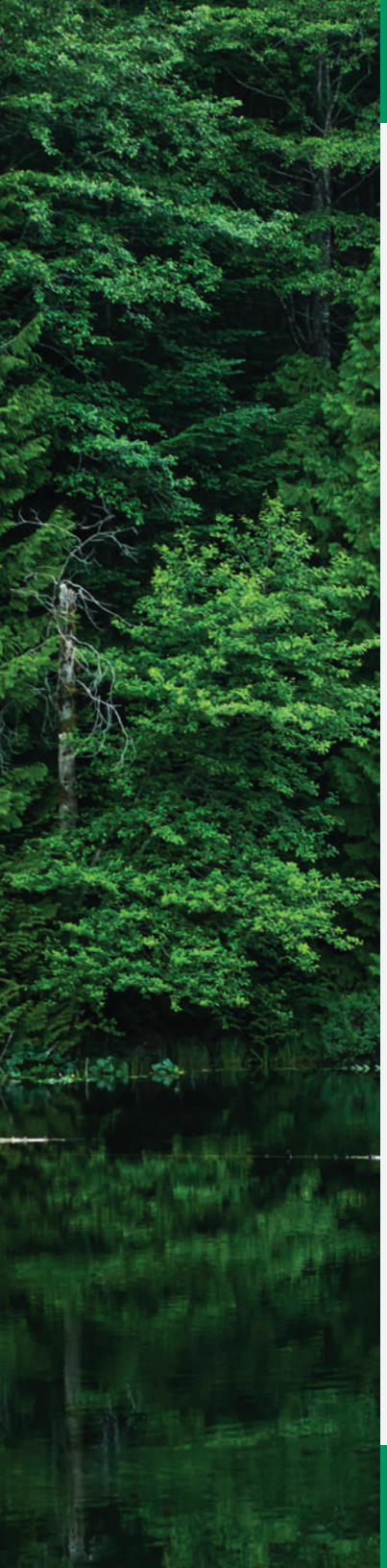
Increase in precipitation

2.1	Inventory and assess the condition of all culverts	Publics Works and Infrastructures
2.2	Update the culvert inventory database and ensure preventive maintenance	Publics Works and Infrastructures
2.3	Modifications in operational practices for snow removal and winter maintenance of roadways	Publics Works and Infrastructures
2.4	Shoreline inspections program	Planning and sustainable development
2.5	Adapting construction methods and materials to address mould in municipal buildings	Planning and sustainable development



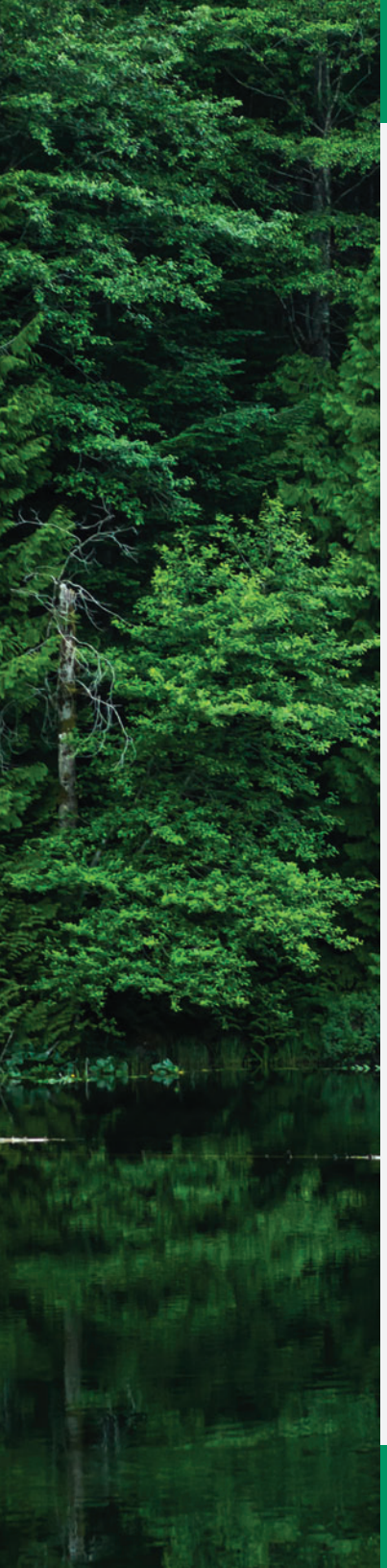
The three climatic events combined

3.1	Develop services and applications for smartphones	Communications
3.2	Develop a comprehensive communications plan to disseminate relevant information on climate change	Communications
3.3	Maintenance and adaptation of infrastructures	Publics Works and Infrastructures
3.4	Purchase equipment to counter bad weather during municipal events	Recreation
3.5	Raising awareness of the effects of climate change in the tourism and business community	Recreation Communications
3.6	Revision of the Master Plan and bylaws taking into consideration the precautionary principles and the effects of climate change	Planning and sustainable development
3.7	Educate internal political staff and City Council on the effects of climate change	Administration
3.8	Include climate change risks in the Civil Protection Plan	Fire department
3.9	Installation of generators in municipal buildings in case of power failure	Fire department
3.10	Establishing a climate change awareness and training program for the municipal staff	Human resources
3.11	Management of an environmental and climate change reserve fund	Finance



Sustainable adaptation to climate change

4.1	Electrify the municipal fleet	Publics Works and Infrastructures Planning and sustainable development
4.2	Encourage the establishment of collective gardens	Recreation
4.3	Conduct an inventory of municipality's GHG emissions	Planning and sustainable development
4.4	Participate in the fight against smog	Planning and sustainable development Communications
4.5	Realize the actions identified in the Water Master Plan and the Regional Wetland and Water Plan	Planning and sustainable development
4.6	Preventive tree maintenance	Publics Works and Infrastructures Planning and sustainable development
4.7	Realize the actions planned in the SDAP	Planning and sustainable development



Detailed impacts

Increase in temperatures

Impacts of heat waves, droughts and winter thaws:

On the built system

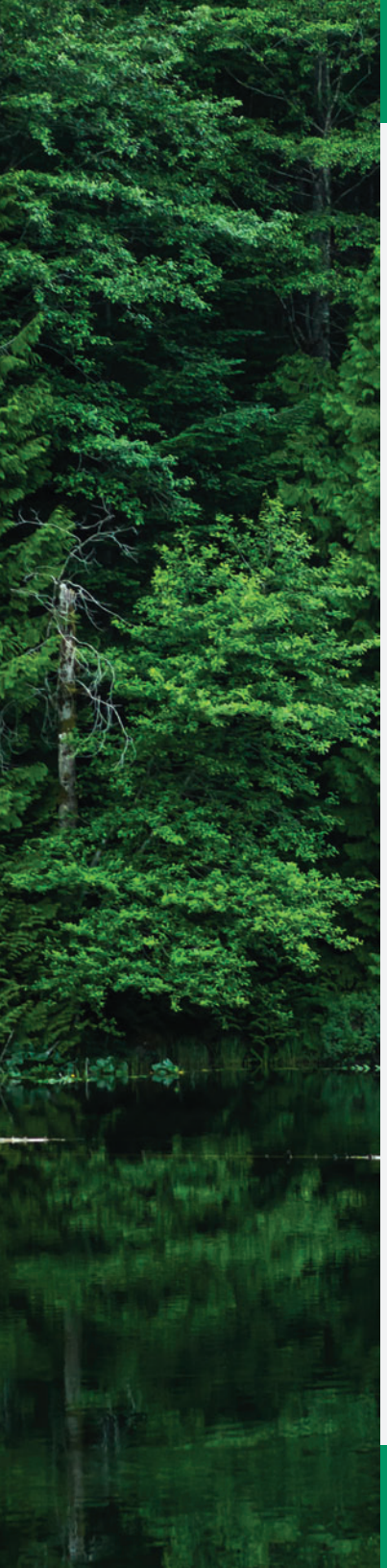
- Requires optimal insulation of buildings with adequate air conditioning. Good insulation maximizes the effect of air conditioning systems in buildings and avoids their overuse during hot periods.
- Increases drought events, which has a direct impact on the availability of drinking water, the aquifer and, therefore, the drilled wells of citizens. Wetlands, aquatic environments, and the aquifer are at risk of drying up.
- Accentuates the freeze/thaw cycles in winter which damages the roadway, infrastructure, and culverts.

On the social system

- Has a considerable impact on people with respiratory or cardiovascular problems and vulnerable individuals such as children and the elderly. This has a direct effect on population mortality and social and mental stress.
- Leads to a migration of species to the north, some of which carry diseases, such as Lyme disease, which is increasingly present in the territory.
- Affects the well-being of the citizens and increases the need for additional facilities to provide refreshment and shade for social, cultural and sports events offered by the Municipality and the Gatineau Park tourism.
- Normally snowy precipitation is watery, which affects recreational events. Snow accumulation is reduced.
- Potentially increases demand for emergency services. People at risk will require more assistance, which may reduce the effectiveness of firsts responders if the demand is too high.
- Parks and green spaces may suffer from heat wave and droughts events.
- Brings discomfort due to odours from waste materials.

On the environmental system

- Enables warmer environments and, therefore, more favorable to the fast growth of invasive exotic species, both animal and plant, which interfere with the growth of native species.
- Dries out vegetation and affects wildlife, which may have to move outside their home area to feed and hydrate.
- Increases freeze/thaw cycles in soils, which can weaken them and create more landslides.
- After some winter thaws, the temperature can cool down again, affecting vegetation and destroying some types of plants.
- Winter thaws in the spring encourage early growth of invasive exotic plants that will spread their roots into the space of native plants. Invasive insect species may also begin breeding earlier in the spring and attack native plants and other species earlier in their growth.



Increase in precipitation

Impacts of heavy rains and snowstorms:

On the built system

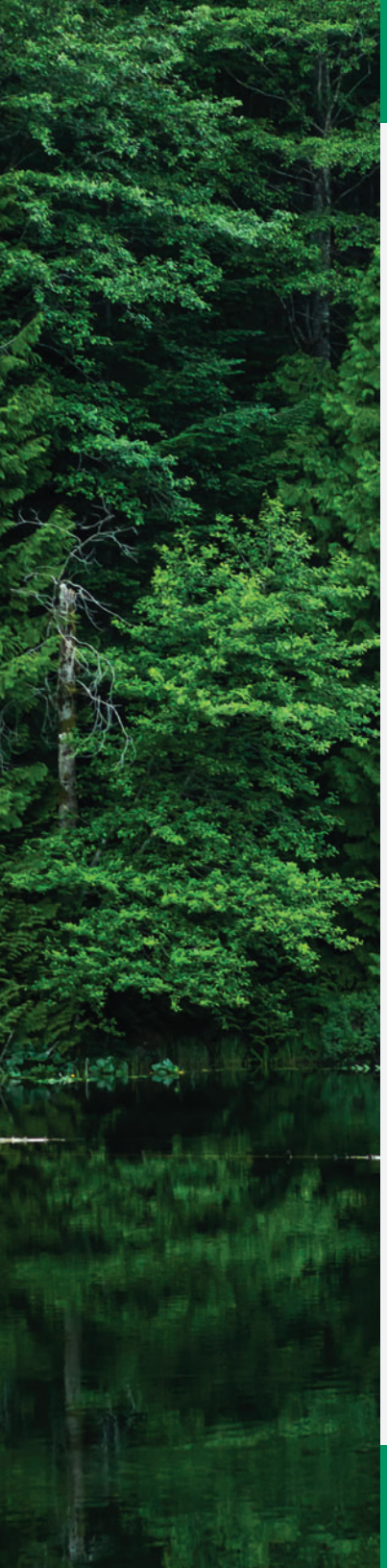
- Affects the structural capacity and capability of building roofs which will be weakened by water loads from intense precipitation and snow accumulation during storms.
- Brings larger loads of water to drinking water treatment systems including urban or industrial pollutants from urban runoff and organic compounds.
- Increases runoff, which reduces the amount of water infiltrated into the soil and therefore into the aquifer. This reduces the capacity to recharge the aquifer, which supplies citizens with drinking water through drilled wells.
- Causes sewer overflows, flooding from under capacity culverts and untreated water overflows.
- Increases maintenance due to large amounts of snowfall that damages roads more quickly than normal.
- Causes the rapid accumulation of snow that is pushed form roadways into ditches by snow removal trucks. When this snow melts, culverts, ditches, and water treatment systems can become saturated with water and do not have the capacity to retain or treat the excessive water load. This also applies to the Hollow Glen Dam.

On the social system

- Rain that mixes with snow becomes heavier, which can affect the effectiveness of snow removal methods.
- Affects visibility on roads.
- Affects the efficiency of waste collection operations, increasing the risk of waste dispersion on private properties and public roads.
- May create travel stress and property damage due to landslides or flooding resulting from intense rains, and power outages.
- Affects the travels of citizens by motor vehicle, bicycle, and on foot.
- Cancellation or postponement of social, cultural and sport activities offered by the Municipality.
- Affects roads by creating water accumulations, which can make them dangerous and impassable.
- Increases demand on emergency services. Response time could be impacted.
- Affects waste collection. Snow causes delays in the collection service and makes it more difficult for households to access their garbage cans.
- Causes a much higher workloads which may require more manpower and resources for snow removal and disposal. Response time for snow removal employees could be impacted by heavy snowfall.
- Reduces roadway capacity and visibility for drivers, including snowplows, which will cause roadway slowdowns.

On the environmental system

- Alters water quality by carrying pollutants into streams during snowmelt and intense precipitation events.
- Increases river and lake bank erosion and water runoff once soils are saturated with water, resulting in more frequent landslides.
- Causes water saturation of the soils, which can lead to a lack of oxygenation and make the vegetation vulnerable.



- Some invasive species can survive in large amounts of water where native species cannot, causing the invasive plant to grow at the expense of the native plant.
- Promotes the creation of wetlands, which can increase the proliferation and hatching of insects in new environment.
- Heavy snowfall will raise water levels in streams and lakes, which may make flood-prone areas vulnerable as well as the amount of water.

Extreme climatic events

Impacts of storms, lightning, thunderstorms, high winds, tornadoes, hail and ice storms:

On the built system

- Causes disturbances, electrical failures in the infrastructure and telecommunication services.
- Causes breakage and damage to infrastructure.

On the social system

- Causes social and mental stress for some citizens affected by power outages, damage to personal property, their own safety, and the safety of their loved ones, as well as fear of other weather events that may occur at the same time.
- Causes damage to citizens' personal property.
- Affects travels on roads, both for vehicles and active modes of transportation.
- Cancellation of social, cultural and sport activities.
- Causes higher demand for emergency services due to breakdowns, power outages or even forest fires caused by lightning storms during drought episodes.
- Green spaces and parks can be impacted by strong winds or tornadoes in terms of infrastructure and vegetation that can be damaged.

On the environmental system

- Vegetation and forests are at risk of damage or fire, especially during drought events.
- Increases bank erosions due to high winds.
- Damage to trees that can cause power outages to citizens.

environnement@chelsea.ca
819 827-6227