Municipality of Clarington **2021**

Corporate Climate **Action Plan**

Clarington

The preparation of this plan was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

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Executive Summary

The climate is changing. According to *Canada's Changing Climate Report* (2019), Canada is warming at almost double the global average rate. In Clarington, climate changes will include weather that is warmer and wetter, with larger and more frequent storms. Climate change will increasingly impact Clarington residents, infrastructure, municipal operations and the economy. The scale to which Clarington is impacted will depend on the actions that the Municipality takes now. Strengthening local action on climate change is an important step by the Municipality of Clarington to enhance the Municipality's longstanding commitment to sustainable development.

The Clarington Corporate Climate Action Plan takes a dual approach in responding to the causes and impacts of climate change:

1) Adaptation components of this plan focus on preparing the Municipality for the impacts of climate change. By preparing for future climate conditions, the Municipality will lessen the negative impacts that climate change will have on municipal operations, the provision of services, residents and the local economy.

2) Mitigation components of this plan focus on decreasing the severity of future climate change impacts by reducing greenhouse gas (GHG) emissions that are contributing to climate change. By doing its part to reduce GHG emissions, the Municipality can help to slow climate change and limit its negative impacts.

This plan contains 115 specific actions that the Municipality will take to reduce GHG emissions, and adapt corporate assets, operations, and services, to limit the negative impacts of climate change. All actions contained in this plan are achievable and within the control of the Municipality.

The adaptation elements of this plan have been guided by the International Council for Local Environmental Initiatives (ICLEI Canada) Building Adaptive & Resilient Communities (BARC) five-milestone framework. BARC milestones include: 1) Initiating; 2) research; 3) planning; 4) implementation and 5) monitoring and review.

The mitigation elements of this plan were guided by the ICLEI Canada Partners for Climate Protection (PCP) program. The PCP program consists of a five-milestone framework to guide the Municipality to reduce GHG emissions. Milestones include: 1) Creating a baseline emissions inventory and forecast; 2) setting emissions reduction targets; 3) developing and action plan; 4) implementing the action plan and 5) monitoring progress and reporting on the results of action implementation.

Over 70 staff from all Municipal departments contributed to the development of this plan. An Interdepartmental Climate Change Working Group (ICCWG) met monthly to guide the development of the plan. Staff from all departments participated in workshops to assess climate change risks to the Municipality, identify and prioritize actions to

reduce climate risks and corporate GHG emissions, and prioritize and finalize all elements of this plan. Senior management reviewed and provided input to ensure climate actions align with corporate strategies and resources.

Using the most up-to-date climate projections, staff participated in a workshop to identify potential climate change risks to the Municipality. A total of 199 risks were identified. From the identified risks, staff participated in a second workshop to rank climate risks based on the likelihood and severity of consequences to the Municipality. Using prioritized risks, staff from all departments participated in a series of workshops to identify and prioritize actions that the Municipality will take to limit climate risks. Included in this plan are 80 climate adaptation actions.

Staff from all departments also participated in workshops to identify and prioritize a list of actions to reduce corporate GHG emissions. All proposed actions had to be within municipal control, attainable, and contribute significantly to GHG emissions reductions. 35 mitigation actions are included in this plan.

The Intergovernmental Panel on Climate Change (IPCC) has determined that global GHG emissions must be reduced significantly to avoid catastrophic climate change (2018). By establishing corporate GHG reduction targets and adopting practices that reduce GHG emissions, the Municipality is doing its part to slow climate change while saving operating and energy costs.

To achieve Milestone 2 of the PCP program, this plan sets a target to **reduce corporate GHG emissions by 35 per cent by 2030 from 2018 levels, and to achieve net zero GHG emissions by 2050.** These targets align with targets established by the IPCC, The Federal Government of Canada, the Provincial Government of Ontario and the Region of Durham. Emissions reduction targets will be achieved through the implementation of the actions outlined in this plan and in the 2019 Clarington Energy Conservation and Demand Management Plan.

In total, this plan includes 115 actions that the Municipality will take to respond to climate change. All actions are categorized into seven goals that have been prioritized through the climate action planning process. Goals include:

1) *Reduce Corporate GHG Emissions*
2) *Maintain Public and Workplace Health and Safety*
3) *Minimize Risks to Buildings and Properties*
4) *Strengthen the Resilience of Municipal Infrastructure*
5) *Protect Ecosystems and Biodiversity*
6) *Minimize disruption to corporate operations and services*
7) *Build Community Resilience*

An implementation schedule was developed for this plan to inform the overall implementation of the climate actions in this plan (Appendix C). The schedule broadly

outlines lead and supporting departments, associated municipal policies and plans, duration of each action, level of effort, and estimated resources needed for implementation. A comprehensive climate action implementation guide, with action-specific project plans, will be developed as a companion to this plan. Action-specific plans will highlight key responsibilities, supporting tasks, co-benefits, timelines, financial projections, and key performance indicators (KPIs) for each action.

The CCCAP is a long-term initiative that will require engagement across all departments over several years to succeed. Ongoing support from Council will be essential to ensure that implementation of this plan maintains momentum. Some actions contained in this plan will also require capital investments to be successful. Funding requirements for specific climate actions will be integrated into the annual municipal budget cycle. Staff will work to capitalize on funding opportunities as they become available from sources outside of the Municipality.

By implementing this corporate climate action plan, the Municipality of Clarington is fulfilling its responsibility to work in the community's best interests. The knowledge contained in this plan will enable the Municipality to make informed decisions to prioritize actions to limit GHG emissions that are contributing to climate change and minimize the impacts that climate change will have on the Municipality. By implementing this plan, the Municipality will take climate change into consideration as part of ongoing municipal operations and work to ensure Clarington remains a safe, healthy and economically prosperous place to live.

Message from the Mayor

The Municipality of Clarington has created this corporate climate action plan to guide our efforts to limit the negative impacts of climate change, protect the wellbeing of staff, residents and businesses, and continue to provide high quality services to the community.

We know that the best defense against climate change is a good offence, which is why we are acting now. The vision, goals, and actions contained in this plan will guide the Municipality's efforts to respond to climate change. By implementing the actions contained in this plan, Clarington will reduce corporate GHG emissions contributing to climate change, reduce energy consumption and expenses, and ensure the Municipality is ready for future climate conditions.

As our community continues to grow, the Municipality remains dedicated to protecting the health and wellbeing of residents. By acting on climate change, we will continue to ensure Clarington is a safe, healthy and economically prosperous place to call home.

Adrian Foster
Mayor of the Municipality of Clarington

Message from the CAO

Our municipality provides services that ensure our community is safe, healthy, clean and prosperous. When extreme weather happens, the Municipality is called upon to protect the wellbeing of residents, while ensuring the safety of staff.

Evidence shows that climate change in Clarington will result in more extreme weather, which has the potential to disrupt Municipal operations and services and place residents, staff and property at risk.

Our municipality must adapt to the changing climate to ensure we are serving the community in the best way possible. This climate action plan is a corporate-wide initiative that will guide our municipality to reduce GHG emissions causing climate change and become resilient to extreme weather. As all departments implement the proactive actions contained in this plan, we will do our part to continue to serve the community and ensure Clarington remains safe, healthy, clean and prosperous.

Andrew Allison
Chief Administrative Officer of the Municipality of Clarington

Indigenous Land Acknowledgement

The Municipality of Clarington is situated within the traditional and treaty territory of the Mississaugas and Chippewas of the Anishinabeg, known today as the Williams Treaties First Nations. Our work on these lands acknowledges their resilience and their longstanding contributions to the area now known as the Municipality of Clarington.

Acknowledgements

Thank you to everyone who participated in the development of this Corporate climate action plan. Strong leadership from Municipal Council and staff is advancing the Municipality's response to climate change. The valuable knowledge and experience of the Ontario Climate Consortium (OCC) and municipal staff was essential to creating this plan. This work was made possible by a grant from the Federation of Canadian Municipalities (FCM) as part of the Municipal Climate Innovation Program (MCIP).

An Interdepartmental Climate Change Working Group (ICCWG), consisting of 18 representatives from all departments, provided expert guidance on all aspects of the development of this plan. Over 70 staff members from all departments participated in multiple workshops to identify and prioritize actions to respond to climate change. Input from workshop participants ensured that all actions contained in this plan are practical, implementable and specific to Clarington. Please see Appendix A for a list of staff participants.

Introduction

The Municipality of Clarington, like other municipalities in Ontario, will be impacted by climate change. This Clarington Corporate Climate Action Plan is the product of a collaborative effort to identify and provide practical solutions to the risks and challenges that climate change poses to the Municipality of Clarington. Contained in this plan are 115 specific actions for the Municipality to take to reduce GHG emissions, and adapt corporate assets, operations and services to limit the negative impact of climate change. By implementing the actions contained in this plan, the Municipality is taking a proactive approach to combat climate change and minimize its impacts on our municipality. By acting on climate change, the Municipality is working to ensure that Clarington is a safe, harmonious and prosperous place to live for the foreseeable future.

Clarington's Commitment to Climate Change

The World Health Organization has described climate change as the greatest challenge of the 21st century (2015). Climate change has the potential to negatively impact global and local economies, expose people to new health and security threats, and alter the natural systems that we depend on for food and clean air and water (IPCC, 2018). Municipal governments, given their role in planning and organizing communities, are uniquely positioned to act on climate change. By endorsing and implementing this plan, the Municipality of Clarington is demonstrating its commitment to minimize the negative impacts of climate change. In addition to the development of this plan the Municipality has taken steps to respond to climate change:

Since 2012, the Municipality has distributed over 7,000 saplings to rural residents through the Trees for Rural Roads Program, restoring Clarington's tree canopy cover and wildlife habitat, recreating the historical landscape of tree-lined roadways and offsetting carbon emissions.

Since 2016 Clarington has partnered with the Region of Durham, Durham area municipalities and other stakeholders to develop the Durham Community Climate Adaptation Plan (DCCAP) and the Durham Community Energy Plan (DCEP). The DCCAP and DCEP contain actions to help the community prepare for climate change, reduce community GHG emissions and increase energy independence while promoting local economic development. Implementation of these plans is being led by the Region of Durham with support provided by the area municipalities, utilities, conservation authorities, and other community partners.

In early 2018 the Municipality established the Priority Green Clarington initiative, which included a framework for sustainable residential developments and a household water and energy efficient demonstration project.

In late 2019, the Municipality released the *Clarington Energy Conservation and Demand Management Plan 2019-2024 (ECDM plan)*. The ECDM plan identifies actions that the

Municipality will take to conserve energy, reduce GHG emissions and save money in Municipal buildings. Also, the Municipality tracks energy consumption and costs on an ongoing basis to identify ways to reduce energy consumption and GHG emissions.

In February 2020, Council passed a motion to prioritize the use of low emissions vehicles in the municipal fleet, reducing corporate GHG emissions that contribute to climate change.

In February 2020, the Municipality joined the ICLEI Canada PCP program. By participating in the PCP program, Clarington is part of a network of over 350 municipal governments committed to reducing GHG emissions that are causing climate change.

In March 2020, the Municipality joined over 400 Canadian municipalities and 1,300 local governments by declaring a climate emergency. By declaring a climate emergency, the Municipality acknowledges its leadership role in responding to climate change by reducing GHG emissions.

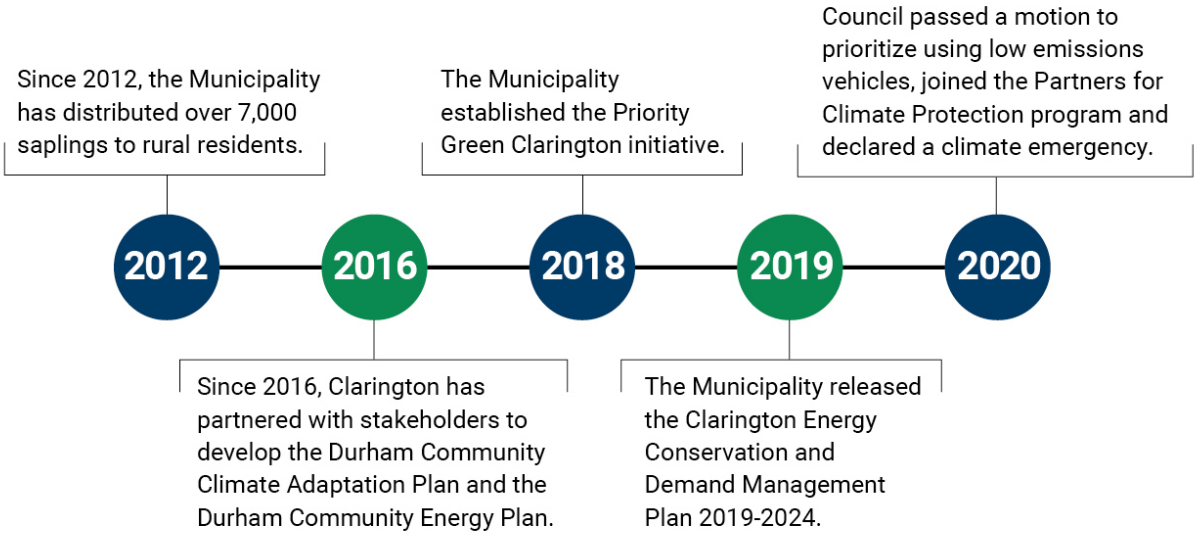


Figure 1 - Timeline of significant climate action actions in Clarington

Climate Adaptation

Climate adaptation involves adjusting our behaviours to reduce the risks posed by climate change while taking advantage of any opportunities. According to the IPCC, based on the amount of GHGs that have already been released into the atmosphere by humans, some degree of climate change is expected to occur regardless of our future actions (2018). Based on climate projections from the Ontario Climate Consortium (OCC), Clarington will experience weather that is significantly hotter and wetter, with storms that are more frequent and extreme (2020). These changes will impact our

infrastructure, economy and the natural environment, placing our wellbeing at greater risk; therefore, adapting to climate change will become increasingly important.

Climate Mitigation

Climate mitigation involves taking actions to limit the quantity of GHG emissions that are being released into the atmosphere and capturing and storing GHGs that have already been released into the atmosphere. The overall goal of climate mitigation is to stabilize the level of GHGs in the atmosphere soon enough to limit the negative impacts of climate change on people and natural ecosystems. If mitigation actions are effective, the climate will change at a rate slow enough for ecosystems and societies to adapt, minimizing impacts on the economy and the wellbeing of people. According to the IPCC, in order to prevent catastrophic climate change, governments must take drastic action to reduce GHG emissions to keep global warming below 1.5 ºC (2018). Although climate mitigation and adaptation are both necessary, the more we choose to mitigate climate change now, the less we will need to adapt later.

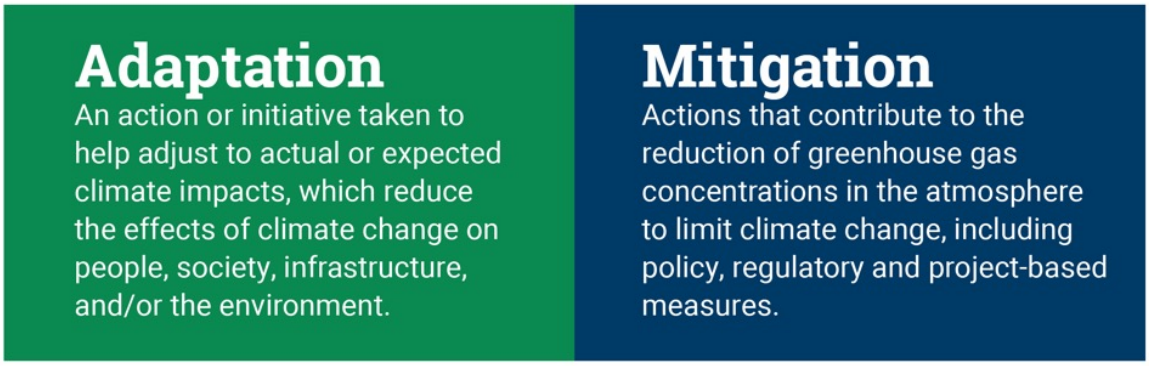


Figure 2 - Definition of climate adaptation and mitigation

The Role of Local Government in Responding to Climate Change

Municipalities are in an ideal position to respond to climate change. According to the FCM, municipalities have control of over 44 per cent of Canada's GHG emissions (2020). Municipalities are also responsible for providing affordable and reliable services to residents, which will be impacted by climate change. Below are several areas where municipalities like Clarington take actions to respond to climate change.

Land Use and Development Planning

Municipalities play a key role in maintaining local infrastructure and planning for future development. Clarington is responsible for creating and enforcing long-term land-use and infrastructure plans, which guide the management of resources, land development and growth, and for maintaining existing infrastructure. Land use and development

planning can incorporate measures to help the Municipality adapt to climate change and reduce GHG emissions.

Licensing and Regulation

Local governments create policies, set regulatory frameworks and enforce by-laws that could be used to implement and enforce climate change adaptation and mitigation regulations. Policy measures to reduce GHGs in our municipal services and facilities can be used to mitigate climate change. An example of this is Clarington's excessive idling bylaw, which places a limit on the amount of time a person can allow their car to idle, cutting down on air pollution and GHG emissions.

Leadership and Awareness

Local governments play an important role in engaging businesses, residents and other stakeholders to act on climate change. Clarington can educate and empower staff and residents to take actions that reduce GHG emissions and make our community more resilient to climate change. By creating this plan, our municipality is already taking a leadership role by identifying measures to adapt to and mitigate climate change in municipal operations and facilities.

Service Delivery

Municipalities work to protect the wellbeing of residents. This is done by providing a variety of community services, including libraries, road maintenance, emergency services, urban forest management. As the climate continues to change, our Municipality will need to adapt, to continue to provide services that promote community wellbeing, and reduce GHG emissions contributing to climate change.

Operations and Workforce

Local governments are responsible for the continued functioning of the Municipality, including maintaining municipal roads, bridges, sidewalks, parks, facilities and snow removal. Incorporating climate change considerations into municipal operations and decision-making and training staff to take climate change into consideration, are valuable ways for our Municipality to reduce GHG emissions while continuing to provide high-quality services in the face of certain climate change.

The Science of Climate Change

What is Climate Change?

Climate change refers to a statistically significant variation in the normal state of the climate for an extended period of time. GHGs, including carbon dioxide, methane, ozone, nitrous oxide, and chlorofluorocarbons, trap heat energy from the sun in Earth's atmosphere, warming the planet and fueling changes to global weather patterns. Although the Earth's climate has naturally fluctuated for millions of years, population growth and modern human activities such as industrial agriculture, industrialization and deforestation have altered the composition of the atmosphere with GHGs, accelerating climate change (Climate Atlas, 2019).

By disrupting the atmospheric balance that keeps the climate stable, we are now seeing a rise in the planet's average surface temperature, warming oceans, shrinking ice sheets and glaciers, decreased snow cover, rising sea level, ocean acidification and extreme weather events (Government of Canada, 2019).

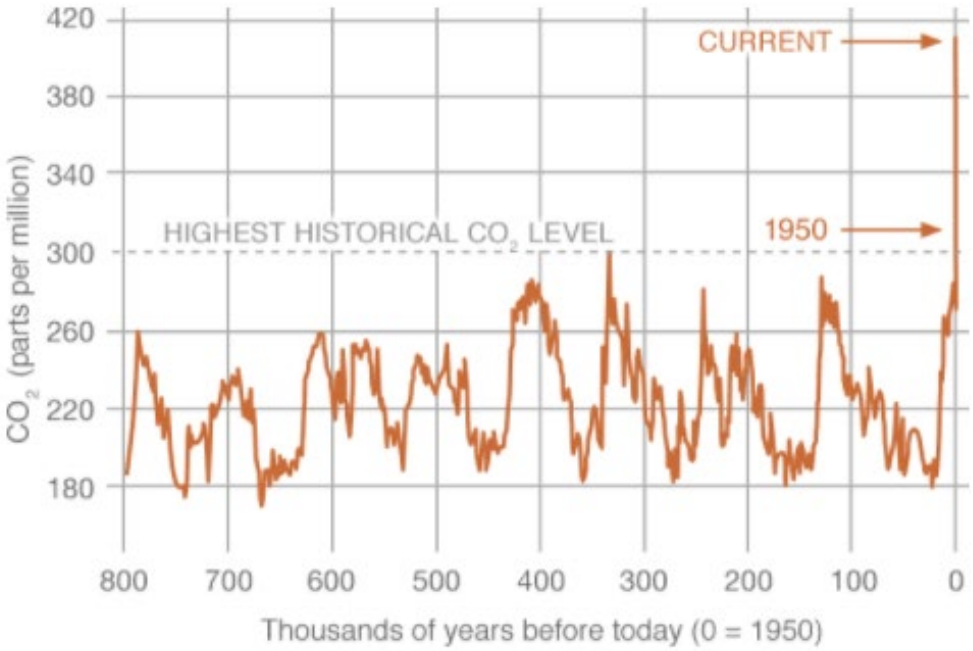


Figure 3 - Global atmospheric carbon dioxide concentrations (CO2) in parts per million (ppm) for the past 800,000 years. Source: National Oceanic and Atmospheric Administration. 2020. Climate Change: Atmospheric Carbon Dioxide (Lindsey, 2020).

According to the IPCC, human activities are estimated to have already caused approximately 1.0°C of global warming above pre-industrial levels. Global warming is estimated to be increasing at 0.2°C per decade due to ongoing emissions. If current trends continue, global warming will likely reach 1.5°C between 2030 and 2052 (2018).

The IPCC has advised that to avoid climate change at a scale that has catastrophic impacts on people and the natural environment, GHG emissions must be reduced by 45 per cent by 2030, compared with 2010 levels, and that net emissions be reduced to zero by 2050 (2018).

Climate Projections for Canada

Since 1948, Canada's mean annual temperature has increased by 1.7ºC overall and by 2.3ºC in northern regions. This rate is almost double the global average. Under a medium emissions scenario, Canada is expected to warm 2°C by 2050 and 4°C by 2080. Seasonally, Canada is expected to experience summertime warming of at least 2.5°C by 2050. If current trends continue, Canadians can expect to experience more frequent and intense heat in the summer and milder winters. This change will increase the severity of heatwaves and contribute to an increased risk of drought and wildfires in the summer (Government of Canada, 2019).

Along with an increase in average temperatures, Canada will continue to experience increased overall precipitation. Since 1950, annual precipitation has increased by 12 per cent, with significant increases in extreme precipitation events. When averaged annually, the largest percentage increase in precipitation has occurred in the high Arctic (25 to 45 per cent), while parts of Southern Canada have seen little change (Government of Canada, 2019).

In the winter, most of Southern Ontario will see a significant decline in annual precipitation. By contrast, Southern British Columbia and Southeastern Canada will likely experience more precipitation in the spring and fall. Overall, less predictable and more extreme fluctuations in precipitation and temperature will contribute to more frequent and severe floods and droughts, which will negatively impact infrastructure, water availability, ecosystems and agriculture (Government of Canada, 2019).

In northern regions, shorter, milder winters are already resulting in less annual snow and ice cover. Since 1981 the number of days per year with snow cover has decreased by 10 per cent per decade due to later seasonal snowfalls, and earlier spring melts as a result of warming. Since 1968, annual sea ice in the Canadian Arctic has decreased by 8 per cent per decade. It is expected that most of the Canadian Arctic marine regions will be completely ice-free in the summers by the 2050s. Reduced snow cover reduces the reflectivity of the Earth's surface, allowing more energy to be absorbed by the land, compounding global warming and climate change (Government of Canada, 2019).

Climate Change Projections for Clarington

The Municipality of Clarington is already experiencing the impacts of climate change and extreme weather, resulting in damage to infrastructure and placing health and safety at risk. In 2013, the Municipality experienced an ice storm that damaged trees and caused power outages; in 2016, the Municipality experienced a significant

heatwave and drought that strained natural ecosystems; in 2017 and 2019 the Municipality experienced lakeshore and overland flooding.

According to climate projections from the OCC, Clarington will continue to experience weather that is warmer and wetter, with larger and more frequent storms. If left unaddressed, climate change will increase the financial and operational challenges faced by the Municipality and place residents and the local economy at risk (2020).

The climate projection data used in this plan originated from the OCC's *Guide to Conducting a Climate Change Analysis at the Local Scale: Lessons Learned from Durham Region* (2020). On behalf of the Region of Durham and Durham area municipalities, the OCC completed climate modelling of Durham Region using the North American Coordinated Regional Climate Downscaling Experiment (NA-CORDEX) ensemble model. In line with their approach, climate projections for this work were broken down into short-term (2011 to 2040), medium-term (2041to 2070) and long-term (2071 to 2100). Projections made in this plan illustrate the most likely climate projections based on current trends.

Increasing Average Annual Temperatures

In the short-term, the average annual temperature in Clarington is expected to increase by 1.6℃ to 13.1℃. Similar trends are expected in the medium and long-term. In the medium-term, the average annual temperature is expected to increase by 2.9℃ to 14.5℃ and 4.8℃ to 16.4℃ in the long-term.

Minimum average annual temperatures are also expected to rise. The short-term average annual minimum is expected to increase by 1.7℃ to 4.1℃. The medium-term average annual minimum is expected to increase by 3.8℃ to 5.8℃, while the long-term average annual minimum is expected to increase by 5.7℃ to 8.1℃.

The minimum winter temperature in Clarington is expected to decrease by 0.3℃ from -8.3℃ in the short-term. In the medium-term, the minimum winter temperature is expected to increase by 2.7℃ to -6.3℃ and increase 5.6℃ to -3.4℃ in the long-term. The shoulder seasons will experience the most notable temperature changes. In the short-term, the minimum spring temperature will likely increase by 3℃ from -1℃ to 2℃.

In the medium-term, the minimum spring temperature is projected to increase by 4.6℃ to 3.6℃, and 6.6℃ to 5.6℃ in the long-term. The minimum fall temperature is expected to increase 0.9℃ from 5.7℃ to 6.6℃ in the short-term, increasing by 2.5℃ in the medium term to 8.2℃ and 4.7℃ in the long-term to 10.4℃.

Increasing Average Annual Maximum Temperatures.

Average annual maximum temperatures are also expected to increase in the Municipality. Most notably, summer maximum temperatures are projected to increase

by 4.9℃ from 21.4℃ to 26.3℃ in the short-term, and to 27.9℃ and 29.9℃ in the medium and long-term respectively.

Extreme heat (over 30℃) will become even more significant as climate change takes greater effect. In the short-term, the number of extreme heat days will increase from 7.2 days per year to 10.9 days per year. In the medium and long-term, extreme heat days will increase to 20.8 and 40.3 days per year, respectively.

Fewer Extreme Cold Days

Extreme cold days are expected to decline significantly in Clarington. In the short-term, the number of days below -20℃ are expected to decline from 8.6 days to 6.6 days. In the medium-term, the number of extreme cold days will decline to 3.3 days and only 1.1 days in the long-term. In addition, there is expected to be 19.1 fewer days below freezing in the short-term, 37.5 and 59.2 fewer days below freezing in the medium and long-term. In the short-term, the Municipality will experience nearly one-month fewer days where the temperature will be below freezing (0℃). In the medium-term, this will be reduced to just over three-and-a-half months, while in the long-term, days below freezing will be reduced to less than three months.

Increased Precipitation

Precipitation in the Municipality is expected to parallel the increase to the annual temperatures. In the short-term, the annual average precipitation is expected to increase by 10.3 per cent from 949.7mm per year to 1059.2 mm per year. In the medium-term precipitation is expected to increase 16 per cent to 1132.3 mm per year, and in the long-term precipitation is expected to increase 23.5 per cent to 1241.9 mm per year. Extreme precipitation (Maximum precipitation in 3 days) will increase notably from 54.9mm to 73.1mm in the short-term, 78.4mm in the medium-term, and 86mm in the long-term.

Fewer Predictable Freeze and Thaw cycles

Freeze-thaw cycles in the Municipality, which take a significant toll on the Municipality's infrastructure and operations, are only expected to decrease slightly with climate change. Currently, the Municipality experiences 79.6 freeze-thaw cycles annually. Freeze-thaw cycles are expected to only decrease to 78.6 cycles annually in the short-term and to 70.1 and 59.6 cycles in the medium and long-term.

Longer Growing Season

Finally, the growing season in Clarington is expected to be extended, notably from 163 days per year to 178 days per year in the short-term. The growing season is expected to extend further in the medium-term to 194 days per year and 215 days per year in the long-term. Currently, the growing season starts on approximately May 15, which in the

short term is expected to begin on May 8, May 1 in the medium-term, and April 18 in the long-term. Currently, the growing season ends around October 24. It is expected to end on October 31 in the short-term, November 9 in the medium-term and November 18 in the long-term.

Local Climate Change Impacts

Physical Impacts

The impacts of climate change will continue to cause significant damage to the built environment, including stormwater infrastructure, buildings, parks, transportation infrastructure and energy systems. Most municipal roads and other built structures were not designed to withstand projected future climate conditions, which will result in increased maintenance requirements and replacement costs.

The variation in temperature between the winter and shoulder seasons indicate a shortened winter season and increased weather variability in the shoulder seasons. With a shortened winter and milder spring and fall, the amount of precipitation in the Municipality is likely to shift from snowfall to rain, placing greater demand on the Municipality's stormwater management systems. Much of the Municipality's stormwater infrastructure was not designed for projected increases in precipitation related to climate change, increasing the potential for overland flooding. Also, irregular freeze and thaw cycles, coupled with increased precipitation, will increase the risk to municipal infrastructure and the public. When thaws occur in conjunction with extreme rain, the likelihood of flooding will increase significantly. Similarly, a freeze after an extreme rain event can cause damage to infrastructure and roads, poses a risk to public safety and increases the need for road salt, which damages natural ecosystems.

Ecological Impacts

Climate change is disrupting ecosystems, which places people at risk. Natural ecosystems provide a wide range of goods and services to people, including drinkable water, pollution control, flood regulation, clean air and food. A warming climate can disrupt the ability of ecosystems to provide services that are valuable to the wellbeing of people. Similarly, climate change can overwhelm an ecosystem's ability to serve as a natural buffer from extreme weather, increasing the vulnerability of people (Government of Canada, 2019). For example, increased annual and extreme precipitation in Clarington will likely result in increased riverine and overland flooding, causing additional erosion, and disrupting natural riverine ecosystems. In addition, a warming climate is allowing for invasive species populations to grow, displacing natural species and creating challenges for local agriculture.

Social Impacts

Climate change will have direct and indirect impacts on social systems that make up our community. Unpredictable weather events, extreme heat, and extreme precipitation have been shown to affect people disproportionately (US Global Research Program, 2014). Prolonged extreme heat has a greater negative impact on people with preexisting health conditions, the elderly, and the very young. People living in poorer neighbourhoods with fewer trees are also more vulnerable to extreme heat. People living in neighbourhoods near creeks, rivers and shorelines are more vulnerable to flooding caused by increased precipitation. In addition, reduced cold days will impact winter recreational activities in the Municipality, as the amount of prolonged snow and ice will be limited by increased freeze and thaw cycles. Similarly, professions that rely on stable, predictable weather conditions will be negatively impacted. The Municipality will need to adapt its community programming, operations and staff policies to take more extreme heat and precipitation into consideration. Actions should also be taken to avoid disruptions to the electrical grid due to extreme weather.

Economic Impacts

Climate change will impact local and global economies and increase expenses for residents and the Municipality. During extreme heat, more power is used to keep buildings cool. According to the Bank of Canada, 20 to 25 per cent more power is needed to cool buildings on a 32^{o}C day than on a 26^{o}C day. Increased demand for electricity increases its cost (2019).

While the agricultural sector will likely benefit from an extended growing season, an extended growing season and warmer winters will increase the risk of pests that will cause damage to food crops. Farmers will also need to cool vulnerable livestock or irrigate more crops during extreme heat, increasing expenses. Spring and fall freeze and thaw cycles are likely to become less predictable, increasing the possibility of unexpected crop damage due to frost. Increased agricultural vulnerability and costs for farmers will increase the cost of food for residents (Government of Canada, 2019).

According to the Intact Centre for Climate Change, increased storms and flooding will increase property damage. As a result, insurance premiums will continue to increase due to the added risks to property damage associated with climate change (Intact Centre on Climate Adaptation, 2019),

Our Approach

The creation of this plan was guided by the ICLEI Canada, Building Adaptive & Resilient Communities (BARC) five-milestone framework and by the FCM PCP program five-milestone framework. Our approach is based on the following key principles:

Collaboration - From the outset, this plan was intended to be a collaborative effort. Over 70 municipal staff members participated in the creation of this plan to identify how the Municipality will be impacted by projected climate change, propose actions that the Municipality can take to adapt to climate change and reduce GHG emissions and prioritize actions to be implemented.

Comprehensive – This plan contains a range of actions to respond to climate change, which will allow staff from across the corporation to leverage opportunities to create partnerships and access funding that will be essential for successful action implementation.

Achievable – All the actions contained in this plan are within the control of the Municipality and identified by staff as achievable. Most actions contained in this plan are recommendations for ways to provide high-quality municipal services while reducing GHG emissions and making the Municipality more resilient to climate change.

Balanced – The impacts of climate change in the future will depend on the actions that we take in the present. This plan seeks to balance the immediate and long-term needs of the Municipality while attempting to limit climate change by reducing GHG emissions.

Adaptable – This plan is intended to be adapted and updated. It is expected that staff will be creative in identifying opportunities to successfully implement the actions contained in this plan. Appendix D contains actions that were proposed by staff but were not intended for immediate implementation. These actions will be reviewed to assess their appropriateness for inclusion in future updates to this plan. It is recommended that this plan will be updated every five years.

ICLEI – BARC

The adaptation elements of this plan have been guided by ICLEI Canada's BARC five-milestone framework. ICLEI Canada's BARC five-milestone framework is a structured approach to help municipalities prepare for the impacts of climate change through a series of progressive steps. Milestones include: 1) initiate; 2) research; 3) plan; 4) implement and; 5) monitor and review.

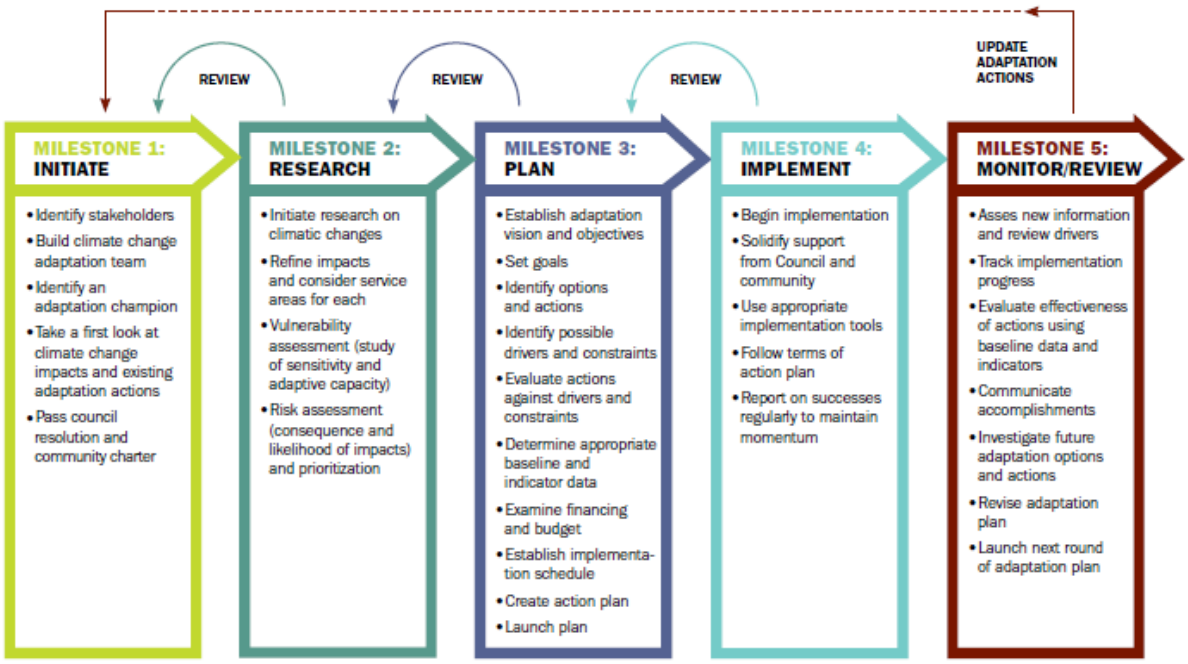


Figure 4 - ICLEI Canada's BARC five-milestone framework

FCM – PCP Program

The mitigation elements of this plan have been guided by FCM's PCP program. The PCP program consists of a five-milestone framework to guide the Municipality to act on climate change by reducing GHG emissions. Milestones include: 1) create a baseline emissions inventory and forecast; 2) set GHG emissions reduction targets; 3) develop a local action plan; 4) implement the local action plan and; 5) monitor progress and report results.

Figure 5 - PCP Five Milestone Framework

Staff Engagement

The creation of this plan has been a collaborative process. All aspects of this plan were directed by the ICCWG, which is made up of representatives from all departments in the Municipality. Throughout the development of this plan, the ICCWG met monthly to provide feedback and participate in workshops to gather information to be included in this plan. ICCWG members consulted with staff from all departments to receive input on key features of the plan and helped coordinate workshops to assess the risk of climate change to the Municipality, identify actions to respond to climate risks, identify actions to reduce corporate GHG emissions, and prioritize and finalize climate actions for inclusion in this plan.

Objective, Vision and Mission

Early in the climate action planning process, members of the ICCWG participated in workshops to establish the objective, vision and mission statements to clearly articulate the purpose and intended outcomes of this climate action plan. First, staff were provided with a summary of how climate change is expected to impact the Municipality. With climate impacts in mind, staff were then asked to brainstorm the best-case outcomes that could result from this plan. Based on best-case scenarios, staff composed the vision statement for this plan. After agreeing upon objective and vision statements, staff were then asked to brainstorm how this plan could contribute to achieving the objective and vision statements, given the changes in climate that are expected. Responses were distilled into the mission statement contained in this plan.

Goal Identification

Following the creation of a vision statement and mission statement, staff participated in an exercise that identified the main goals of this plan. All goals are intended to contribute to achieving the project's vision and mission. Goals were revised throughout the climate action planning process as staff gained greater knowledge about climate risks, and responses were identified. All climate actions within this plan are categorized based on seven goals. The goals of the plan include:

1) *Reduce Corporate GHG Emissions*
2) *Maintain Public and Workplace Health and Safety*
3) *Minimize Risks to Buildings and Properties*
4) *Strengthen the Resilience of Municipal Infrastructure*
5) *Protect Ecosystems and Biodiversity*
6) *Minimize disruption to corporate operations and services*
7) *Build Community Resilience*

Risk and Vulnerability Assessment

Staff worked with the Ontario Climate Consortium (OCC) to bring together representatives from all departments to complete a climate change risk and vulnerability assessment. The risk and vulnerability assessment identifies the likelihood and consequences of impacts that climate change will have on municipal operations and service delivery. The risk and vulnerability assessment was undertaken in four stages: 1) analyzing the most up-to-date climate projections to identify the climate conditions that can be expected by the Municipality; 2) working with staff from all departments to identify the risks and most likely impacts that climate change will have on municipal operations and services; 3) working with staff to assess the likelihood and consequences of climate impacts on municipal operations and service delivery and; 4) producing risk statements that reflect the impact that climate change will have on municipal operations and services. Figure 6 below illustrates the overall risk assessment process.

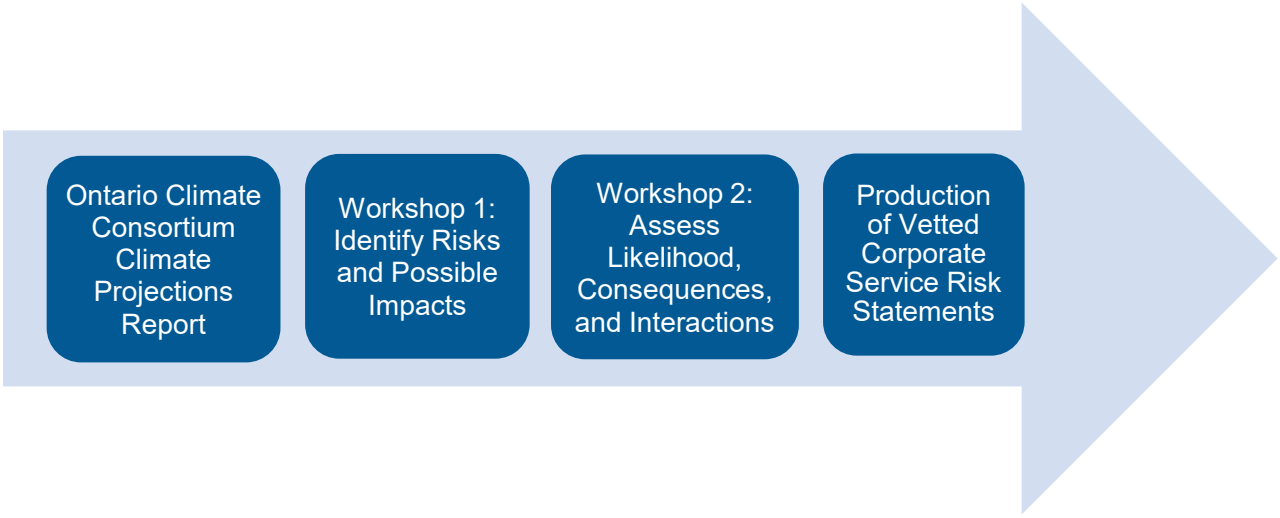
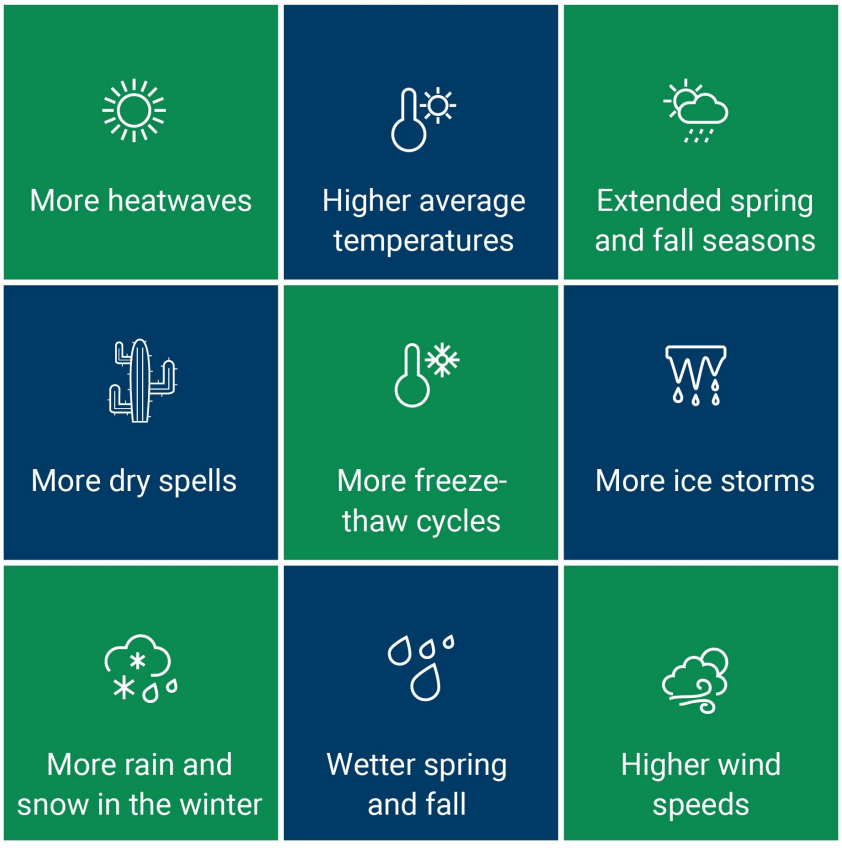


Figure 6 - Risk Assessment Planning Process

Department-Specific Risks and Possible Impacts - Workshop 1

In September 2019, representatives from all departments participated in a workshop to review climate projections and identify local climate risks and their most likely impacts on the Municipality. Staff were provided with a list of 9 climate conditions that are expected to impact the Municipality based on the most up-to-date climate projections from the Ontario Climate Consortium. Climate conditions include:

- *More heat waves,*
- *Higher average temperatures,*
- *Extended spring and fall seasons,*
- *More dry spells*
- *More freeze-thaw cycles*
- *More ice storm,*
- *More rain and snow in the winter*
- *Wetter spring and fall*
- *Higher wind speeds*



Using the climate conditions listed above, participants were guided through two workshop activities. In the first activity, participants generated climate change risk

statements based on likely impacts to municipal operations and service provision. Next, participants identified the departments that would be most impacted by climate change and how they would be impacted. Participants were asked to brainstorm and document the risks that climate change presents to the Municipality using the “If-Then-So” methodology. The “If-Then-So” methodology is consistent with traditional risk-based approaches, where “if” is associated with a particular event (in this case, a climate condition or extreme event occurring); “then” is associated with a particular service or function, and “so” is the final result or consequence of the climate change impact. For example, *if* more extreme rain events occur, *then* this may lead to more frequent drainage issues, *so* this may require increased maintenance of stormwater management infrastructure and increase costs to the Municipality. All of the information gathered from staff was analyzed using an integrated risk management approach, summarized, and used to frame the proceeding conversations in workshop two (Ontario Climate Consortium, 2020).

Ranking the Severity and Likelihoods - Workshop 2

In October 2019, representatives from each department reconvened to participate in a second workshop to rank the risks that climate change presents to the Municipality. The risks of climate change to the Municipality were assessed for the present time period, projected to mid-century (2050s). All risks were identified assuming a “business as usual” approach to reducing GHG emissions, which is based on current GHG emissions trends (this climate change scenario is referred to as the Representative Concentration Pathway 8.5 climate scenario). Based on climate projections for the Municipality, the ranking of each climate risk was determined by relating the severity of consequences of a climate risk to the likelihood of the risk occurring. The below equations were used to rank the identified climate change risks to the Municipality following Workshop 2:

$$\textit{Current Climate Risk} = \textit{Current Likelihood} \times \sum \textit{Consequences (across all categories)}$$

$$\textit{Future Climate Risk} = \textit{Future Likelihood} \times \sum \textit{Consequences (across all categories)}$$

Summary of Climate Risks for the Municipality of Clarington

Through the climate risk scan process, a total of 199 unique risks were identified. Each risk statement included a climate condition, an associated risk, and consequences associated with municipal services and operations. All risk statements were grouped by department, based on the likelihood a department’s operations and services would be impacted. The Public Works department had the greatest number of identified risks, with a total of 75. All other departments each had less than 30 identified risks.

Workshop participants identified extreme heat and intense rainfall as the climate conditions currently the greatest risk to the Municipality. When considering future

climate trends projected to mid-century (2050s), extreme heat, intense rainfall and extended spring and fall seasons were identified to be the climate conditions that pose the greatest risks to the Municipality.

Ice storms, more intense rainfall and extreme heat were among the top climate conditions identified to have the most significant consequences to the Municipality.

Table 1 below highlights the top five climate conditions that will have the greatest likely consequences for the Municipality.

If	Then	So (examples)	Flagged Departments	Future Risk
More Ice Storms	Clarington resources many be too limited to respond to extreme weather events.	More staffing, more planning for these events, more resources	Emergency and Fire Services	High Risk
More Intense Rainfall	Development limits outdated	Floodplain and hazard mapping may not be as accurate	Planning and Development Services	High Risk
More Intense Rainfall	Potential for expanded flood zones	Trails and other infrastructure will need to be re-routed	Planning and Development Services	High Risk
More Ice Storms	Increased salt usage and more salt being washed away with stormwater through runoff	Increased costs, groundwater impacts and more contracting and significant impacts to water quality in local water bodies and to habitats in these water bodies	Public Works	Moderate Risk
More Heat Waves	More invasive species	Increased costs for reducing the number of invasive species, staff time and pesticides	Public Works	Moderate Risk

Table 1 - Top 5 risks identified as having the highest consequence to the Municipality of Clarington

Notably, many departments share the same climate risks to their services and operations. For example, more heatwaves were identified as a concern for the Emergency and Fire Services and Public Works departments, as prolonged extreme heat would have negative impacts on staff health.

Similar risks between departments provides opportunities for collaboration and resource sharing when taking actions to respond to the risk.

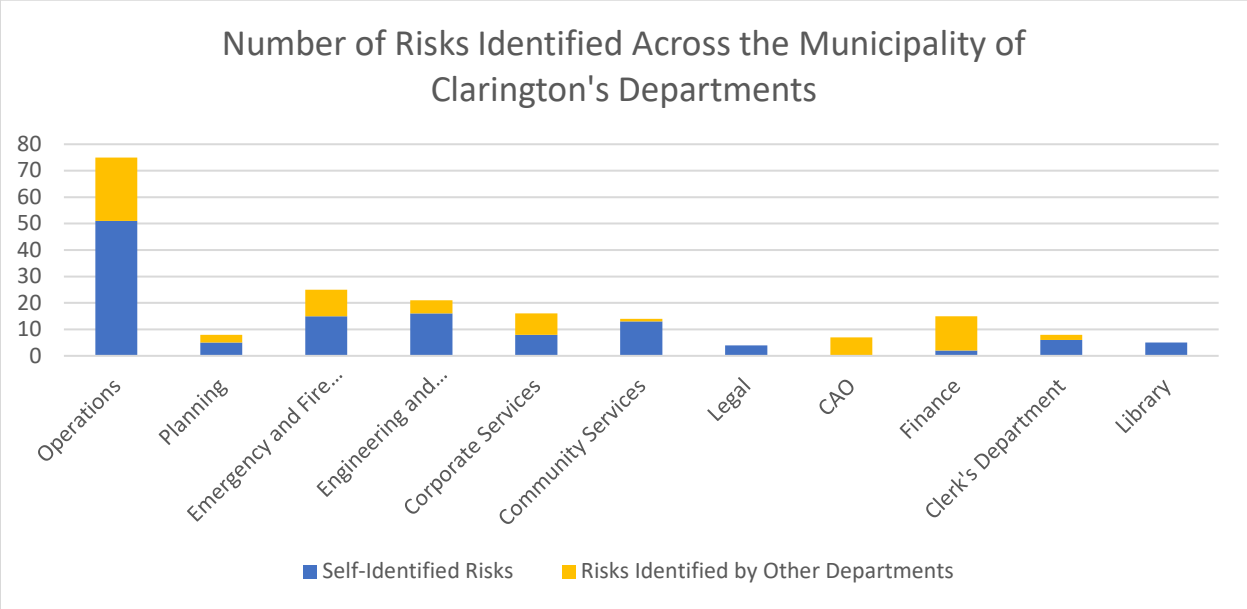


Figure 7 - Number of unique climate risks identified across the Municipality of Clarington's Departments. Blue represents self-identified risks, and yellow represents the risks identified by other departments (Ontario Climate Consortium, 2020). Note: This component of the plan was completed prior to changes to the Municipality's organizational structure.

Clarington's Energy Consumption and GHG Emissions Inventory

Using the International Local Government GHG Emissions Analysis Protocol (IEAP), staff completed a GHG inventory to establish a baseline for GHGs emitted by the Municipality. The GHG emissions inventory was calculated using information from four areas of municipal operations, including buildings, vehicles, streetlights and solid waste. Please view Appendix I for an outline of the methods used to calculate baseline municipal GHG emissions.

Buildings

Data for building consumption was assessed using monthly fuel and electricity invoices for each building. GHG emissions were calculated based on the fuel mix consumed by each building and the average CO2 equivalent (CO2e) emissions that are released per kWh of electricity consumed in Ontario. The building inventory includes 27 of the 42 buildings owned by the Municipality, as these are the buildings that are operated and maintained by the Municipality. The other 15 buildings are operated and maintained by independent boards.

Fleet

When collecting data, fleet was separated into three areas: 1) Corporate fleet vehicles, 2) Emergency and Fire Services vehicles and 3) staff vehicles used for municipal purposes. Fuel consumption data for corporate fleet vehicles came from fuel purchase invoices for bulk fuel purchased for corporate vehicles. Fuel consumption data for Fire and Emergency Services vehicles came from fuel purchase invoices for individual fire vehicles. Staff vehicle consumption data was calculated based on staff mileage claims for corporate use. Fuel consumption was based on an average per kilometer fuel consumption of 9.48 litres/100km (average mileage for a light-duty vehicle).

Streetlights

Streetlight consumption data came from monthly invoices. Signal light data is not included in this data, as they are a Region of Durham responsibility. GHG emissions were calculated based on the average CO2e emissions that are released per kWh of electricity consumed in Ontario.

Solid waste

Data for corporate solid waste production came from invoices from contacted waste services for each facility. Clarington's waste is incinerated at the Durham-York Energy Centre, energy from waste facility. The weight of the waste was calculated at an average of 250lbs per yard. Calculations were based on an average composition of municipal solid waste as presented by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006).

Municipal Energy Consumption and GHG Emissions

Data collected for the municipal energy consumption and GHG emissions baseline inventory revealed that the Municipality consumed 110,077 GJ of energy in the 2018 baseline year. Municipal buildings are responsible for most of the energy consumed, followed by streetlights and fleet vehicles.

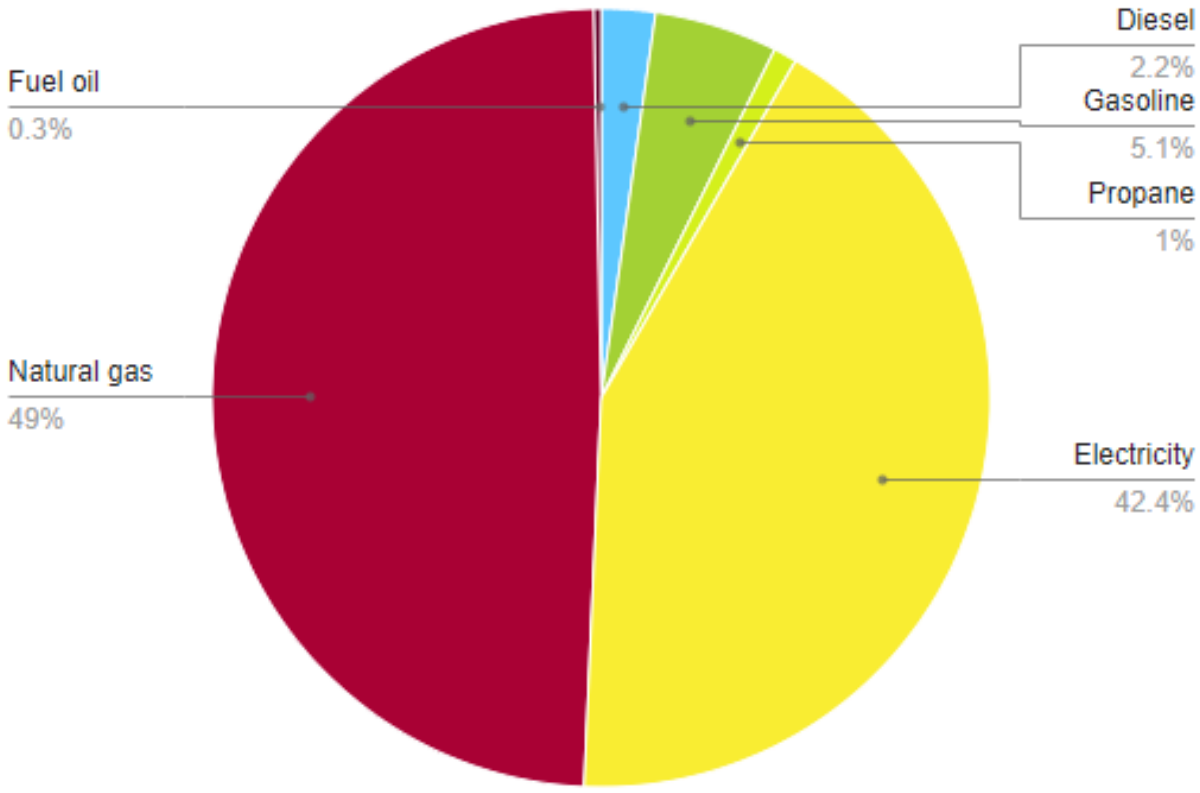


Figure 8 - Energy (GJ) Consumption by Source

Data collected for the municipal energy consumption and GHG emissions baseline inventory revealed that the Municipality produced 4,039.4 tons of CO2e emissions in the baseline year. Of the CO2e emissions released by the Municipality, the majority originated from municipal buildings, followed by fleet vehicles, waste and streetlights.

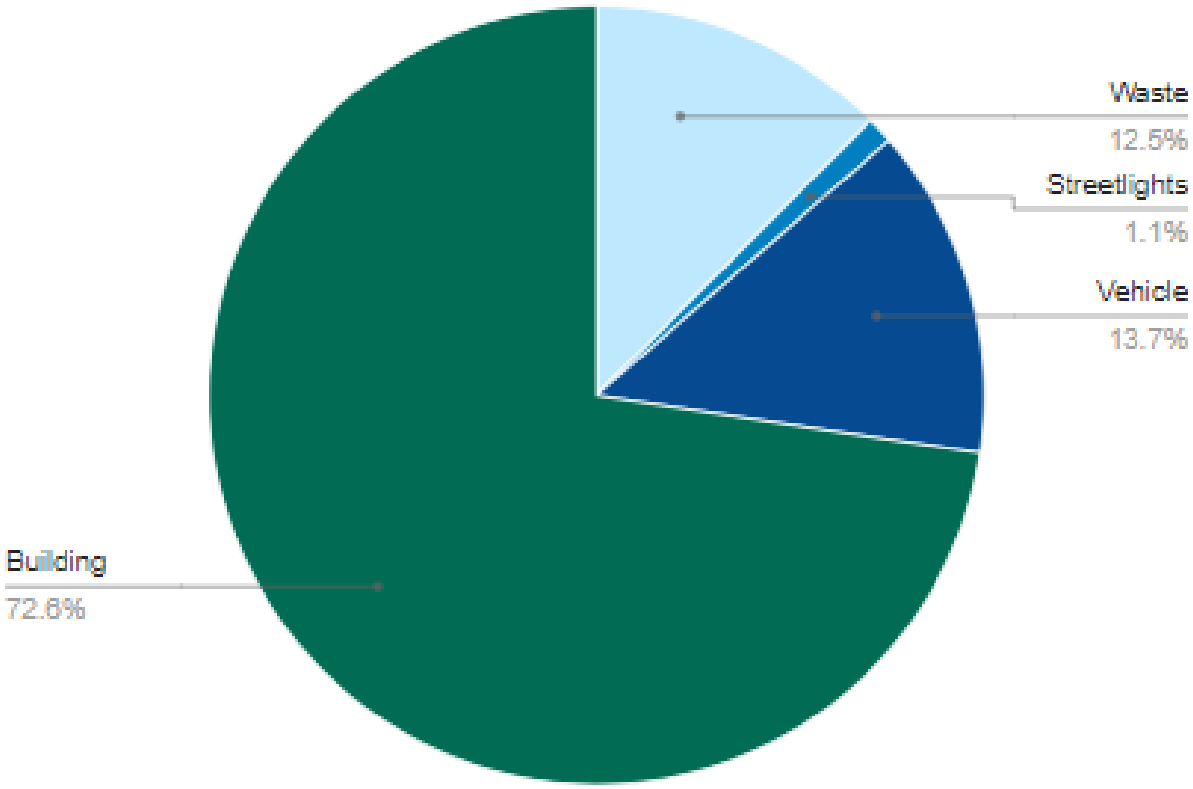


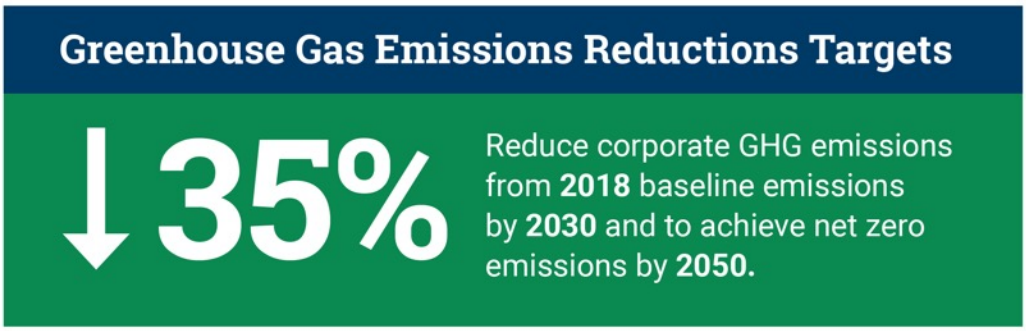
Figure 9 - Greenhouse Gas Emissions (tCO2e) by Source

GHG Emission Reductions Targets

The IPCC has concluded that global GHG emissions must be reduced significantly to limit global warming to below 1.5ºC to avoid catastrophic impacts of climate change (2018). By establishing GHG reduction targets and adopting practices that reduce GHG emissions, the Municipality is doing its part to limit climate change that will negatively impact staff and residents while saving money in operating and energy costs.

After completing the Corporate Energy Consumption and GHG Emissions Inventory, ICCWG staff participated in two workshops to discuss Municipal sources of GHG emissions and identify recommended Municipal GHG emissions reduction targets. GHG emissions reduction targets were informed by best practices established by the FCM, IPCC, and several municipalities in Ontario. Staff identified emissions reduction targets using three criteria: 1) targets must be achievable by the Municipality; 2) targets must be significant in helping to limit climate change and; 3) targets must demonstrate the Municipality's commitment to avoiding the negative impacts of climate change.

This plan sets a target to **reduce corporate GHG emissions by 35 per cent from 2018 baseline emissions by 2030 and to achieve net zero emissions by 2050**. These targets align with targets established by the IPCC, and by the Durham Community Climate Adaptation Plan and the Durham Community Energy Plan, which were both approved in principle by the Clarington Council. These targets will be achieved through the implementation of the actions outlined in this Plan and in the 2019 Clarington Energy Conservation and Demand Management Plan.



Action Identification and Prioritization

Mitigation Actions

Action identification

Staff from all departments participated in workshops to identify a long list of actions to reduce corporate GHG emissions. Conversations to identify actions to reduce emissions were framed by three questions: 1) How can the Municipality reduce GHG emissions in its current operations while continuing to provide high-quality services? 2) What new services can the Municipality provide to reduce GHG emissions? and; 3) What can each department do to reduce GHG emissions as part of their ongoing operations? In addition, all mitigation actions were based on three criteria. All actions must: 1) be within municipal control; 2) be attainable, and 3) contribute to achieving corporate GHG emissions reduction targets. Other actions to reduce corporate GHG emissions were identified by reviewing best practices being implemented by other municipalities.

Action Evaluation and Prioritization

Staff participated in two workshops to evaluate actions to reduce corporate GHG emissions. All identified mitigation actions were evaluated using criteria adapted from the *Canadian Communities' Guidebook for Adaptation to Climate Change* to assess the presence of factors essential to the successful implementation of actions to reduce corporate GHG emissions (2008). Participants were asked to evaluate each action based on a set of qualitative criteria, including sustainability, effectiveness, opportunities, and ease of implementation. Once complete, the criteria of each action were added, resulting in a corresponding action evaluation score. Please see Appendix H for details about the mitigation evaluation criteria.

Next, all mitigation actions were rated based on their potential to reduce corporate GHG emissions relative to current corporate practices. Actions were placed into five categories: Low, Medium - Low, Medium, Medium - High and High. To prioritize mitigation actions, each action's evaluation score and GHG emissions rating was combined into a Mitigation Action Prioritization Matrix. Actions with high emissions reduction potential and high action evaluation scores were categorized as 'Must Do.' Actions with moderate emissions reduction potential and action evaluation scores were categorized as 'Monitor.' Actions with the lowest emissions reduction potential and action evaluation scores were categorized as 'Investigate Further.' 'Must Do' actions were included in this plan for short-term development and implementation. 'Monitor' actions are intended to be monitored for development implementation should opportunities present themselves in the mid-term. Actions categorized as 'Investigate Further' are intended to be revisited later for consideration in future climate action plans. Please see Appendix D to review the list of actions for future consideration.

		GHG Emissions Potential				
		Low	**Medium-Low**	**Medium**	**Medium-High**	**High**
Action Evaluation Score	**Low**	Investigate Further	Investigate Further	Investigate Further	Monitor	Monitor
	Medium	Investigate Further	Monitor	Monitor	Monitor	Must Do
	High	Monitor	Monitor	Must Do	Must Do	Must Do

Table 2 - Mitigation Action Prioritization Matrix

Adaptation Actions

Action Identification

Using the list of climate impacts compiled from the risk and vulnerability assessment, staff from all departments participated in workshops to identify a list of potential actions to help the Municipality adapt to each climate impact. Two approaches were taken to develop a list of adaptation actions: 1) List each impact, then identify options and relevant service areas and 2) Review actions taken by other similar municipalities and select actions that relate to the Municipality. All potential actions were identified by staff using three criteria. Adaptation actions must: 1) be within municipal control; 2) focus on corporate operations, infrastructure and/or services, and 3) be achievable by the Municipality.

Action Evaluation and Prioritization

The list of potential adaptation actions was evaluated using criteria adapted from the *Canadian Communities' Guidebook for Adaptation to Climate Change* to assess the presence of factors essential to their successful implementation within a municipal context (2008). Participants were asked to evaluate each action based on a set of qualitative criteria, including sustainability, effectiveness, risk and uncertainty, opportunities, and ease of implementation. Once complete, the criteria of each action were added, resulting in a corresponding action evaluation score. Please see Appendix H for detail about the adaptation action evaluation criteria.

Next, a risk score was calculated for each proposed adaptation action based on the climate impact consequence and likelihood data generated from the risk and vulnerability assessment. Climate impact consequences and likelihoods were multiplied together to generate a risk score. Actions were then ranked from low to high risk, depending on their risk score.

Risk Score Matrix						
	Consequences					
Likelihood		1	2	3	4	5
	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5

Table 3 - Adaptation Action Risk Score Matrix

Risk Score Rankings	
Low	1 - 5
Medium low	6 - 10
Medium	11 - 15
Medium High	16 - 20
High	21 - 25

Table 4 - Adaptation Action Risk Score Rankings

To prioritize identified adaptation actions, each action's evaluation score and risk score were combined into an adaptation action prioritization matrix. Actions with high risk and high action evaluation scores were categorized as 'Must Do.' Actions with moderate combined risk and action evaluation scores were categorized as 'Monitor'. The lowest scores were categorized as 'Investigate Further'. 'Must Do' actions were included in this plan for short-term development and implementation. 'Monitor' actions are intended to be monitored for implementation should opportunities present themselves in the mid-term. Actions categorized as 'Investigate Further' are intended to be revisited for

consideration in future updates to Clarington's climate action plans. Please see Appendix D to review the list of actions for future consideration.

		Risk Score				
		Low Risk	**Medium - Low**	**Medium**	**Medium - High**	**High**
Action Evaluation Score	**Low**	Investigate Further	Investigate Further	Investigate Further	Monitor	Monitor
	Medium	Investigate Further	Monitor	Monitor	Monitor	Must Do
	High	Monitor	Monitor	Must Do	Must Do	Must Do

Table 5 - Adaptation Action Prioritization Matrix

Objective, Vision, Mission, Goals and Actions

Objective

Identify actions that enable the Municipality to avoid the unmanageable and manage the unavoidable impacts of climate change

Vision

To ensure Clarington is a safe, stable and prosperous community.

Mission

To provide leadership and tangible solutions to combat climate change and environmental damage while providing efficient and high-quality services to the community.

Goals and Actions

This plan includes 115 actions that the Municipality will take to respond to climate change. Seven goals were developed to organize and guide the development of actions the Municipality can take to respond to climate change. The goals reflect the Municipality's response to the most likely impacts of climate change on the Municipality.

1) Reduce Corporate GHG Emissions

Climate change will continue to present significant challenges to the Municipality, its residents, operations and services. By taking actions to reduce GHG emissions, Clarington is doing its part to slow climate change and reduce its impacts. This plan sets a target to **reduce corporate GHG emissions 35 per cent by 2030 from 2018 levels, and to achieve net zero GHG emissions by 2050.**

1.1	Encourage waste and recycling service providers document GHG emissions on invoices submitted to the Municipality to help the Municipality track it's GHG emissions more easily.
1.2	Consider building envelope upgrades, building automation and lighting upgrades as part of all building renewal projects.
1.3	Install/upgrade Building Automation Systems (BAS) and Smart Thermostats in municipal buildings.
1.4	Continue to convert all lighting in municipal buildings to energy efficient LEDs.

1.5	Expedite actions outlined in the 2019 Clarington Energy Conservation Demand Management Plan.
1.6	Offset the use of petroleum-based natural gas with renewable natural gas in buildings through renewable natural gas purchasing agreements.
1.7	Establish a policy to replace all appliances with Energy STAR rated appliances.
1.8	Install Smart Water Metering to major equipment at facilities and parks (i.e. ice rinks, pools and splash pads) to better understand water consumption trends and ensure that equipment is operating at optimal efficiency.
1.9	Conduct utility consumption audits in municipal facilities, beginning with buildings with the highest potential for savings.
1.10	Conduct building re-commissioning to optimize building operations where applicable.
1.11	Replace mechanical equipment (boilers, chillers, air conditioning units) in remaining facilities with high efficiency according to building assessments.
1.12	Implement and energy management system (EMS) to track utility bills to monitor energy consumption and GHG emissions, and inform building maintenance and recommissioning
1.13	Assess and retrofit buildings with insulation where possible to reduced energy consumption.
1.14	Incentivize municipal staff to choose low carbon transportation options including: carpooling, cycling and adopting EVs.
1.15	Expand corporate waste reduction and diversion initiatives to further reduce waste and promote recycling and composting.
1.16	Develop a Green Procurement Policy that aligns procurement and vendor selection with the climate resilience and mitigation goals outlined in the CCAP.
1.17	Include a line item in the annual budget to provide funding for studies and/or components of capital projects that support the implementation of the CCAP.
1.18	Establish a Green Revolving Fund (GRF) that is dedicated to funding energy efficiency, renewable energy, and/or sustainability projects that generate cost savings.
1.19	Review and update municipal anti-idling by-law and consider expanding idle-free zones.
1.20	Create a Corporate Energy Commodity Policy that prioritizes energy savings, locally produced energy and low carbon energy options.
1.21	Create corporate protocols to incorporate climate change considerations into Council reports.

1.22	Undertake a feasibility study to identify opportunities for the Municipality of to generate and sell renewable energy.
1.23	Develop a communications plan to share corporate progress on climate action with staff and the public on an ongoing basis.
1.24	Investigate the feasibility for District Energy Systems in new and existing secondary plan areas.
1.25	Update the Priority Green Clarington Green Development Framework criteria checklists to include considerations for climate change mitigation and adaptation.
1.26	Update Clarington's Planning and Development Design Standards and Guidelines to align with the Clarington Priority Green Development Framework to support moving toward net zero communities.
1.27	Complete the implementation of Clarington's Green Development Standards, including the development of a program guidebook, application instructions, and terms of reference for sustainability reporting.
1.28	Establish beyond-code energy efficiency design standards for new municipal buildings
1.29	Conduct a review of existing Community Improvement Plans to evaluate the potential for program expansions to support corporate energy efficient retrofits.
1.30	Update the Municipal Green Fleet Strategy and establish a five-year plan to electrify municipal fleet vehicles where practicable.
1.31	Complete the conversion of outdoor lighting in parks and streetlights to energy efficient LEDs
1.32	Implement a Municipal Automatic Vehicle Location Monitoring System (AVL) in fleet vehicles to track fuel consumption, evaluate idling and optimize routes for regular travel
1.33	Purchase electric tools and equipment where possible.
1.34	Right-size fleet vehicles based on their use to reduce fuel consumption.
1.35	Integrate green infrastructure and Climate Change into Clarington's Asset Management Plan.

2) Maintain Public and Workplace Health and Safety

Extreme weather caused by climate change will place the health and safety of residents and staff at greater risk. The Municipality will take actions to protect residents and staff from extreme weather caused by climate change.

2.1	Extend pool hours during extreme heat, taking into consideration staffing, infrastructure and maintenance needs
2.2	Ensure water and sunscreen are available to staff during all municipal summer outdoor events.
2.3	Allow outdoor activities to be held at indoor recreation facilities during extreme heat events where possible.
2.4	Design summer outdoor community programming to take into consideration extreme heat to ensure staff adequately prepared.
2.5	Ensure staff have access to cooling rest areas for relief during extreme heat.
2.6	Update safety training for staff to incorporate extreme weather risks associated with climate change including extreme heat.
2.7	Establish protocols for staff during extreme wind events. Identify "Shelter in Place" safe zones for staff.
2.8	Create/update workplace policies to mandate weather-appropriate clothing to protect staff against extreme weather conditions including heat, cold, windy and wet conditions.
2.9	Update municipal emergency contact lists annually.
2.10	Incorporate weather monitoring into staff management processes to forecast staff needs and ensure there are enough staff available to respond to extreme weather such as snowstorms and ice storms.
2.11	Expand online safety training program to ensure safety training accessible to staff in the field.
2.12	Expand mutual aid agreements with other municipalities to avoid labour and equipment shortfalls during weather-related emergences.
2.13	Ensure adequate resources are in place to ensure adequate response to the increased frequency of climate-related emergencies.
2.14	Update the Clarington Emergency Plan to incorporate a strategy for extreme weather based on climate projections.
2.15	Work with stakeholders to identify and promote the location of evacuation centres to the public.

2.16	Develop an extreme heat policy that establishes maximum outdoor working temperatures for staff and enables staff to complete outdoor work during the cooler times of the day.
2.17	Extend library hours to keep libraries open to the public during extreme heat and cold weather.
2.18	Create a communications strategy that clearly categorises levels of weather-related risk and communicates actions that should be taken to by the public and stay safe.
2.19	Incorporate shade structures and trees in the designs of outdoor recreation areas for relief from extreme heat.
2.20	Increase signage near municipally owned and maintained bodies of water including beaches and stormwater management ponds, warning about the dangers of thin ice.
2.21	Identify roadways that are the least likely to be impacted by flooding and incorporate them into community emergency evacuation plans.
2.22	Incorporate textured, slip proof floor surfaces into the design of public spaces.

3) Minimize Risks to Buildings and Properties

Extreme weather caused by climate change will increase the risk of damage to buildings and properties, resulting in increased maintenance, repair and insurance needs. The Municipality will take actions to prevent damage to new and existing buildings and properties caused by extreme weather and climate change.

3.1	Utilize climate projections to assess which municipal buildings are at risk due to extreme weather. Prioritize building upgrades based on identified risk.
3.2	Update design standards for municipal buildings using climate projections to ensure municipal buildings are resilient to extreme weather.
3.3	Work with the Conservation Authorities to update flood mapping based on the most up-to-date climate projections.
3.4	Update zoning bylaws to prohibit development in flood hazard areas.
3.5	Include natural hazards and climate projections as criteria in Clarington's Land Acquisition Strategy.
3.6	Assess the municipal trail system to determine areas that are most vulnerable to flooding based on climate projections.
3.7	Update trail design standards to take into account accurate climate projections.

3.8	Utilize climate projections to identify areas of roads that are vulnerable to flooding. Create a plan to upgrade road areas that are at high risk.

4) Strengthen the Resilience of Municipal Infrastructure

Existing municipal infrastructure was not designed for the extreme weather conditions that will result from climate change. Infrastructure damage and failure will cost the Municipality money and place the safety of staff and residents at risk. The Municipality will take actions to improve existing and future infrastructure to limit the negative impacts of climate change.

4.1	Assess the depth of wells that service corporate buildings to ensure water will be available during a drought and establish a mitigation plan for managing drought
4.2	In new building designs and building retrofits, locate cooling condensers on the shady side of the building. Ensure proper ventilation and maintenance for efficient operation.
4.3	Increase backup power supply including generators and solar battery storage options at maintenance facilities.
4.4	Update building design standards to incorporate green and reflective roofs into municipal building designs.
4.5	Revise asset management policy and equipment repair and replacement schedules to reflect wear from increased use due to extreme weather.
4.6	Add surge protectors to all electronic equipment and backup batteries to all computers.
4.7	Store electronic equipment in a location that is secure and not vulnerable to flooding or fire.
4.8	Ensure all evacuation centres are equipped with and emergency backup power supply.
4.9	Review zoning regulations to promote ground water permeability.
4.10	Utilize water catchment for irrigation in park designs where possible.
4.11	Establish a strategy to control invasive plant species that have negative impacts on stormwater management ponds, sightlines, drainage ditches and water quality.
4.12	Update the municipal road maintenance plan by increasing the road maintenance cycle to accommodate less predictable freeze/thaw cycles.

4.13	Assess and upgrade stormwater infrastructure using accurate climate projections.
4.14	Design new splash pads to clean and recirculate water to consume less water.
4.15	Incorporate lighting into new field designs so they can be used in the evening when outdoor temperatures are cooler.
4.16	Expand the rural ditching maintenance program to reduce flooding and avoid infrastructure and property damage.
4.17	Assess bridges and embankments to determine areas that are most vulnerable to flooding based on climate projections.
4.18	Upgrade storm water management infrastructure with on-site ponds, cisterns and landscaping decisions to minimize storm water run-off.
4.19	Expand preventative maintenance and repair program for roads, sidewalks and bridges to mitigate damage due to increased freeze and thaw cycles.
4.20	Increase construction standards for higher order roads that are used for hauling to mitigate damage due to increased freeze and thaw cycles.
4.21	Review road weight restrictions to prohibit hauling on local roads. Prioritize hauling on higher order Regional roads.
4.22	Design new parks and sports fields to accommodate flooding and function as stormwater management areas where reasonable to do so.
4.23	Upgrade existing parks and sports fields with permeable asphalt and other permeable materials to reduce overland flooding.

5) Protect Ecosystems and Biodiversity

Climate change threatens to disrupt natural ecosystems and the services they provide, including animal habitat, air and water filtration, crop pollination, erosion protection, groundwater recharge, and human health benefits. The Municipality will take actions to protect ecosystem biodiversity and ecosystem services.

5.1	Review the implementation of an urban tree preservation bylaw to prevent urban trees from being cut down without a permit.
5.2	Integrate urban heat island projections into the Clarington Urban Forest Strategy. Plant more trees in areas with the greatest potential for becoming urban heat islands.
5.3	Require winter maintenance staff become Smart About Salt certified. This program will provide training on the application of road salt to improve winter

	salting practices and decrease salt-related damage to ecosystems and infrastructure.
5.4	Consider alternatives to conventional road salt (NaCl) to reduce the negative impacts on the environment.
5.5	Expand municipal tree planting programs and partnerships to include urban and rural tree planting on public and private properties.
5.6	Integrate the Clarington Urban Forestry Strategy and Clarington's development guidelines.
5.7	Establish municipal tree canopy, biodiversity and green space targets for urban areas.
5.8	Update parks maintenance programs to include vegetation and tree species that are resilient to extreme heat, extreme weather, and invasive species.
5.9	Investigate environmentally friendly road surface treatments to control dust.

6) Minimize Disruptions to Corporate Operations and Services

Increased frequency of extreme weather will increase the risk of disruptions to municipal operations and services. The Municipality will take actions to prepare for extreme weather to avoid disruptions to municipal services and ensure the needs of the community continue to be met.

6.1	Plan municipal events and programs with backup dates in the event of cancellations due to extreme weather.
6.2	Revise refund policy for municipal recreation programs to exclude refunds for cancellations due to extreme weather. Instead, provide credits on customer accounts for weather-related cancelations.
6.3	Back up corporate data and store a in location that is not vulnerable to flooding or fire.
6.4	Develop a work-from-home policy that utilizes telecommuting technologies and provides staff with the tools to work from home to avoid weather-related service disruptions and reduce fuel consumption.
6.5	During elections, promote advanced voting, allow a longer time frame for voting during extreme weather and promote online voting options.
6.6	Update the Council Procedural Bylaw to allow Council meetings to be conducted remotely during extreme weather.
6.7	Create an extreme weather policy that identifies the weather condition that will close municipal facilities

7) Build Community Resilience

Climate change will continue to place residents and their property at greater risk due to more extreme and less predictable weather. The Municipality will take actions within its ongoing operations to build community resilience to climate change.

7.1	Establish partnerships with organizations with facilities that could be used as cooling centres during summer heatwaves.
7.2	Create guidelines for non-essential use of water during heatwaves to conserve water.
7.3	Stockpile sandbags and sand to prepare for emergency flooding and store in a location that is protected from UV light.
7.4	Create a dedicated reserve fund for climate-related emergencies and adaptation and mitigation efforts.
7.5	Evaluate the implementation of a stormwater fee (and credit) program to encourage residents and businesses to maintain permeable surfaces on their property and generate funds to upgrade and maintain stormwater management infrastructure.
7.6	Consider the inclusion of incentives for sustainable development in the DC review, ensuring alignment with the Green Development Framework.
7.7	Review the Municipal Insurance Program to ensure adequate coverage for staff and the public during extreme weather events.
7.8	Create a strategy to communicate the risks associated with climate change. Educate the public about the actions that they can take to prepare for extreme weather events.
7.9	Educate elected officials on how the municipality will be impacted by climate change by creating climate risks briefing packages.
7.10	Encourage the federal and provincial governments to dedicate funding to help municipalities adapt to and mitigate climate change.
7.11	Undertake regular departmental risk audits that include climate-related risks to the Municipality.

Implementation

This plan identifies the main risks that climate change presents to the Municipality and actions that can be taken to limit identified climate risks. The amount that the Municipality is impacted by climate change will depend on how successfully this plan is implemented. Successful implementation of this plan will depend largely on four factors:

Council Support – By dedicating resources and commissioning the development of this Climate Action Plan, Council has taken the first steps to prepare the Municipality for climate change. Ongoing support from Council will be essential for the successful implementation of this plan. Staff will continue to align the design and implementation of climate actions with direction from Council.

Funding – Actions contained in this plan will require financial investment to be successful. Staff will work to develop a business case for each action requiring funding and will capitalize on funding opportunities as they become available from the Federal and Provincial Governments. Staff will also seek cost-sharing partnerships where possible. Funds for specific climate actions will be requested as part of the annual municipal budget cycle, taking care to achieve the maximum possible benefits from any funds invested.

Partnerships – Where possible, the Municipality will work to establish partnerships with businesses, community organizations and government agencies in its efforts to successfully implement this plan. Partnerships will be established for mutual benefit to share knowledge and resources for the purpose of solving the problems presented by climate change. Partners may include utility companies, conservation authorities, academic institutions, non-governmental organizations and community groups. Internally, interdepartmental cooperation will be essential to the success of this plan. Climate change will impact the operation and services provided by all departments. By coordinating efforts across the corporation, the Municipality will be in the best position to succeed in its efforts to respond to climate change.

Staff Capacity – Staff who are responsible for coordinating the implementation of climate adaption and mitigation actions will continue to be essential for the Municipality to achieve its climate change and environmental sustainability goals. Dedicated climate change and sustainability staff have greater capacity to engage with community partners, identify funding opportunities and raise awareness about the projected impacts of climate change. Dedicated staff are essential to coordinate climate action efforts across municipal departments and integrate climate change considerations into municipal policies, plans, programs and decision making. Staff are also needed to monitor and report on the Municipality's progress in responding to climate change. The ICCWG will continue to be invaluable in this role.

Guiding Principles

Several principles were identified to guide the successful implementation of climate actions and achieve the vision contained in this plan:

Collaborative – Implementation of this plan will be a collaborative effort by all departments and will seek out partnerships with all levels of government utility companies, conservation authorities, academic institutions, non-governmental organizations and community groups where possible.

Impactful - Actions that prepare the Municipality for the widest range of climate risks will be prioritized for implementation.

Integrated – Where possible, the implementation of actions will contribute to other municipal priorities and initiatives.

Iterative – The implementation of climate actions will be adjusted and enhanced as new information and funding opportunities become available.

Sustainable – Where possible, the implementation of climate actions will advance the sustainability efforts of the Municipality generally.

Climate Action Implementation Schedule

The climate action implementation schedule for this plan was developed to guide the overall process of implementing the actions contained in this plan. The implementation schedule outlines climate actions; the lead department for each action; supporting departments; relevant municipal plans, policies and strategies; potential implementation partners; costs; level of effort and duration of time it will take to implement each action; and whether each action will be one-time or ongoing. See Appendix C to view the climate action implementation schedule in greater detail. Flexibility while implementing this plan will allow the Municipality to integrate new policies, financial resources and partnership opportunities into the implementation process as they become available.

Implementation Tools

A variety of tools are available to enable the Municipality to implement the actions contained in this plan. As part of milestone 4 of the ICLEI BARC tool and the PCP Five Milestone Framework, the Municipality will explore the tools most appropriate to the implementation of each climate action. Implementation tools include:

Communications – Staff will regularly update Council on the risks of climate change to the Municipality, progress on implementing climate actions, pathways for action implementation, and the co-benefits of implemented climate actions.

Education and Training – Staff will work to educate staff and Council about the overall impacts of climate change and ways to incorporate climate change considerations into municipal decision-making. Increased knowledge about the impacts of climate change will allow the Municipality to effectively implement climate actions.

Pilots – Where possible, the Municipality will fully integrate climate actions into Municipal operations and decision-making. In situations where the outcomes of climate actions are less predictable, the Municipality can initially assess climate actions through pilot initiatives.

Policy – Corporate policies inform the way the Municipality operates. Where appropriate, the Municipality will integrate climate considerations into corporate policies to ensure long-term integration of climate actions into the municipal, corporate structure.

Monitoring and Evaluation

Monitoring and evaluating the implementation of climate actions on an ongoing basis will enable staff to adjust and optimize climate action implementation and ensure the highest level of success. Progress on the implementation of climate adaptation actions will be monitored using key performance indicators (KPIs) that are tailored to each climate action. Mitigation actions will be monitored by tracking customized KPIs and corporate GHG emissions. Specific KPIs for each climate action are included in the Climate Action Implementation Schedule (Appendix C) and will be refined during the development of the Climate Action Implementation Plan.

Municipal staff will complete an annual climate action report that will be submitted to Council and posted on the Municipal website. The annual report will summarize KPIs and GHG emissions, highlight successes and lessons learned throughout the action implementation process, and provide an overview of the work that will be undertaken in the following year. This corporate climate action plan is a living document that will be adapted throughout the implementation process. The plan will be updated every five years. Updates to the Plan will incorporate lessons learned from implementing the Plan and will be updated based on the current context, Council priorities and new opportunities.

Next Steps

The first step in implementing this plan will be to identify climate actions that can be implemented immediately without the need for significant planning or financial inputs. The ICCWG will also create an implementation plan that will guide the implementation of climate actions outlined in this plan over a 5-year term. The implementation plan will be divided into 1-year terms, aligning with the Municipality's annual budget cycle. The implementation plan will identify the year within which each action will be undertaken and highlight key responsibilities, supporting tasks, implementation co-benefits, timelines, financial projections, and KPIs for each action.

Once the implementation plan is complete, ad-hoc action-specific working groups will be formed to implement each action based on the timeline outlined in the implementation plan. Where needed, action-specific working groups will create work plans that detail specific budget needs, timelines, key responsibilities, implementation activities and KPIs to measure completion.

Conclusion

By implementing this corporate climate action plan, the Municipality of Clarington is fulfilling its responsibility to work in the best interests of the community. The knowledge contained in this plan will enable the Municipality to make informed decisions to limit GHG emissions that are contributing to climate change and minimize the impacts that climate change will have on the Municipality. By implementing this plan, the Municipality will take climate change into consideration as part of ongoing municipal operations and work to ensure Clarington remains a safe, healthy and economically prosperous place to live.

Appendices

Appendix A - CCCAP Participants

Report Authors

Doran Hoge, Energy and Climate Change Response Coordinator, Planning and Development Service

Jenna Salvatore, Environmental Summer Student, Planning and Development Services

Interdepartmental Climate Change Working Group (ICCWG)

Al Meraw, Lead Hand, Facilities, Community Services

Alexandra Baker, Financial Analyst, Financial Services

Amy Burke, Senior Planner, Planning and Development Services

Andrew Allison, Chief Administrative Officer, Office of the CAO

Ben Pegles, Capital Works Coordinator, Public Works

Brent Rice, Chief Building Official, Planning and Development Services

Catherine Carr, Internal Audit Manager, Financial Services

Erica Mittag, Community Development Coordinator, Community Services

Erika Watson, Asset Management and Development Financing Manager, Financial Services

Karen Richardson, Manager, Development Engineering, Public Works

Leanne Walker, Communication / Social Media Specialist, Office of the CAO

Lockie Longhurst, Fleet Supervisor, Public Works

Michael Ste. Croix, Accountant, Financial Services

Randy Cowan, Deputy Chief, Emergency and Fire Services

Sandra McKee, Assistant Purchasing Manager, Financial Services

Tim Calhoun, Deputy Chief, Emergency and Fire Services

Workshop Participants

Adam Dunn, Senior Plans Examiner, Planning and Development Services

Adrienne Nazarko, Employee Relations Representative, Corporate Services

Al Meraw, Lead Hand, Community services

Alexandra Baker, Financial Analyst, Financial Services

Amy Burke, Senior Planner, Planning and Development Services

Andrew Payne, Planner I, Planning and Development Services

Anne Taylor Scott, Senior Planner, Planning and Development Services

Ashley Moss, Older Adult Programmer, Community Services

Basia Radomski, Corporate Communications Officer, Office of the CAO

Becky Rogers, Senior Buyer, Corporate Services

Brent Rice, Chief Building Official, Planning and Development Services

Brett Novak, Roads Supervisor, Public Works

Brianna Bate, Acting Recreation Programmer, Community Services

Catherine Carr, Internal Audit Manager, Financial Services

Clint Peters, Supervisor, Public Works

Cody Brown, GIS Technician, Planning and Development Services

Dan Welsh, Facilities Supervisor, Community Services

David Ferguson, Purchasing Manager, Financial Services

Doran Hoge, Climate Change Response Coordinator, Planning and Development Services

Erica Mittag, Community Development Coordinator, Community Services

Erika Watson, Asset Management and Development Financing Manager, Financial Services

Frances Delany, Project Coordinator, Ontario Climate Consortium

George Acorn, Director, Community Services

Glen Milner, Senior Project Manager, Ontario Climate Consortium

Gord Weir, Fire Chief/Clarington Emergency Management Coordinator, Emergency and Fire Services

Greg Bunker, Planner II, Planning and Development Services

Heather Lynch, Administrative Assistant, Financial Services

Jason Muir, Lead Hand, Community Services

Jenna Salvatore, Environmental Summer Student, Planning and Development Services

Jenna Stevenson, Temporary Fitness Programmer, Community Services

Jennifer Stycuk, Community Development Coordinator, Community Services

Jessica Ward, Communications Coordinator, CAO

Jim Campbell, Facility Lead Hand, Community Services

Joanne Barchard, Law Clerk, Legislative Services

Kara Ross, Aquatic Programmer, Community Services

Karen Richardson, Manager, Development Engineering, Public Works

Katelyn Brown, Customer Services Coordinator, Community Services

Ken Ferguson, Facilities Supervisor, Community Services

Ken Mercer, Operations Supervisor, Public Works

Kersti Pascoe, Older Adult Coordinator, Community Services

Khaoula Bengezi, Researcher, York University

Kristina Dokoska, Project Coordinator, Ontario Climate Consortium

Larry Postill, Operations Supervisor, Roads, Public Works

Lauren Alexander, Acting Recreation & Fitness Coordinator, Community Services

Leanne Walker, Communications / Social Media Specialist, Office of the CAO

Lee-Ann Reck, Client Services Manager, Community Services

Lindsey Patenaude, Licensing Clerk, Legislative Services

Lockie Longhurst, Fleet Supervisor, Public Works

Mark Jull, Planner I, Planning and Development Services

Mark Sutherland, Facilities Supervisor, Community Services

Megan Elliot, Business Manager, Clarington Public Library

Michael Ste. Croix, Accountant, Financial Services

Natalie King, Clerk II, Legislative Services

Paul Creamer, Deputy Treasurer, Financial Services

Peter Windolf, Manager of Park Development, Public Works

Randy Cowan, Deputy Chief, Emergency and Fire Services

Rob Groen, Supervisor of Buildings and Property, Community Services

Ruth Porras, Senior Planner, Planning and Development Services

Sandra McKee, Assistant Purchasing Manager, Financial Services

Sarah Vaisler, Deputy Director, Clarington Public Library

Sean Bagshaw, Capital Works Engineer, Public Works

Shahzad Mir, Planner, Community Planning and Design, Planning and Development Services

Stephen Brake, Manager of Operations, Public Works

Stephen Myers, Recreation Services Manager, Community Services

Steve Burns, Facility Lead Hand, Community Services

Theresa Gamble, Administrative Assistant, Planning and Development Services

Tim Calhoun, Deputy Chief, Emergency and Fire Services

Tracey Leonard, Aquatic Coordinator, Community Services

Wendy Gorniak, Administrative Assistant, Community Services

Appendix B - Glossary and Acronyms

Glossary

The definitions below are adapted from the Federation of Canadian Municipalities (FCM) and the Intergovernmental Panel on Climate Change (IPCC). FCM is made up of a collective of over 2,000 Canadian municipalities working to solve key issues that impact municipalities, including climate change. The IPCC is an intergovernmental organization of the United Nations that is dedicated to providing objective, scientific information about the risks related to climate change.

Adaptive Capacity - The ability of social, natural, economic, political, and institutional systems to adjust to change, moderate potential damage, take advantage of opportunities, and cope with the consequences.

Baseline - The state against which change is measured. A baseline can be a reference point or period for projected climate changes that is used to compare climate fluctuations between one period and another.

Carbon Footprint - The total amount of carbon generated by an individual, event, organization, service or product over a period of time.

Carbon Neutral - Achieving net zero carbon dioxide emissions by balancing carbon dioxide emissions with removal (often through carbon offsetting) or by eliminating carbon dioxide emissions altogether.

Carbon Sequestration - The process of capturing and storing carbon dioxide naturally through trees and plants or through the capture and storage of CO_2 produced by industry.

Climate - The overall weather conditions of a place over an extended period of time. Unlike short-term weather events, climate is relatively stable and predictable over time.

Climate Adaptation - An action or initiative taken to help adjust to actual or expected climate impacts, which reduce the effects of climate change on people, society, infrastructure, and/or the environment.

Climate Change - Climate change refers to changes in global or regional climate patterns caused by natural phenomena and human activity that alter the chemical composition of the atmosphere through the build-up of greenhouse gases. Greenhouse gases trap heat from the sun in the Earth’s atmosphere and reflect it back to the Earth’s surface.

Climate Change Scenario - A simplified representation of the future climate based on a set of climatological relationships that have been constructed using evidence-based modelling to investigate the potential consequences of climate change.

Climate Impact - The effects of extreme weather and climate change on natural and human systems. Impacts generally refer to effects on health, ecosystems, economies, societies, cultures, services, and infrastructure.

Extreme Weather Events - Rare meteorological events that occur at a place and time of year beyond the normal range of activity. Extreme weather events include droughts, extreme heat, extreme precipitation, hurricanes, tornados and wildfires.

Fossil Fuels – Fuels containing carbon that were formed as a result of geologic processes acting on the remains of organic matter produced by photosynthesis. Fossil fuel sources include coal, oil and natural gas.

Global Climate Models (GCMs) - Global climate models are based on well-documented physical processes and use mathematical equations to characterize how energy and matter interact in different parts of the ocean, atmosphere and on land. These models are used to estimate changes in climate due to increased GHGs.

Greenhouse Gas (GHG) Emissions - Natural and industrial gases that stop heat energy from escaping the Earth’s atmosphere, resulting in global warming. Water vapour (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary GHGs in the Earth's atmosphere.

Heatwave - A prolonged period of extremely high temperatures for a region. A heatwave can be the result of climate change and can affect agriculture, human health and ecosystems. Environment Canada issues heatwave warnings for central and southern Ontario when two consecutive days of daytime maximum temperatures are expected to reach 31ºC or when two consecutive days of humidex values reach 40ºC or more.

Maladaptation - The failure to adjust adequately or appropriately to an environment or situation. Maladaptation can result in increased vulnerability to climate change. One example of maladaptation is any adaptation action that increases greenhouse gas emissions, as it will increase the likelihood of climate change, which will require the need for further adaptation.

Mitigation - Actions that contribute to the reduction of greenhouse gas concentrations in the atmosphere, including policy, regulatory and project-based measures. Examples of mitigation actions include renewable energy and energy efficiency programs that reduce greenhouse gas emissions.

Renewable Energy - Any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use. The five renewable sources that are used most often are wind, solar, biomass, hydropower and geothermal.

Resilience - The ability to anticipate, prepare for and respond to hazardous events, trends, or disturbances related to climate change. Improving climate resilience involves assessing how climate change will create new or alter current climate-related risks and taking preemptive steps to minimize these risks.

Risk - Risk can be considered as the combination of an event, its likelihood and its consequences – risk equals the probability of climate hazard multiplied by the consequence of that event.

Sensitivity - The degree to which a given system is directly or indirectly affected (either adversely or beneficially) by climatic conditions (i.e. temperature increases) or a specific climate change impact (i.e. increased flooding).

Vulnerability - The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of both the sensitivity and the adaptive capacity of a given sector.

Weather - The short-term atmospheric conditions of a specific location, including temperature, cloudiness, rainfall, wind and other meteorological conditions.

Acronyms

BARC - Building Adaptive and Resilient Communities

CCCAP - Clarington Corporate Climate Action Plan

ECDM - Energy Conservation and Demand Management

FCM - Federation of Canadian Municipalities

GHG - Greenhouse Gases

ICCWG - Interdepartmental Climate Change Working Group

ICLEI - International Council for Local Environmental Initiatives

IPCC - Intergovernmental Panel on Climate Change

KPI - Key Performance Indicators

MCIP - Federation of Canadian Municipalities Municipal Climate Innovation Program

OCC – Ontario Climate Consortium

PCP - Partners for Climate Protection

Appendix C - Climate Action Implementation Schedule

Key	Description
Action	The action that will be developed and implemented by the Municipality
Lead Department	The department(s) that will take the lead developing and implementing the climate action
Supporting Departments	Departments that will support the lead department in implementing the climate action
Indicators	Proposed measurements to evaluate the success of implementing climate actions. All mitigation actions
Associated Municipal Plan/ Policy/ Strategy	Plans, policies and strategies that will inform the development and implementation of the climate action.
Potential Partners	Potential partners and stakeholders who could support the design and implementation of climate actions.
Cost	$ = Low Cost $0-$100,000 $$= Medium Cost $100,000-$500,000 $$$= High Cost $500,000+
Level of Effort	Low - Action requires a low level of effort to implement Medium - Action requires a moderate level of effort to implement High - Action requires a high level of effort to implement
Duration	Short-term - Action will be undertaken over a 1-2 year period Medium-term - Actions will be undertaken over a 3-5 year period Long-term - Action will be undertaken over 5 or more years
Frequency	One time - Single action will be taken Recurrent - Several actions will be taken Ongoing - Action implemented as an organizational process or integrated into policy

Reduce Corporate GHG Emissions

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.1	Encourage waste and recycling service providers document GHG emissions on invoices submitted to the Municipality to help the Municipality track it's GHG emissions more easily.	Community Services	Finance	Municipality of Clarington Official Plan: Chapter 5.5 Sustainable Design and Climate Change	Region of Durham	$	Low	Short-term	Ongoing
1.2	Consider building envelope upgrades, building automation and lighting upgrades as part of all building renewal projects.	Community Services		Clarington Energy Conservation and Demand Management Plan	Clean Air Partnership	$$	High	Long-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.3	Install/upgrade Building Automation Systems (BAS) and Smart Thermostats in municipal buildings.	Community Services		Clarington Energy Conservation and Demand Management Plan		$$$	High	Medium-term	One time
1.4	Continue to convert all lighting in municipal buildings to energy efficient LEDs.	Community Services		Clarington Energy Conservation and Demand Management Plan		$$	Medium	Long-term	Ongoing
1.5	Expedite actions outlined in the 2019 Clarington Energy Conservation Demand Management Plan.	Community Services	Finance	Clarington Energy Conservation and Demand Management Plan	Energy Utilities	$-$$$	High	Long-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.6	Offset the use of petroleum-based natural gas with renewable natural gas in buildings through renewable natural gas purchasing agreements.	Community Services		Clarington Energy Conservation and Demand Management Plan		$$	High	Medium-term	Ongoing
1.7	Establish a policy to replace all appliances with Energy STAR rated appliances.	Community Services		Clarington Energy Conservation and Demand Management Plan		$	Medium	Medium-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.8	Install Smart Water Metering to major equipment at facilities and parks (i.e. ice rinks, pools and splash pads) to better understand water consumption trends and ensure that equipment is operating at optimal efficiency.	Community Services		Clarington Energy Conservation and Demand Management Plan	Energy Utilities	$$$	High	Medium-term	One time
1.9	Conduct utility consumption audits in municipal facilities, beginning with buildings with the highest potential for savings.	Community Services		Clarington Energy Conservation and Demand Management Plan	Energy Utilities	$	Low	short-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.10	Conduct building re-commissioning to optimize building operations where applicable.	Community Services		Clarington Energy Conservation and Demand Management Plan		$$	High	Medium-term	Recurrent
1.11	Replace mechanical equipment (boilers, chillers, air conditioning units) in remaining facilities with high efficiency according to building assessments.	Community Services		Clarington Energy Conservation and Demand Management Plan		$$$	High	Medium-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.12	Implement and energy management system (EMS) to track utility bills to monitor energy consumption and GHG emissions, and inform building maintenance and recommissioning	Community Services		Clarington Energy Conservation and Demand Management Plan	Energy Utilities	$	Low	Short-term	One time
1.13	Assess and retrofit buildings with insulation where possible to reduced energy consumption.	Community Services		- Increased infrastructure resiliency to climate change		$$	High	Medium-term	One time
1.14	Incentivize municipal staff to choose low carbon transportation options including: carpooling, cycling and adopting EVs.	Corporate Services			Clean Air Partnership	$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.15	Expand corporate waste reduction and diversion initiatives to further reduce waste and promote recycling and composting.	Facilities		Municipality of Clarington Official Plan: Chapter 5.5 Sustainable Design and Climate Change	Region of Durham	$	Low	Long-term	Ongoing
1.16	Develop a Green Procurement Policy that aligns procurement and vendor selection with the climate resilience and mitigation goals outlined in the CCAP.	Finance				$	Low	Medium-term	One time
1.17	Include a line item in the annual budget to provide funding for studies and/or components of capital projects that support the implementation of the CCAP.	Finance	Office of the CAO			$$	Medium	Short-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.18	Establish a Green Revolving Fund (GRF) that is dedicated to funding energy efficiency, renewable energy, and/or sustainability projects that generate cost savings.	Finance		Clarington Energy Conservation and Demand Management Plan	Clean Air Partnership The Green Infrastructure Ontario Coalition	$	Low	Short-term	Ongoing
1.19	Review and update municipal anti-idling by-law and consider expanding idle-free zones.	Legislative Services		Clarington Anti-idling bylaw	Region of Durham, Durham Area Municipalities, Clean Air Partnership, Natural Resources Canada	$	Medium	Medium-term	One time
1.20	Create a Corporate Energy Commodity Policy that prioritizes energy savings, locally produced energy and low carbon energy options.	Office of the CAO	Planning & Development Services, Public Works	Clarington Energy Conservation and Demand Management Plan	Energy Utilities	$	Low	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.21	Create corporate protocols to incorporate climate change considerations into Council reports.	Office of the CAO	Finance	Municipality of Clarington Official Plan: Chapter 5.5 Sustainable Design and Climate Change		$	Low	Short-term	One time
1.22	Undertake a feasibility study to identify opportunities for the Municipality of to generate and sell renewable energy.	Office of the CAO		Clarington Energy Conservation and Demand Management Plan, The Atmospheric Fund, The Ontario Energy Board Act	Energy Utilities	$$	Medium	Medium-term	One time
1.23	Develop a communications plan to share corporate progress on climate action with staff and the public on an ongoing basis.	Office of the CAO	Corporate Services			$	Medium	Long-term	Recurrent
1.24	Investigate the feasibility for District Energy Systems in new and existing secondary plan areas.	Planning & Development Services		Municipality of Clarington Official Plan: Chapter 5.5 Sustainable Design and Climate Change	Energy Utilities, Natural Resources Canada, The Atmospheric Fund	$$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.25	Update the Priority Green Clarington Green Development Framework criteria checklists to include considerations for climate change mitigation and adaptation.	Planning & Development Services	Public Works	Priority Green Clarington: Green Development Framework and Implementation Plan	Federation of Canadian Municipalities, Clean Air Partnership	$	Medium	Short-term	One time
1.26	Update Clarington's Planning and Development Design Standards and Guidelines to align with the Clarington Priority Green Development Framework to support moving toward net zero communities.	Planning & Development Services Public Works		Priority Green Clarington: Green Development Framework and Implementation Plan	Federation of Canadian Municipalities, Clean Air Partnership	$	Medium	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.27	Complete the implementation of Clarington's Green Development Standards, including the development of a program guidebook, application instructions, and terms of reference for sustainability reporting.	Planning & Development Services	Public Works	Priority Green Clarington: Green Development Framework and Implementation Plan		$$	High	Long-term	Ongoing
1.28	Establish beyond-code energy efficiency design standards for new municipal buildings	Planning & Development Services	Community Services	Municipality of Clarington Official Plan: Chapter 5.5 Sustainable Design and Climate ChangePriority Green, Green Development Framework and Implementation Plan	Natural Resources Canada	$$	Medium	Long-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.29	Conduct a review of existing Community Improvement Plans to evaluate the potential for program expansions to support corporate energy efficient retrofits.	Planning & Development Services	Community Services	Bowmanville, Newcastle and Orono Community Improvement Plans (CIPs)	Region of Durham	$	Medium	Medium-term	One time
1.30	Update the Municipal Green Fleet Strategy and establish a five-year plan to electrify municipal fleet vehicles where practicable.	Pubic Work	Finance, Community Services	Energy Conservation and Demand Management Plan Durham Community Energy Plan Durham Community Climate Adaptation Plan	Region of Durham, Durham Area Municipalities, Clean Air Partnership	$	Low	Short-term	One time
1.31	Complete the conversion of outdoor lighting in parks and streetlights to energy efficient LEDs	Public Works Community Services		Clarington Energy Conservation and Demand Management Plan		$$	Medium	Long-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
1.32	Implement a Municipal Automatic Vehicle Location Monitoring System (AVL) in fleet vehicles to track fuel consumption, evaluate idling and optimize routes for regular travel	Public Works			Clean Air Partnership	$$	Medium	Short-term	One time
1.33	Purchase electric tools and equipment where possible.	Public Works	All Departments	Clarington Energy Conservation and Demand Management Plan	Clean Air Partnership	$$	Medium	Short-term	One time
1.34	Right-size fleet vehicles based on their use to reduce fuel consumption.	Public Works	All Departments		Clean Air Partnership	$$$	Medium	Medium-term	One time
1.35	Integrate green infrastructure and Climate Change into Clarington's Asset Management Plan.	Public Works-Fleet		Clarington Asset Management Plan Green Infrastructure Ontario	Clean Air Partnership The Green Infrastructure Ontario Coalition	$	Medium	Medium-term	Recurrent

Maintain Public and Workplace Health and Safety

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.1	Extend pool hours during extreme heat, taking into consideration staffing, infrastructure and maintenance needs	Community Services		# of cases of illness related to extreme heat		$$	High	Short-term	Recurrent
2.2	Ensure water and sunscreen are available to staff during all municipal summer outdoor events.	Community Services		# of cases of illness related to extreme heat		$	Medium	Short-term	Ongoing
2.3	Allow outdoor activities to be held at indoor recreation facilities during extreme heat events where possible.	Community Services		# of cases of illness related to extreme heat		$$	Medium	Short-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.4	Design summer outdoor community programming to take into consideration extreme heat to ensure staff adequately prepared.	Community Services		# of cases of illness related to extreme heat		$$	Medium	Medium-term	Ongoing
2.5	Ensure staff have access to cool rest areas for relief during extreme heat.	Community Services		Decreased # of cases of illness related to extreme heat	Workplace Health and Safety Policies	$	Low	Long term	Ongoing
2.6	Update safety training for staff to incorporate extreme weather risks associated with climate change including extreme heat.	Corporate Services	All Departments	- # of cases of injury/accidents related to heat extreme weather events	Municipality of Clarington Emergency Plan, Workplace Health and Safety Policies	$	Low	Short-term	Ongoing
2.7	Establish protocols for staff during extreme wind events. Identify "Shelter in Place" safe zones for staff.	Corporate Services		# of cases of injury/accidents related to extreme weather events	Workplace Health and Safety Policies	$	Low	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.8	Create/update workplace policies to mandate weather-appropriate clothing to protect staff against extreme weather conditions including heat, cold, windy and wet conditions.	Corporate Services		# of cases of illness related to extreme weather	Workplace Health and Safety Policies	$	Low	Short-term	One time
2.9	Update municipal emergency contact lists annually.	Corporate Services		# of cases of injury/accidents related to extreme weather events, Emergency contact list is up-to date (yes/no)	Municipality of Clarington Emergency Plan	$	Low	Short-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.10	Incorporate weather monitoring into staff management processes to forecast staff needs and ensure there are enough staff available to respond to extreme weather such as snowstorms and ice storms.	Corporate Services	Public Works	# of cases of injury/accidents related to extreme weather events, # of service disruptions		$$	Medium	Long-term	Ongoing
2.11	Expand online safety training program to ensure safety training accessible to staff in the field.	Corporate Services		# of cases of injury/illness related to extreme weather events	Workplace Health and Safety Policies	$$	Medium	Short-term	Ongoing
2.12	Expand mutual aid agreements with other municipalities to avoid labour and equipment shortfalls during weather-related emergences.	Emergency and Fire		- # of cases of injury/accidents related to extreme weather events	Municipality of Clarington Emergency Plan	$	Low	Medium-term	One-time

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.13	Ensure adequate resources are in place to ensure adequate response to the increased frequency of climate-related emergencies.	Emergency and Fire		- response time to extreme weather-related emergencies	Municipality of Clarington Emergency Plan	$$$	High	Long-term	Ongoing
2.14	Update the Clarington Emergency Plan to incorporate a strategy for extreme weather based on climate projections.	Emergency and Fire		# of cases of injury/accidents related to extreme weather events, Emergency Response Strategy developed (yes/no)	Municipality of Clarington Emergency Plan	$	Medium	Medium term	One time
2.15	Work with stakeholders to identify and promote the location of evacuation centres to the public.	Emergency and Fire, Office of the CAO		Evacuation centres identified in the municipality (yes/no) # of cases of injury/accidents related to extreme weather events	Municipality of Clarington Emergency Plan	$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.16	Develop an extreme heat policy that establishes maximum outdoor working temperatures for staff and enables staff to complete outdoor work during the cooler times of the day.	Emergency and Fire, Corporate Services	Community Services	# of cases of illness related to extreme heat	Workplace Health and Safety Policies	Ontario Ministry of Labour	$	Low	Short-term
2.17	Extend library hours to keep libraries open to the public during extreme heat and cold weather.	Office of the CAO	Legislative Services, Library	# of cases of illness related to extreme heat and cold events	Clarington Public Library Strategic Plan		$$	Medium	Short-term

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.18	Create a communications strategy that clearly categorises levels of weather-related risk and communicates actions that should be taken to by the public and stay safe.	Office of the CAO	Communications	# of injuries/accidents related to hazardous weather conditions	Municipality of Clarington Emergency Plan	Region of Durham Emergency Management Office and Social Services Department, Emergency Management Ontario	$	Medium	Medium-term
2.19	Incorporate shade structures and trees in the designs of outdoor recreation areas for relief from extreme heat.	Public Works	Community Services	# of cases of illness related to extreme heat			$$	Medium	Long-term

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.20	Increase signage near municipally owned and maintained bodies of water including beaches and stormwater management ponds, warning about the dangers of thin ice.	Public Works		# of injuries/accidents related to at municipally owned and maintained bodies of water.	Municipality of Clarington Emergency Plan	Region of Durham Emergency Management Office and Social Services Department, Emergency Management Ontario, Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$	Medium	Medium-term

Action Number	Action	Lead Department(s)	Supporting Departments	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
2.21	Identify roadways that are the least likely to be impacted by flooding and incorporate them into community emergency evacuation plans.	Public Works	Fire and Emergency Services	Emergency Response Routes identified? (yes/no)	Municipality of Clarington Emergency Plan	Region of Durham Emergency Management Office and Social Services Department, Emergency Management Ontario, Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$$	Medium	Short-term
2.22	Incorporate textured, slip proof floor surfaces into the design of public spaces.	Public Works	Community Services, Planning and Development Services	# of cases of injury/accidents related to extreme weather events			$$	Medium	Medium-term

Minimize Risks to Buildings and Property

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
3.1	Utilize climate projections to assess which municipal buildings are at risk due to extreme weather. Prioritize building upgrades based on identified risk.	Community Services		# of reported damage to buildings from extreme weather events			$	Medium	Long-term	Recurrent
3.2	Update design standards for municipal buildings using climate projections to ensure municipal buildings are resilient to extreme weather.	Community Services		# of reported damage to buildings from extreme weather events			$$-$$$	Medium	Short-term	recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
3.3	Work with the Conservation Authorities to update flood mapping based on the most up-to-date climate projections.	Planning & Development Services		# of reported properties experiencing flooding	Clarington Flood Response Plan	Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$$	High	Medium-term	One time
3.4	Update zoning bylaws to prohibit development in flood hazard areas.	Planning & Development Services		# of reported properties experiencing flooding	Zone Clarington	Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$	Low	Short-term	One time
3.5	Include natural hazards and climate projections as criteria in Clarington's Land Acquisition Strategy.	Planning & Development Services		Extreme weather-related property damage, Updated Land Acquisition Strategy (yes/no)	Clarington's Land Acquisition Strategy	Environment Canada	$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
3.6	Assess the municipal trail system to determine areas that are most vulnerable to flooding based on climate projections.	Public Works		# of reported properties experiencing flooding		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority, Environment Canada	$	Medium	Short-term	One time
3.7	Update trail design standards to take into account accurate climate projections.	Public Works		# of reported properties experiencing flooding		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority, Environment Canada	$	Medium	Short-term	One time
3.8	Utilize climate projections to identify areas of roads that are vulnerable to flooding. Create a plan to upgrade road areas that are at high risk.	Public Works		Decreased # of reported properties experiencing flooding			$$	High	Medium-term	One time

Strengthen the Resilience of Municipal Infrastructure

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.1	Assess the depth of wells that service corporate buildings to ensure water will be available during a drought and establish a mitigation plan for managing drought	Community Services		# well water shortages			$	Medium	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.2	In new building designs and building retrofits, locate cooling condensers on the shady side of the building. Ensure proper ventilation and maintenance for efficient operation.	Community Services		energy consumption, utility expenditures, equipment service life			$$	Medium	Medium-term	Recurrent
4.3	Increase backup power supply including generators and solar battery storage options at maintenance facilities.	Community Services		# service disruptions, Backup power installed (yes/no)			$$$	Medium	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.4	Update building design standards to incorporate green and reflective roofs into municipal building designs.	Community Services		Utility consumption, Updated design standards (yes/no), Green and reflective roofs installed			$$$	High	Medium-term	One time
4.5	Revise asset management policy and equipment repair and replacement schedules to reflect wear from increased use due to extreme weather.	Corporate Services		Updated Asset Management Corporate Policy (yes/no), Service disruptions due to equipment failure			$	Low	Medium-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.6	Add surge protectors to all electronic equipment and backup batteries to all computers.	Corporate Services		Service disruptions due to equipment failure, Equipment replacement costs			$$	Medium	Short-term	One time
4.7	Store electronic equipment in a location that is secure and not vulnerable to flooding or fire.	Corporate Services		Service disruptions due to equipment failure, Equipment replacement costs			$	Low	Long-term	Ongoing
4.8	Ensure all evacuation centres are equipped with and emergency backup power supply.	Emergency and Fire		# service disruptions, backup power installed (yes/no)			$	Medium	Short-term	Recurrent
4.9	Review zoning regulations to promote ground water permeability.	Planning & Development Services		# of reported properties experiencing flooding			$	Medium	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.10	Utilize water catchment for irrigation in park designs where possible.	Public Works		water consumption for irrigating municipal properties			$$	Medium	Long-term	Ongoing
4.11	Establish a strategy to control invasive plant species that have negative impacts on stormwater management ponds, sightlines, drainage ditches and water quality.	Public Works		Damage to infrastructure from invasive species, Water quality		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority, Ontario Invasive Plant Council Provincial Government	$$	High	Long-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.12	Update the municipal road maintenance plan by increasing the road maintenance cycle to accommodate less predictable freeze/thaw cycles.	Public Works		# of reported damage to infrastructure from freeze and thaw cycles		Ministry of Transportation Ontario, Ontario Good Roads Association	$	Medium	Medium-term	One time
4.13	Assess and upgrade stormwater infrastructure using accurate climate projections.	Public Works		# of reported properties experiencing flooding			$$$	Medium	Medium-term	Ongoing
4.14	Design new splash pads to clean and recirculate water to consume less water.	Public Works		municipal water consumption, utility expenditures			$$	Medium	Medium-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.15	Incorporate lighting into new field designs so they can be used in the evening when outdoor temperatures are cooler.	Public Works	Community Services	accessibility to outdoor areas # service disruptions			$$	Medium	Short-term	Ongoing
4.16	Expand the rural ditching maintenance program to reduce flooding and avoid infrastructure and property damage.	Public Works		# of reported properties experiencing flooding, # reported damage to properties			$$	Medium	Medium-term	One time
4.17	Assess bridges and embankments to determine areas that are most vulnerable to flooding based on climate projections.	Public Works		Vulnerable bridges and embankment identified (yes/no), # of reported properties experiencing flooding			$	Medium	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.18	Upgrade storm water management infrastructure with on-site ponds, cisterns and landscaping decisions to minimize storm water run-off.	Public Works		Stormwater management infrastructure upgraded (yes/no), # of reported properties experiencing flooding			$$-$$$	High	Medium-term	Ongoing
4.19	Expand preventative maintenance and repair program for roads, sidewalks and bridges to mitigate damage due to increased freeze and thaw cycles.	Public Works		# of reported damage to infrastructure from weather conditions			$$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.20	Increase construction standards for higher order roads that are used for hauling to mitigate damage due to increased freeze and thaw cycles.	Public Works		# of reported damage to infrastructure from weather conditions			$$	Medium	Short-term	One time
4.21	Review road weight restrictions to prohibit hauling on local roads. Prioritize hauling on higher order Regional roads.	Public Works		# of reported damage to infrastructure from weather conditions		Ontario Good Roads Association	$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
4.22	Design new parks and sports fields to accommodate flooding and function as stormwater management areas where reasonable to do so.	Public Works		# of reported properties experiencing flooding	Clarington Official Plan		$$	High	Medium-term	Recurrent
4.23	Upgrade existing parks and sports fields with permeable asphalt and other permeable materials to reduce overland flooding.	Public Works		# of reported properties experiencing flooding	Clarington Official Plan		$$-$$$	High	Medium-term	One time

Protect Ecosystems and Biodiversity

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
5.1	Review the implementation of an urban tree preservation bylaw to prevent urban trees from being cut down without a permit.	Planning & Development Services		% of tree canopy cover		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$	Low	Short-term	One time
5.2	Integrate urban heat island projections into the Clarington Urban Forest Strategy. Plant more trees in areas with the greatest potential for becoming urban heat islands.	Planning & Development Services		% of tree canopy cover		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$	Medium	Medium-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
5.3	Require winter maintenance staff become Smart About Salt certified. This program will provide training on the application of road salt to improve winter salting practices and decrease salt-related damage to ecosystems and infrastructure.	Public Works		Salt damage to infrastructure or natural areas, Quantity of salt used, Cost of salt used		Smart About Salt Council	$	Low	Short-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
5.4	Consider alternatives to conventional road salt (NaCl) to reduce the negative impacts on the environment.	Public Works		Salt damage to infrastructure or natural areas, Quantity of salt used, Cost of salt used		Smart About Salt Council	$	Low	Medium-term	One time
5.5	Expand municipal tree planting programs and partnerships to include urban and rural tree planting on public and private properties.	Public Works		% of tree canopy cover		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority, Maple Leaves Forever The Region of Durham	$	Low	short-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
5.6	Integrate the Clarington Urban Forestry Strategy and Clarington's development guidelines.	Public Works		% of tree canopy cover		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$	Medium	short-term	Ongoing
5.7	Establish municipal tree canopy, biodiversity and green space targets for urban areas.	Public Works		established tree canopy, biodiversity and green space targets (yes/no)	Clarington Urban Forest Strategy	- Central Lake Ontario Conservation Authority - Ganaraska Region Conservation Authority	$	Low	Short term	Recurrent
5.8	Update parks maintenance programs to include vegetation and tree species that are resilient to extreme heat, extreme weather, and invasive species.	Public Works	Emergency & Fire	loss of vegetation/trees due to drought and temperature changes		Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority	$	Low	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
5.9	Investigate environmentally friendly road surface treatments to control dust.	Public Works		Identify alternatives to road salt (yes/no)		Ontario Good Roads Association	$	Medium	Short-term	Ongoing

Minimize Disruptions to Corporate Operations and Service Delivery

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
6.1	Plan municipal events and programs with backup dates in the event of cancellations due to extreme weather.	All Departments		# of weather-related service disruptions			$	Low	Short-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
6.2	Revise refund policy for municipal recreation programs to exclude refunds for cancellations due to extreme weather. Instead, provide credits on customer accounts for weather-related cancelations.	Community Service	Finance	Refund policy for extreme weather exists (yes/no)			$	Medium	Short-term	One time
6.3	Back up corporate data and store in a location that is not vulnerable to flooding or fire.	Corporate Services		# of weather-related service disruptions, equipment replacement costs			$	Low	Short-term	Ongoing

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
6.4	Develop a work-from-home policy that utilizes telecommuting technologies and provides staff with the tools to work from home to avoid weather-related service disruptions and reduce fuel consumption.	Corporate Services		- work from home policy exists (yes/no)		Clean Air Partnership	$	Medium	Long-term	Ongoing
6.5	During elections, promote advanced voting, allow a longer time frame for voting during extreme weather and promote online voting options.	Legislative Service		# of weather-related service disruptions		Elections Ontario	$	Low	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
6.6	Update the Council Procedural Bylaw to allow Council meetings to be conducted remotely during extreme weather.	Legislative Services		# of weather-related service disruptions			$	Low	Short-term	One time
6.7	Create an extreme weather policy that identifies the weather condition that will close municipal facilities	Office of the CAO		Extreme weather policy created (yes/no)		Environment Canada	$	Medium	Short-term	Recurrent

Build Community Resilience

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
7.1	Establish partnerships with organizations with facilities that could be used as cooling centres during summer heatwaves.	Community Services	Emergency & Fire	Identified cooling centres (yes/no)			$$	Medium	Short-term	Ongoing
7.2	Create guidelines for non-essential use of water during heatwaves to conserve water.	Community Services	Corporate Services	guidelines exist (yes/no), Municipal water consumption, Expenditure on water		- Conservation Ontario - Source Protection Regions	$	Low	Short-term	One time
7.3	Stockpile sandbags and sand to prepare for emergency flooding and store in a location that is protected from UV light.	Emergency and Fire Services	Public Works	Sandbags stockpiled (yes/no), Property damage due to flooding			$	Low	Short-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
7.4	Create a dedicated reserve fund for climate-related emergencies and adaptation and mitigation efforts.	Finance		Annual municipal expenditures directly related to climate change adaptation			$$	Medium	Short-term	One time
7.5	Evaluate the implementation of a stormwater fee (and credit) program to encourage residents and businesses to maintain permeable surfaces on their property and generate funds to upgrade and maintain stormwater management infrastructure.	Finance	Public Works	% of permeable surfaces/total ground coverage, property damage caused by overland flooding	Clarington Official Plan		$	Medium	Medium-term	One time

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
7.6	Consider the inclusion of incentives for sustainable development in the DC review, ensuring alignment with the Green Development Framework.	Finance	Planning and Development Services	Development charge incentives (yes/no), # of sustainably developments in the Municipality			$$	Medium	Medium-term	Recurrent
7.7	Review the Municipal Insurance Program to ensure adequate coverage for staff and the public during extreme weather events.	Finance		Adequate insurance coverage considering climate impacts (yes/no).			$$	Medium	Medium-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
7.8	Create a strategy to communicate the risks associated with climate change. Educate the public about the actions that they can take to prepare for extreme weather events.	Office of the CAO		# of climate change-related public/corporate events and available information		Local media	$	Low	Short-term	One time
7.9	Educate elected officials on how the municipality will be impacted by climate change by creating climate risks briefing packages.	Office of the CAO		Climate change briefing packages exist (yes/no), # climate change related conversations and decisions by Council			$	Low	Medium-term	Recurrent

Action Number	Action	Lead Department(s)	Supporting Departments	Indicator(s)	Associated Municipal Plan/ Policy/ Strategy	Potential Partners	Estimated Cost	Level of Effort	Duration	Frequency
7.10	Encourage the federal and provincial governments to dedicate funding to help municipalities adapt to and mitigate climate change.	Office of the CAO		# of plans, policies, and programs that include climate adaptation considerations, available funding sources			$	Low	Short-term	One time
7.11	Undertake regular departmental risk audits that include climate-related risks to the Municipality.	Office of the CAO		# of climate related risk audits conducted Risks identified (yes/no)			$	High	Medium-term	Recurrent (every two years)

Appendix D - Actions for Future Consideration

KEY	
Action	The action that will be developed and implemented by the Municipality
Lead Department	The department(s) that will take the lead developing and implementing the climate action
Implementation	All actions in the long list have been categorized as monitor or investigate further. 'Monitor' actions will be monitored regularly. 'Investigate further' actions require further research to assess their achievability. Actions will be considered in future updated to the CCCAP

Reduce Greenhouse Gas Emissions

Action	Lead Department	Implementation
Install geothermal heating and cooling systems for new buildings and during major renovations of older buildings where practical.	Community Services	Monitor
Address "phantom load" management in all facilities by the use of power bars or unplugging equipment when not in use where practical.	Community Services	Monitor
Upgrade fans and blowing equipment in remaining facilities according to building assessments.	Community Services	Monitor
Expand battery collection initiatives zones across municipal facilities.	Community Services	Monitor
Incorporate solar hot water heating into new and existing buildings.	Community Services	Investigate Further

Action	Lead Department	Implementation
Perform External Benchmarking against facilities in other municipalities to identify conservation opportunities.	Community Services	Investigate Further
Install hand dryers and remove paper towel dispensers in bathrooms OR add organic bins in municipal washrooms to encourage compost disposal of paper towels.	Community Services	Investigate Further
Implement an employee training program on energy efficiency and sustainability.	Corporate Services	Monitor
Require all municipal drivers/operators to complete a training program on energy efficient driving.	Corporate Services	Monitor
Explore funding/grant opportunities for innovative pilot projects and opportunities to enhance resilience and reduce greenhouse gas emissions (e.g., heat pump retrofits).	Finance	Monitor
Establish a program that would re-invest funds saved from energy efficiency into other climate change initiatives.	Finance	Investigate Further
Expand the municipality's ban of single-use plastics in municipal facilities to include local businesses and service providers.	Legislative Services	Monitor
Expand library lending to include tools and other household items that could be used by residents and staff to cut down on unnecessary consumption of household goods that are infrequently used.	Library	Investigate Further
Work with the Region of Durham to increase awareness about blue bins and waste programs in Clarington.	Office of the CAO	Investigate Further

Action	Lead Department	Implementation
Consider partnering with the Green Burial Society of Canada to adopt an environmentally sustainable alternative to contemporary burial practices.	Office of the CAO	Investigate Further
Designate areas of the municipality for mixed use, locating commercial, residential, institutional and office uses in close proximity to encourage other methods of transportation than vehicles.	Planning and Development Services	Monitor
Designate land for public green space that can be used to grow community gardens with composting facilities to accommodate residential organic waste and minimize waste send to landfill.	Planning and Development Services	Monitor
Develop and implement methodology to quantify the value of natural systems in Clarington (i.e., parks, riparian areas, natural areas, urban forest, etc.) as a greenhouse gas sink, and incorporate into GHG inventory reporting.	Planning and Development Services	Monitor
Implement sustainable construction practices for municipal buildings to reduce waste through reusing/recycling existing materials, maximizing efficient use of aggregates, using materials that sequester carbon (wood over concrete).	Public Works	Monitor
Reduce corporate water consumption through computer-automated irrigation systems and water-efficient landscaping.	Public Works	Monitor
Extend areas of natural grassland, wood edges and increase area of existing woodlands.	Public Works	Monitor

Maintain Public Health and Safety

Action	Lead Department	Implementation
Extend spring and fall pool opening as needed.	Community Services	Monitor
Ensure all fleet vehicles are equipped with air conditioning where practical.	Corporate Services	Monitor
Train staff on how to drive in a variety of weather conditions.	Corporate Services	Monitor
Train staff on how to prevent vector borne illness.	Corporate Services	Monitor
Provide staff uniforms that reduce vulnerability to ticks and mosquitos.	Corporate Services	Monitor
Designate space for domestic animals at emergency evacuation centres.	Office of the CAO	Monitor
Change minimum care requirements for animals to include extreme heat and other weather-related events and provide generators to animal shelters to maintain heat during winter power outages.	Office of the CAO	Monitor
Provide snowplough drivers with the ability to report unsafe driving during snow and ice conditions (similar to school bus drivers).	Public Works	Monitor
Research alternate misting and low water consumption alternatives for public cooling.	Public Works	Monitor

Action	Lead Department	Implementation
Increase staff complement to conduct maintenance after ice storms. Include fulltime, part time and contract staff.	Public Works	Monitor
Include humidity monitoring in building maintenance regimes.	Public Works	Monitor

Minimize Risks to Buildings and Property

Action	Lead Department	Implementation
Create a building maintenance and replacement reserve fund to prepare and repair buildings vulnerable to extreme weather.	Finance	Monitor
Identify areas at risk for erosion, establish priority areas and take appropriate stabilization actions.	Public Works	Monitor
Conduct a climate vulnerability audit of all buildings.	Public Works	Monitor

Strengthen Infrastructure Resilience

Action	Lead Department	Implementation
Review operating parameters of rink refrigeration systems and adjust as needed.	Community Services	Investigate Further

Upgrade to weather appropriate resilient materials when renewing fields.	Public Works	Monitor

Protect Biodiversity and Ecology

Action	Lead Department	Implementation
Work with the Conservation Authorities to identify, protect and rehabilitate riparian areas that need rehabilitation.	Planning Services	Monitor
Research and implement natural alternatives to reduce mosquito populations.	Public Works	Monitor
Create a program to manage invasive species on rural roadways and roadside ditches that included strategies of managing dog strangling vines, phragmites, ticks and giant hogweed.	Public Works	Monitor
Collaborate with the conservation authorities to expand in-house knowledge of invasive species management.	Public Works	Monitor
Plant trees away from the edge of roads on municipal properties to protect them from road salt.	Public Works	Monitor
Update municipal invasive species management practices to take climate change into consideration.	Public Works	Monitor
Increase roadside grass cutting to reduce the likelihood of roadside fires.	Public Works	Monitor
Create a greenspace/open space management plan to reduce fires, which includes cutting tall dry grasses and eliminating standing deadwood.	Public Works	Monitor

Create standing water bylaws to reduce the amount of standing water on private properties in urban areas.	Public Works	Monitor

Minimize Disruption to Corporation

Action	Lead Department	Implementation
Take advantage of variable weather throughout the year by transitioning Operations tasks from seasonal to year-round where possible.	Public Works	Monitor
Train staff to undertake a greater variety of seasonal tasks to respond to greater seasonal variation.	Public Works	Monitor
create a contractor services registry that includes prequalified contractors that can be called upon for services on short notice.	Public Works	Monitor

Build Community Resilience

Action	Lead Department	Implementation
locate recreation areas near the lakefront to take advantage of the natural cooling effect of late Ontario.	Community Services	Monitor
Work with existent emergency response groups to develop an emergency response strategy for extreme weather.	Emergency and Fire	Monitor

Action	Lead Department	Implementation
Work with the Durham Emergency Management Office to provide risk management education and support to reduce climate change related risks to the public.	Office of the CAO	Monitor
Encourage the Region to expand their public education programming related to recycling practices.	Office of the CAO	Investigate Further

Appendix E - Climate Change Projections

Climate Change Trends in the Municipality of Clarington under the RCP 8.5 scenario

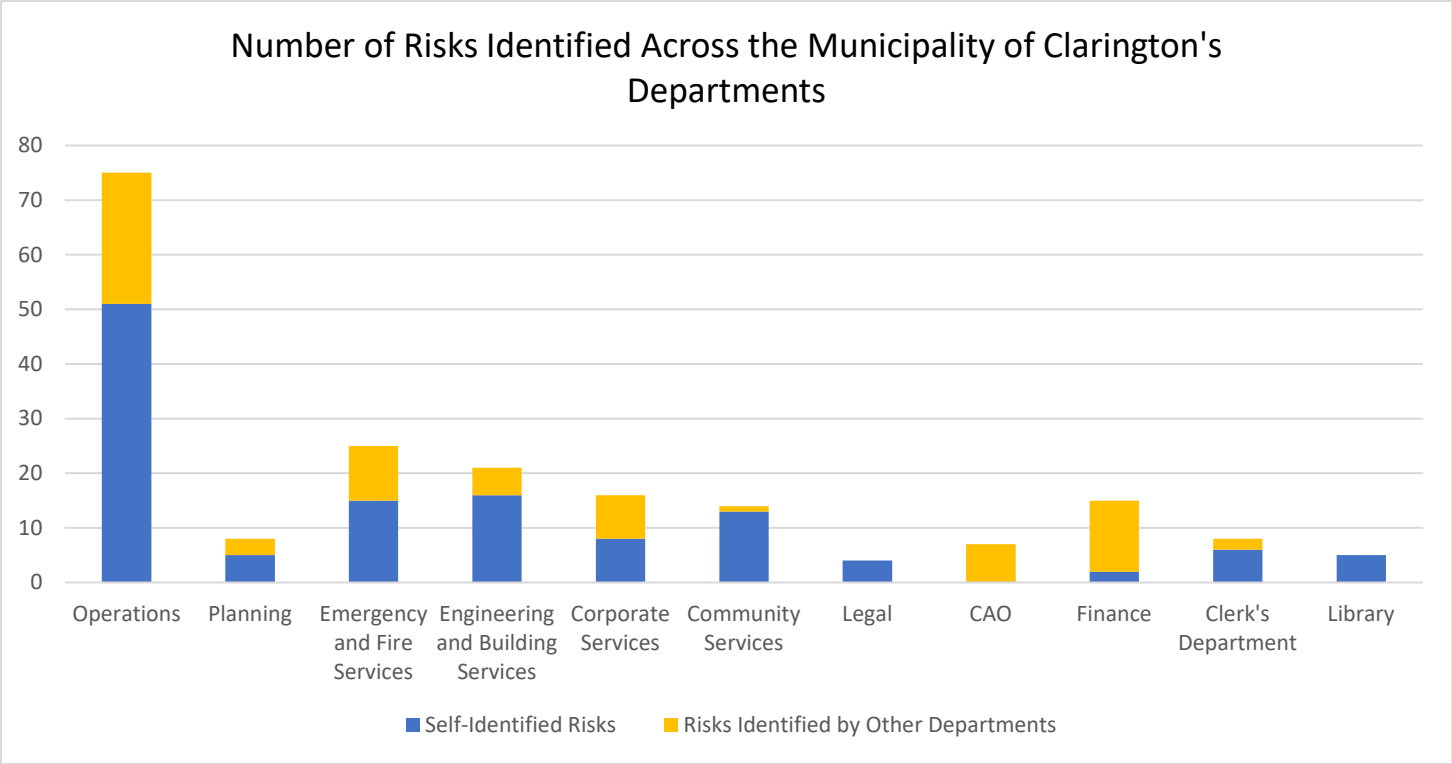
Climate Parameter	Detailed Parameter	1971-2000	2011-2040	2041-2070	2071-2100	Trend
Mean Temperature (°C)	Annual	7.0	8.6	10.1	12.2	↑
	Winter	-3.0	-4.0	-2.5	-0.1	↓
	Spring	3.6	6.8	8.3	10.1	↑
	Summer	17.1	21.0	22.7	24.7	↑
	Fall	10.1	10.4	11.9	14.0	↑
Maximum Temperature(°C)	Max Annual Temperature	11.6	13.1	14.5	16.4	↑
	Max Winter Temperature	2.1	-0.1	1.2	3.2	↑
	Max Spring Temperature	8.3	11.6	12.9	14.6	↑
	Max Summer Temperature	21.4	26.3	27.9	29.9	↑
	Max Fall Temperature	14.5	14.4	15.9	18.0	↑
Minimum Temperature (°C)	Min Annual Temperature	2.4	4.1	5.8	8.1	↑
	Min Winter Temperature	-8.0	-8.3	-6.3	-3.4	↓
	Min Spring Temperature	-1.0	2.0	3.6	5.6	↑

Climate Parameter	Detailed Parameter	1971-2000	2011-2040	2041-2070	2071-2100	Trend
	Min Summer Temperature	12.7	15.9	17.5	19.6	↑
	Min Fall Temperature	5.7	6.6	8.2	10.4	↑
Extreme Heat (days/year)	Days Above 35°C	0.2	0.6	2.1	7.2	↑
	Days Above 30°C	7.6	10.9	20.8	40.3	↑
	Days Above 25°C	42.1	51.1	70.5	93.4	↑
	Days Above 20°C (Tropical Nights)	100.6	111.3	127.9	145.4	↑
Extreme Cold (days/year)	Days Below -20°C	8.6	6.6	3.3	1.0	↓
	Days Below -10°C	49.0	33.8	22.9	12.2	↓
	Days Below 0°C (freezing days)	146.8	127.7	110.3	87.6	↓
Total Precipitation (mm)	Annual (mm/year)	949.7	1059.2	1132.3	1241.9	↑
	Winter (mm/season)	228.3	228.3	255.7	283.1	↑
	Spring (mm/season)	219.2	273.9	292.2	328.7	↑
	Summer (mm/season)	228.3	292.2	301.3	319.6	↑
	Fall (mm/season)	273.9	273.9	283.1	301.3	↑
Extreme Precipitation	Max Precipitation in 1 day (mm)	33.8	51.7	56.1	61.3	↑
	Max Precipitation in 3 days (mm)	54.9	73.1	78.4	86.0	↑

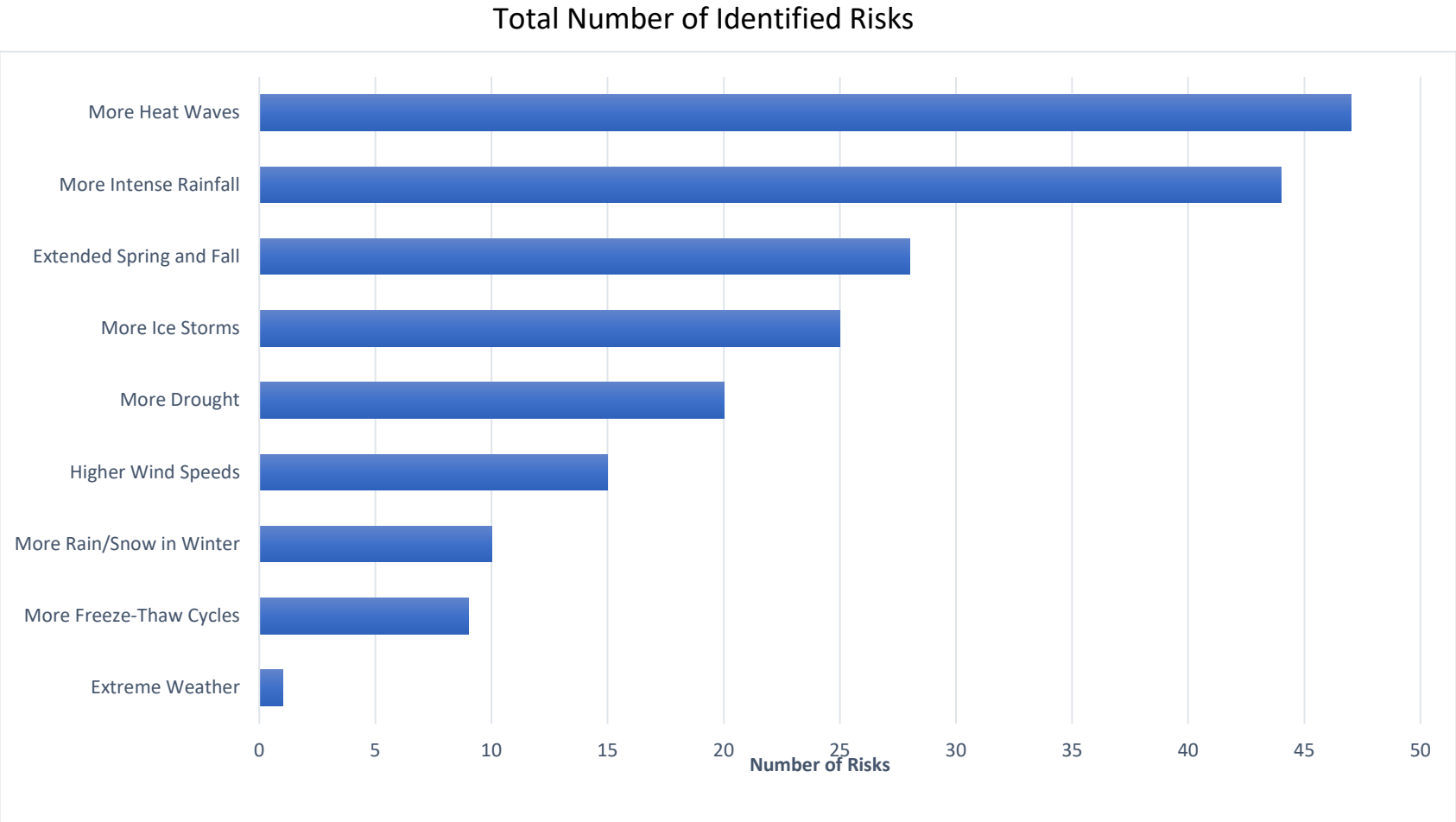
Climate Parameter	Detailed Parameter	1971-2000	2011-2040	2041-2070	2071-2100	Trend
	Simple Daily Intensity Index (SDII) (mm/day)	2.6	2.9	3.1	3.4	↑
	95th Percentile Precipitation (mm)	36.1	45.4	45.9	61.3	↑
	99th Percentile Precipitation (mm)	11.2	15.0	15.2	86.0	↑
Dry Days (days/year)	Total Annual	145.3	199.4	199.6	195.7	↓
	Total Annual Consecutive Dry Days	18.2	22.3	22.3	22.3	-
Growing Season	Growing Season Start Date (day of year)	44330.0	44324.0	44317.0	44304.0	↑
	Growing Season End Date (day of year)	44493.0	44500.0	44509.0	44518.0	↑
	Growing Season Length (days/year)	163.0	178.0	194.0	215.0	↑
Agricultural Variables	Corn Heat Units	3193.9	3610.2	4147.6	4779.9	↑
	Growing Degree Days (Base 0°C)	3197.9	3563.7	4000.4	4552.4	↑
	Canola Growing Degree Days (Base 4°C)	2236.3	2515.4	2892.9	3372.9	↑
	Forage Crops Growing Degree Days (Base 5°C)	2024.5	2285.2	2647.7	3109.0	↑
	Corn and Bean Growing Degree Days (Base 10°C)	1119.2	1304.2	1595.9	1969.0	↑

Climate Parameter	Detailed Parameter	1971-2000	2011-2040	2041-2070	2071-2100	Trend
	Growing Degree Days - Risk of Presence of Pests (Base 15°C)	462.5	587.6	803.0	1090.6	↑
Ice and Snow	Freeze-Thaw Cycles (cycles per year)	79.6	78.6	70.1	59.6	↓
	Ice Potential (days per year)	28.8	15.0	12.0	8.0	↓

Appendix F - Risks and Vulnerability Assessment Outcomes



Number of unique climate risks identified across the Municipality of Clarington's Departments. Blue represents self-identified risks, and yellow represents the risks identified by other departments.



Total number of identified risks within the Municipality of Clarington for each climate parameter examined in this study

Appendix G - Climate Modeling Criteria

Factors	2020 Durham Climate Modeling Summary
Climate Models	8 different GCMs 5 different RCMs
Emissions Scenarios	RCP 8.5 and RCP 4.5 (latest)
Time Period	2020s, 2050s and 2080s
Baseline	1971 - 2000
Regional Averages	Uses all climate stations in Durham Region to develop averages
Climate Parameters	Mean temperature, maximum temperature, minimum temperature, extreme heat, extreme cold, total precipitation, extreme precipitation, dry days., growing season, agriculture variables, freeze-thaw cycle and ice potential

Appendix H - Adaptation and Mitigation Evaluation Criteria

Adaptation Action Evaluation Criteria

Evaluation Criteria		Rating		
		Low (1)	Medium (2)	Hight (3)
Sustainability	Mitigation Co-benefits	Could result in increased GHG emissions	Not likely to affect GHG emissions	Could reduce GHG emissions
	Equity	Benefits only some people	Benefits many people	Significant benefits to many people
	Implementation costs	Cost is high relative to the cost of inaction	Cost is moderate relative to the cost of inaction	Cost is low relative to the cost of inaction
Effectiveness	Robustness	Effective for a narrow range of plausible future scenarios	Effective across many plausible future scenarios	Effective across a wide range of plausible future scenarios
Risk and Uncertainty	Urgency	Impacts are likely to occur in the longer term	Impacts are likely to appear in the near term	Impacts are already occurring

Evaluation Criteria		Rating		
		Low (1)	Medium (2)	Hight (3)
Opportunity	Ancillary Benefits	Will contribute little to other goals and programs in the organization	Will contribute somewhat to other goals and programs in the organization	Will contribute significantly to other goals and programs in the organization
	No Regret	Will have little or no benefit if climate change impacts do not occur	Will have some benefit regardless of actual climate change impacts	Will result in significant benefits regardless of actual climate change impacts
	Window of Opportunity	There is no window of opportunity	A window of opportunity could be created	A window of opportunity exists to implement
Implementation	Political (or public) Acceptability	Could face some public or political opposition	Not likely to receive much public or political attention	Likely receive public / political support
	Funding Sources	Additional funding sources are required but have not been identified	Additional funding sources may be required	Funding is available or not required
	Capacity (information, technical, staff, resources)	Current Capacity is insufficient, and gaps cannot be easily addressed	Gap exit in one or more areas but can likely be addressed	Current capacity is sufficient to implement the action

Evaluation Criteria		Rating		
		Low (1)	Medium (2)	Hight (3)
	Institutional	Implementation requires coordination with, or action by other jurisdictions	Implementation may require externa approval or coordination	Implementation is within our municipality's control

Mitigation Action Evaluation Criteria

Evaluation Criteria		Rating		
		Low (1)	Medium (2)	Hight (3)
Sustainability	Adaptation Co-benefits	Will not contribute climate adaptation	May contribute climate adaptation	Will contribute climate adaptation
	Implementation costs	High Cost	Moderate cost	Low Cost
Effectiveness	Robustness	Effective for a narrow range of plausible future scenarios	Effective across many plausible future scenarios	Effective across a wide range of plausible future scenarios

Evaluation Criteria		Rating		
		Low (1)	Medium (2)	Hight (3)
Opportunity	Ancillary Benefits	Will contribute little to other goals and programs in the organization	Will contribute somewhat to other goals and programs in the organization	Will contribute significantly to other goals and programs in the organization
	No Regret	Will have little or no benefit if climate change impacts do not occur	Will have some benefit regardless of actual climate change impacts	Will result in significant benefits regardless of actual climate change impacts
	Window of Opportunity	There is no window of opportunity	A window of opportunity could be created	A window of opportunity exists to implement
Implementation	Political (or public) Acceptability	Could face some public or political opposition	Not likely to receive much public or political attention	Likely receive public / political support
	Funding Sources	Additional funding sources are required but have not been identified	Additional funding sources may be required	Funding is available or not required

Evaluation Criteria		Rating		
		Low (1)	Medium (2)	Hight (3)
	Capacity (information, technical, staff, resources)	Current Capacity is insufficient, and gaps cannot be easily addressed	Gaps exit in one or more areas but can likely be addressed	Current capacity is sufficient to implement the action
	Institutional	Implementation requires coordination with, or action by other jurisdictions	Implementation may require external approval or coordination	Implementation is within our municipality's control

Appendix I - GHG Emissions Calculations

Municipal Solid Waste Composition Data by Per Cent

Region	Food Waste	Paper / cardboard	Textiles	Rubber / leather	Wood	Plastic	Metal	Glass	Other
North America	33.9	23.2	6.2	3.9	1.4	8.5	4.6	6.5	9.8

	$CO_2\ Emmissions = m \times \sum_i (WF_i \times dm_i \times CF_i \times FCF_i \times OF_i) \times (\frac{44}{12})$
Description	
$CO_2\ Emmissions$	= Total CO2 emissions from incinerated solid waste in tonnes
m	= Mass of waste incinerated
WF_i	= Fraction of waste consisting of type i matter
dm_i	= Dry matter content in the type i matter

	$\boldsymbol{CO_2\ Emmissions = m \times \sum_i (WF_i \times dm_i \times CF_i \times FCF_i \times OF_i) \times (\frac{44}{12})}$
CF_i	= Fraction of carbon in the dry matter of type i matter
FCF_i	= Fraction of fossil carbon in the total carbon component of type i matter
OF_i	= Oxidization fraction or factor
i	= Matter type of the solid waste incinerated such as paper/cardboard, textile, food waste, etc.
	Note: $\sum_i FW_i = 1$
	Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

C02 emissions from waste were calculated based on non-biogenic CO2 emissions from the incineration of waste as presented by the IPCC Guidelines for National Greenhouse Gas Inventories (2006)

	$CH_4\ Emmissions = \sum(IW_i \times EF_i)10^{-6}$
Description	
$CH_4\ Emmissions$	= CH_4 emissions in the inventory year, tonnes
IW_i	= Amount of solid waste of type i incinerated, tonnes
EF_i	= Aggregate CH_4 emission factor, g CH_4 / tonne of waste type i
10^{-6}	= Converting factor from g CH_4 to t CH_4
i	= Category or type of waste incinerated/open-burned, specified as follows: MSW municipal solid waste, ISW industrial solid waste, HW: hazardous waste, CW clinical waste, SS sewage sludge, others.
	Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

CH4 emissions from waste were calculated based on emissions from the incineration of waste using continuous stoker incineration with an incineration factor of 0.02 (IPCC 2006).

	$N_2O\ Emmissions = \sum(IW_i \times EF_i) \times 10^{-6}$
Description	
$N_2O\ Emmissions$	= N_2O Emissions in inventory year, in tonnes
IW_i	= Amount of solid waste of type i incinerated or open burned, in tonnes
EF_i	= Aggregate N_2O emission factor g CH_4 / ton of waste type i
i	= Category or type of waste incinerated/open burned specified as follows: MSW: municipal solid waste, ISW: industrial solid waste, HW: hazardous waste, CW: clinical waste, SS: sewage sludge, others (that must be specified)
	Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

NO2 emissions from waste were calculated based on emissions from the incineration of waste using continuous incineration and a rate of 50g of NO2/t of waste (IPCC 2006).

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