



# Corporate Climate Change Adaptation Plan

Town of Orangeville

2021



# Table of Contents

---

<b>Introduction .....</b>	<b>1</b>
<b>The Changing Climate .....</b>	<b>6</b>
<b>Approach .....</b>	<b>9</b>
<b>Adaptation Planning .....</b>	<b>21</b>
<b>Moving Forward .....</b>	<b>27</b>
<b>References .....</b>	<b>29</b>
<b>Appendices .....</b>	<b>31</b>

# Acknowledgements

---

© 2021, The Corporation of the Town of Orangeville. All Rights Reserved.

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.

## The Climate Action Team

- Brandon Ward – Manager of Planning
- Charles Cosgrove – Manager of Facilities and Parks
- Heather McGinnity – Manager of Environment
- Ruth Phillips – Manager of Economic Development and Culture
- John Lackey – Manager of Transportation and Development
- Tara Clayton – Manager of Public Works
- Allison Myles – Climate Change Co-ordinator

## The Steering Committee

- Andrea McKinney – General Manager of Corporate Services
- Doug Jones – General Manager of Infrastructure Services
- Raymond Osmond – General Manager of Community Services

## Extended Project Team

- Bruce Ewald – Building Manager (CBO)
- Darla Fraser – Librarian
- Jason Hall – Manager of IT
- Jennifer Gohn – Manager of Human Resources
- Irena Kontrec – Risk Management Inspector
- Larysa Russell – Senior Planner
- Sarah Pihel – Project Technologist
- Sharon Doherty – Manager of Recreation and Events
- Sheila Duncan – Manager of Communications
- Tim Thompson – Waterworks Technologist

## Additional Staff Members

The Climate Action Team would also like to acknowledge the additional staff that helped in the identification of vulnerabilities and impacts and through the development and refinement of adaptation actions.

# Executive Summary

---

The Town of Orangeville has developed an actionable Corporate Climate Change Adaptation Plan (“the Plan”) to aid in mainstreaming adaptation across Town operations, planning and decision-making processes. The focus of the Plan is to scope and prepare for the effects of a changing climate on Town-managed infrastructure, assets, and services. The Plan intends to address the broad range of potential risks that climate change poses to Orangeville’s physical, economic, social, and ecological systems. The development of this Plan was guided by ICLEI Canada’s Building Adaptive and Resilient Communities (BARC) Program, a 5-Milestone adaptation planning framework for local governments. Following this framework, a list of actions has been identified for implementation to enhance Orangeville’s ability to address climate change and build local resilience moving forward.



**The Town of Orangeville aims to not only cope with the impacts but thrive as a community in face of a changing climate.**

# Glossary

---

**Adaptation** includes any initiatives or actions taken in response to actual or projected climate change impacts and which reduce the effects of climate change on built, natural and social systems.

**Adaptive capacity** is the ability of built, natural and social systems to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

**Climate** is the weather of a place averaged over a period of time, often 30 years. Climate information includes the statistical weather information that tells us about the normal weather, as well as the range of weather extremes for a location.

**Climate change** refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

**Extreme Weather Event** is a meteorological event that is rare at a place and time of year, such as an intense storm, tornado, hailstorm, flood or heat wave, and is beyond the normal range of activity. An extreme weather event would normally occur very rarely or fall into the tenth percentile of probability.

**Global Climate Models (GCM)** are based on physical laws and physically-based empirical relationships and are mathematical representations of the atmosphere, ocean, ice caps and land surface processes. They are therefore the only tools that estimate changes in climate due to increased greenhouse gases for a large number of climate variables in a physically consistent manner.

**Greenhouse Gas (GHG) Emissions** are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation, emitted by the Earth's surface, the atmosphere itself, and by clouds. Water vapour (H<sub>2</sub>O), carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), ozone (O<sub>3</sub>), and chlorofluorocarbons (CFCs) are the six primary greenhouse gases in the Earth's atmosphere in order of abundance.

**Hazard** is the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources.

**Impact** refers to the effects of existing or forecasted changes in climate on built, natural, and human systems.



**Impact** refers to the effects of existing or forecasted changes in climate on built, natural, and human systems.

**Intergovernmental Panel on Climate Change (IPCC)** is an international body administered by the United Nations. It was created to assess climate science research, and it regularly issues authoritative assessment reports about the science of climate change, climate change impacts, and policy options for adaptation and mitigation.

**Low Carbon Resilience (LCR)** is a lens that coordinates adaptation and mitigation strategies in planning, policy, and implementation processes.

**Non-climatic stressor** is a change or trend unrelated to climate that can exacerbate hazards.

**Maladaptation** are actions that may lead to increased risk of adverse climate-related outcomes, including via increased GHG emissions, increased vulnerability to climate change, or diminished welfare, now or in the future.

**Mitigation** includes the promotion of policy, regulatory and project-based measures that contribute to the reduction of greenhouse gas concentrations in the atmosphere.

**Projections** are potential future climate conditions by computer-based models of the Earth system. Projections are based on sets of assumptions about the future.

**Resilience** is the capacity of a system, community or society exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.

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

**Sensitivity** is the degree to which a system, population or resource is or might be affected by hazards.

**Vulnerability** is 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 system.

**Weather** is the day-to-day state of the atmosphere, and its short-term variation in minutes to weeks.

# Acronyms

---

**BARC** – Building Adaptive and Resilient Communities

**CAT** – Climate Action Team

**CCCR** – Canada’s Changing Climate Report

**ICLEI** – International Council for Local Environmental Initiatives

**LCR** – Low Carbon Resilience

**LIDs** – Low Impact Developments

**RCP** – Representative Concentration Pathways

**SNAP** – Sustainable Neighbourhood Action Plan

**SWM** – Stormwater Management

# Introduction

---

Many municipalities, including Orangeville have already experienced impacts of a changing climate. As practitioners of good governance, local governments have started to develop climate change adaptation plans that work towards protecting their residents, assets, and service areas. Climate change will pose risks to Orangeville's physical, economic, social, and ecological systems. Therefore, the development and implementation of the Corporate Climate Change Adaptation Plan is a key step in minimizing the local risks associated with climate change and building community resilience.



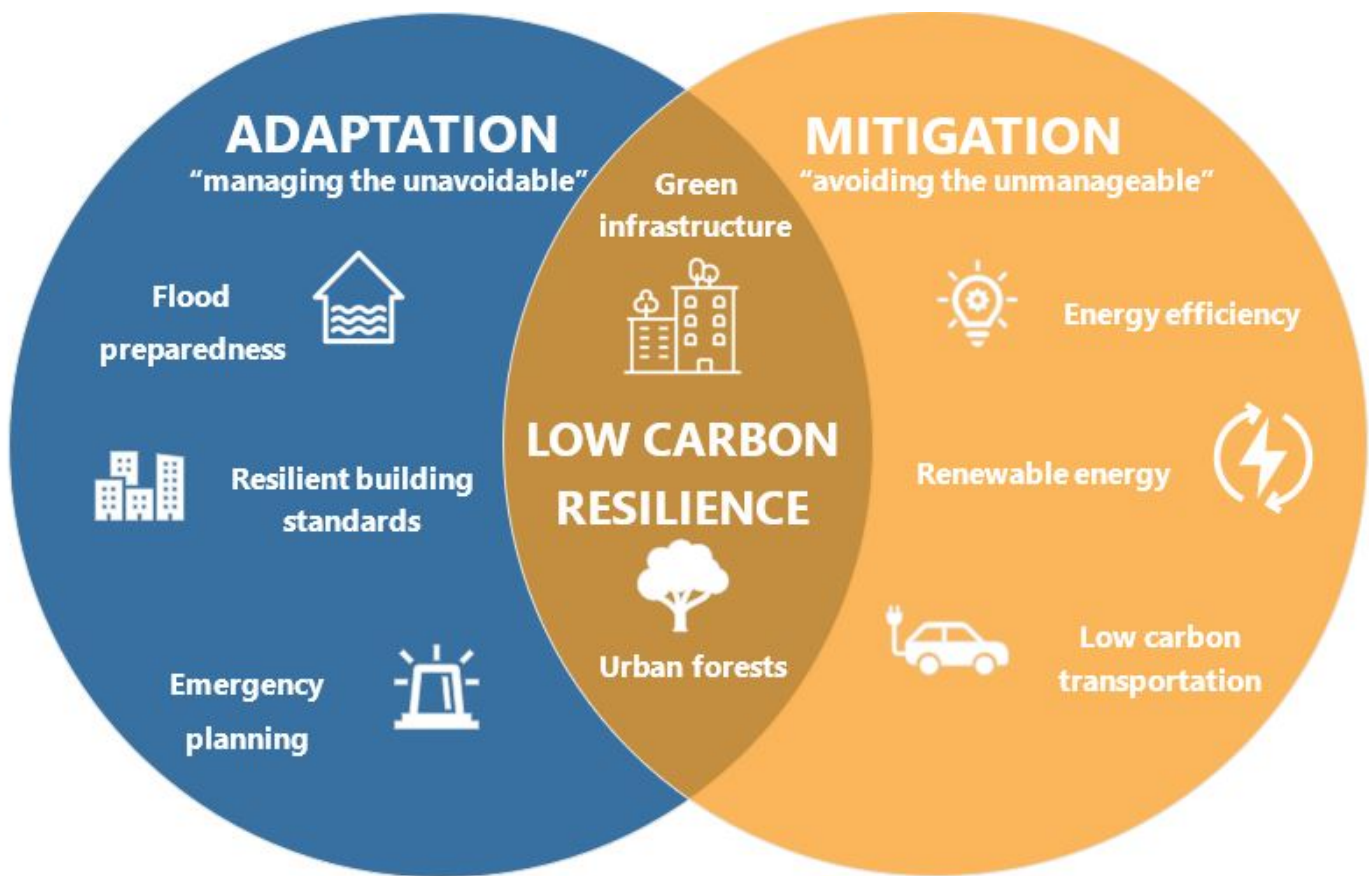
## Role of Local Governments

Municipalities are well positioned to respond to climate change as they are the closest level of government to residents and are on the frontlines of responding to community impacts. The Town has recognized their ability to target local risks and tailor adaptation responses accordingly. Through strategic planning and implementation, the Town will work to ensure the delivery of its services remain environmentally, economically, and socially responsible, despite changes in the climate.



The Town of Orangeville has demonstrated local leadership in addressing both climate change mitigation and adaptation in the past. While mitigation aims to reduce the amount of greenhouse gas (GHG) emissions being released into the atmosphere; adaptation aims to minimize the risks and impacts associated with climate change (see Exhibit 1). It is important to note that adaptation planning does not reduce or dismiss the need to mitigate the causes of climate change and where possible the two areas of work should be integrated. However, regardless of how successful mitigation efforts are moving forward, the impacts of climate change will continue to be felt in Orangeville for years to come<sup>1</sup>. In response, the Town has recognized the urgency to begin adaptation planning and implementation to build capacity to address the projected local climate impacts.

**Exhibit 1: Mitigation vs. Adaptation**



Adapted from the City of Waterloo

<sup>1</sup> Bush, E. and Lemmen, D.S. Environment and Climate Change Canada, 2019. "Canada in a Changing Climate Report". <https://changingclimate.ca/CCCR2019/>

## Provincial and Federal Policy Direction

The federal government has developed several policy documents that support and guide lower-tier governments on climate change adaptation. In 2016, the Government of Canada released its Pan-Canadian Framework on Clean Growth and Climate Change which sets out adaptation priorities to protect the health and well-being of Canadians while also minimizing risks to the economy, communities and ecosystems<sup>2</sup>. Guided by this plan, the federal government launched an Expert Panel on Climate Change Adaptation and Resilience to help advise and measure progress on resilience and adaptation initiatives<sup>3</sup>.

Natural Resources Canada has led the development of several guidance and scientific reports on climate change. Several national assessments have been released over the years, summarizing impacts, adaptation, and vulnerability across Canada. Canada in a Changing Climate: Advancing our Knowledge for Action is the most recent national assessment on climate change, covering how and why Canada's climate is changing; the impacts of these changes; and how Canada is adapting. The first report of this assessment, Canada's Changing Climate Report (CCCR), provides a scientific foundation of how and why Canada's climate has changed and what changes are projected for the future<sup>4</sup>.

At the provincial level, Ontario has also taken steps to support local governments on climate change impacts and adaptation. The province's Provincial Policy Statement was updated in 2014 to direct municipalities to consider climate change through land use and development patterns<sup>5</sup>. Several other key policy documents at the provincial level have started to account for climate change impacts, including stormwater management and green infrastructure guidelines.

In 2018, the Province released the Made-in-Ontario Environmental Plan<sup>6</sup>. The Plan includes some adaptation considerations such as updating the Building Code to include measures to increase the resilience of homes and buildings, reviewing recovery responses, and updating policy direction on climate change through land use planning policies.

More recently, the provincial government launched the first-ever Provincial Climate Change Impact Assessment<sup>7</sup>. The Assessment will use climate science to better understand where and how climate change is likely to affect Ontario communities, critical infrastructure, economies and

---

<sup>2</sup>Government of Canada. 2016.

<https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html>

<sup>3</sup>Expert Panel on Climate Change Adaptation and Resilience. <https://www.canada.ca/en/environment-climate-change/services/climate-change/adapting/expert-panel-adaptation-resilience.html>

<sup>4</sup> Canada in a Changing Climate Report. 2019. <https://changingclimate.ca/CCCR2019/>

<sup>5</sup> Provincial Policy Statement. 2014. <https://files.ontario.ca/mmah-provincial-policy-statement-2020-accessible-final-en-2020-02-14.pdf>

<sup>6</sup> Made-in-Ontario Environmental Plan. 2018. <https://prod-environmental-registry.s3.amazonaws.com/2018-11/EnvironmentPlan.pdf>

<sup>7</sup> Provincial Climate Change Impact Assessment Media Release. 2020.

<https://news.ontario.ca/en/release/57998/ontario-launches-first-ever-climate-change-impact-assessment>

the natural environment, while helping to strengthen the province's overall climate resilience. This assessment will be instrumental for effective adaptation planning and implementation at the provincial and regional level.

Both federal and provincial governments have provided strategic direction and guidance on climate change impacts and adaptation overtime. However, local governments are moving beyond the planning stage and prioritizing the implementation of measures that are tailored to local circumstances in order to effectively build climate resilience.

## **Orangeville's Commitment to Sustainability**

The Corporate Climate Change Adaptation Plan builds on a rich history of other sustainability efforts completed by Town staff, Sustainable Orangeville and community organizations, stakeholders, and residents. A few examples of corporate plans that highlight Orangeville's commitment to sustainability include the Town's Sustainable Neighbourhood Action Plan<sup>8</sup>, Cycling and Trails Master Plan<sup>9</sup>, Water Conservation Plan<sup>10</sup> and Source Water Protection Program<sup>11</sup>. Climate change adaptation also aligns with the goals and priorities outlined in the Town's Strategic Plan<sup>12</sup>, as climate resilience is required to ensure our infrastructure, assets and service areas remain operational.

The Town of Orangeville is a participant of the Smart Cities initiative led by Infrastructure Canada. This initiative empowers communities to adopt a 'smart cities' approach to improve the lives of their residents through innovation, data and connected technology. The Town has started to plan and implement various projects that utilize innovative technologies to improve the quality and use of local data and information. These developments can be used to strengthen the Town's sustainability efforts by increasing efficiency and conservation in corporate facilities and service areas.

Specific to local climate action, the Town has worked towards advancing both mitigation and adaptation efforts through a variety of programs and commitments. Exhibit 2 highlights the milestones the Town has reached, working towards mitigating local GHG emissions and building climate resilience to adapt to the changing local conditions.

---

<sup>8</sup> Town of Orangeville. 2019. Sustainable Neighbourhood Action Plan.

<https://www.orangeville.ca/en/town-hall/resources/Documents/Sustainable-Neighbourhood-Action-Plan.pdf>

<sup>9</sup> Town of Orangeville. 2019. Cycling and Trails Master Plan. <https://www.orangeville.ca/en/town-hall/resources/Documents/Cycling-and-Trail-Master-Plan.pdf>

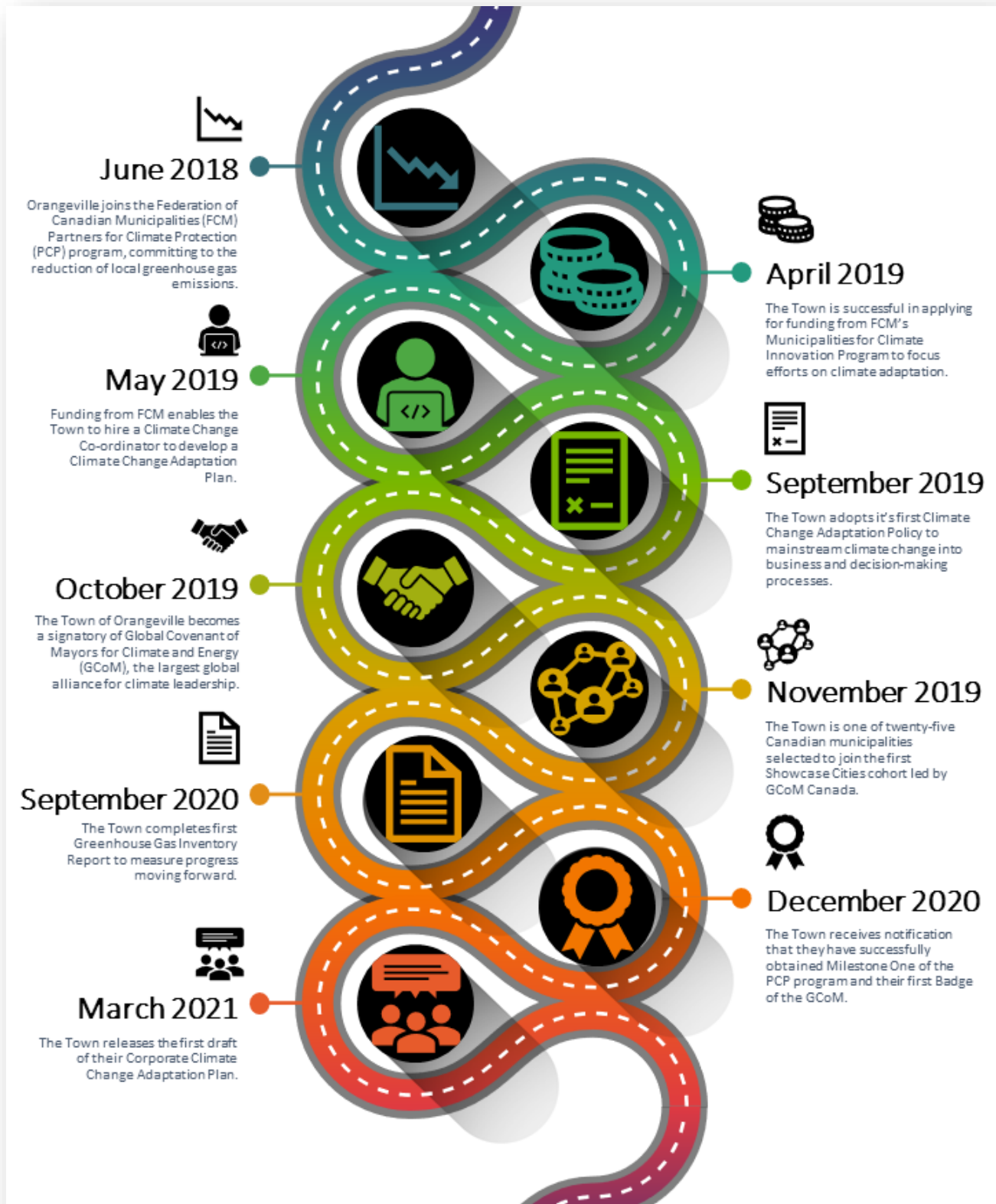
<sup>10</sup> Town of Orangeville. 2020. Water Conservation Plan. <https://www.orangeville.ca/en/living-here/water-conservation.aspx>

<sup>11</sup> Town of Orangeville. Source Water Protection. <https://www.orangeville.ca/en/living-here/source-water-protection.aspx>

<sup>12</sup> Town of Orangeville. 2017. Orangeville Forward: A Strategic Action Plan.

<https://www.orangeville.ca/en/town-hall/resources/Documents/Strategic Plan 2017.pdf>

## Exhibit 2: Timeline of Orangeville’s Climate Change Efforts



# The Changing Climate

---

## Climate Change

In 2015 the Paris Agreement was signed at the 21st Conference of the Parties (COP21) by 195 nations. The agreement built on the foundational work of the United Nations Framework Convention on Climate Change (UNFCCC), bringing all participating nations together to undertake ambitious efforts to combat climate change. This was done by setting a collective target of keeping a global temperature rise well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C<sup>13</sup>.

Despite local and international efforts to reduce global GHG emissions, the global climate system has continued to warm rapidly since the Industrial Era. The global average temperature has already increased by approximately 1°C above pre-industrial levels. Currently, the last five years are the warmest years on record<sup>14</sup>.

The IPCC Fifth Assessment Report (AR5) highlights the requirement for both adaptation and mitigation strategies to be taken in order to reduce and manage the risks of climate change and contribute to climate resilient pathways for sustainable development<sup>15</sup>

With Canada's climate warming twice as fast as the global average (Bush and Lemmen, 2019), climate change is no longer a problem for future generations. Due to human activity, as well as a combination of climate processes and feedback mechanisms, warming in Canada is expected to continue increasing at a rapid rate. In recent years, the impacts associated with a changing climate have become more apparent in day-to-day life, imposing risks to physical, economic, social and ecological systems (Bush and Lemmen, 2019).

From an economic perspective, it is estimated that for every CAD \$1 billion invested in disaster mitigation, CAD \$6 billion in costs can be avoided.<sup>16</sup> Municipalities are on the frontlines of climate change, and it is therefore critical to apply a climate risk lens on short- and long-term financial planning, operational budgets and capital investments.

---

<sup>13</sup> Intergovernmental Panel on Climate Change (IPCC). 2014. "Climate Change 2014: Synthesis Report".

<sup>14</sup> National Oceanic and Atmospheric Administration (NOAA). 2020. "Climate at a Glance".  
<https://www.ncdc.noaa.gov/cag/>

<sup>15</sup> Intergovernmental Panel on Climate Change, 2018. "Global Warming of 1.5°C"  
[https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15\\_Full\\_Report\\_High\\_Res.pdf](https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf)

<sup>16</sup> FCM and Insurance Bureau of Canada (IBC). 2020 "Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level." <https://fcm.ca/en/resources/investing-in-canadas-future>



## Orangeville's Changing Climate

The Town of Orangeville has experienced both direct and indirect impacts of a changing climate, with at least six noteworthy flooding events since 2005. Summer storms on June 23, 2017 (102 mm of rain over 8 hours) and August 1, 2017 (79 mm of rain over 1.5 hours) caused widespread riverine flooding. Recent winter rainfall events on February 21, 2018 (40 mm over 20 hours and snowmelt) and January 11, 2020 (75 mm over 24 hours and snowmelt) caused similar flooding impacts across the community, resulting in property damages, road washouts and localized power outages.

The Town has also experienced other types of extreme weather events in recent years including ice storms and extreme winds causing considerable tree and property damages, along with extreme heat and irregular seasonal temperatures.

After reviewing downscaled climate projections from several sources supported by the Canadian Centre for Climate Services<sup>17</sup>, it is clear that Orangeville will continue to experience these types of impacts, likely increasing in frequency and magnitude overtime.

Exhibit 3 highlights some of the projected changes that are expected for Orangeville's local climate. Past events and future projections highlight the requirement for adaptation interventions at the Town-level to increase preparedness for ongoing and future challenges. See Appendix A for a summary of localized climate projections.

---

<sup>17</sup> Canadian Centre for Climate Services. 2020. <https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services.html>

### Exhibit 3: Climate Projections for the Town of Orangeville under RCP 8.5<sup>18</sup>

#### TEMPERATURE



- The annual average temperature is projected to increase by 2.5°C by 2050 and by 4.5 °C by 2080 period.
- Trends show significant warming across seasons, with the greatest degree of warming to occur in the winter.
- The number of very hot days (above 30°C) is expected to rise from an average of 5 days per year to 14 days by 2050 and 41 days by 2080.
- The number of nights that do not fall below 20°C is expected to increase from a baseline of 1 night per year, to 7 nights by 2050 and to 20 nights by 2080.

#### PRECIPITATION



- The average total annual precipitation is projected to rise by 7% by 2050 and by 10% by 2080.
- Projections indicate an increase in total precipitation during the fall, spring and winter seasons and a slight decrease in total summer precipitation.
- There will be an increased potential for freezing rain events in the winter and shoulder seasons.
- The intensity, duration, and frequency of extreme rainfall events is projected to increase overtime.

**Climate projections indicate that Orangeville will experience warming temperatures, increased variability in precipitation and more frequent extreme weather events.**

<sup>18</sup> Climate Data, 2020. <https://climatedata.ca/>

# Approach

---

The Town of Orangeville took a corporate-facing approach to begin initial adaptation planning and implementation. Moving forward the Town will expand their approach for both adaptation and mitigation initiatives.

The main purpose of the Plan is to scope and prepare for the effects of a changing climate on Town-managed infrastructure, assets, and services. The Plan intends to address the broad range of potential risks that climate change poses to Orangeville's physical, economic, social, and ecological systems.

Corporate consultation was integral to the development of the Plan. This process involved working with staff to examine local climate projections, advance internal understanding on how these trends could impact the Town's services, operations and assets, and identify measures to increase corporate capacity and address local impacts and risks.



## Guiding Principles

Exhibit 4 outlines the principles that were identified early in the process to help guide the Town of Orangeville in advancing climate change adaptation across the corporation.

### Exhibit 4: Guiding Principles

<b>Science-Driven</b>	Ensure the Town is using the best available climate data and methods to generate downscaled climate projections to inform adaptation planning.
<b>Proactive Adaptation</b>	The Town will strive to plan and implement anticipatory adaptation measures to minimize risks and avoid community losses as opposed to reacting to impacts that have already been incurred.
<b>No Regrets Approach</b>	When possible, the Town will adopt adaptation measures that provide benefits regardless of future climate conditions. These options will increase resilience to the potential impacts of climate change while also yielding other economic, environmental, or social benefits.
<b>Consultative and Collaborative</b>	A consultative and collaborative approach will ensure that adaptation efforts are implemented to address both corporate and community priorities.
<b>Recognize Complexity</b>	Cascading impacts and interdependencies amongst sectors and divisions and non-climatic stressors will be considered throughout adaptation planning processes.
<b>Strategic Implementation</b>	Adaptation measures will be prioritized and implemented based on the severity of risk, committed levels of service, associated costs and co-benefits.
<b>Adaptive Management</b>	Adaptation measures are intended to be regularly monitored, updated and improved as new information and resources become available.
<b>Mainstreaming Adaptation</b>	Promote and facilitate the incorporation of climate change information and adaptation considerations across Town divisions and operations.
<b>Increase Awareness and Educate</b>	Increase awareness and understanding of local climate change impacts and adaptation among Town staff, Council members, external stakeholders and residents.
<b>Best Practices</b>	Utilize best practices and lessons learned on adaptation planning and implementation at the local level by initiating and maintaining communications with surrounding climate change practitioners.

## Plan Pillars

During the development of this plan, three major concepts were integrated throughout each step and milestone, reflecting Town values and priorities.

### Low Carbon Resilience

Low Carbon Resilience (LCR) is an innovative approach to planning for climate change. The approach focuses on developing integrated strategies that both reduce GHG emissions (mitigation) and vulnerability to climate change impacts (adaptation). By coordinating mitigation and adaptation activities, co-benefits associated with health, equity, biodiversity and community livability can be achieved<sup>19</sup>.

The Plan does not adopt a complete LCR approach based on the scope of the work. However, LCR opportunities were integrated throughout the development of the Plan. This ensured that any co-benefits were identified early in the process and actions were supportive of both initiatives, avoiding potential competing values (i.e. adaptation actions that could challenge emission reduction efforts or mitigation actions that increase vulnerability to climate risks).

Moving forward, the Town will work to further coordinate adaptation and mitigation actions, policies, planning and implementation to generate community benefits, improve efficiency of implementation and save resources.

### Climate Equity

Another area that was considered throughout the development of the Plan, and more importantly will be prioritized during implementation is climate equity. Overtime it has become clear that climate change disproportionately impacts pre-existing marginalized populations. The implementation of the future community measures will equitably address the risks of climate change and share the costs and benefits of actions across the municipality. Considerations have included impacts on access to services, vulnerable areas and populations, investments in infrastructure and others. The Town's Equity, Diversity and Inclusion Committee will be consulted upon the implementation of community-facing measures to ensure equitable access and benefits across residents.

### Community Resilience

Resilience and adaptation are at times used interchangeably in the climate change sphere. Resilience involves building a community's ability or capacity to adapt to any scenario, including but not limited to climate change risks. By taking a resiliency approach during adaptation planning, measures that are not exclusively focused on climate impacts are incorporated.

The COVID-19 pandemic has introduced new challenges for the Town, while also uncovering strengths throughout the community. Now more than ever it is clear that community resilience

---

<sup>19</sup> Harford and Raftis, 2020. "Low Carbon Resilience: Transformative Climate Change Planning for Canada" <https://act-adapt.org/lcr-report/>



is required for the Town to continue to grow and thrive. By building community resilience to withstand and recover from risks allows for the Town to not only increase their capacity to recover from shocks, but also cultivates preparedness and will result in various social, health and economic benefits<sup>20</sup>. Building community resilience in Orangeville will move beyond exclusively adapting to local climate impacts; this approach works to build social cohesion, address existing inequities and increase overall economic vitality.

## The Process

### BARC Framework

This Plan has followed the International Council for Local Environmental Initiatives (ICLEI) Canada's Building Adaptive and Resilient Communities (BARC) framework<sup>21</sup>. The BARC framework guides municipalities through a comprehensive planning methodology that includes research and climate impact assessment, plan development, action-setting, implementation, planning, and monitoring. ICLEI's BARC framework is a proven methodology that has been implemented by several municipalities across the country. A model of the BARC's milestone framework is shown in Exhibit 5.

The first major task moving through the BARC framework was to establish an internal working group who would oversee and inform the development of the Plan and ensure that actions are implemented and monitored overtime. The internal staff team, titled the Climate Action Team (CAT), is a multi-divisional group, made up of Town staff with diverse expertise and experience with Town infrastructure, assets and services.

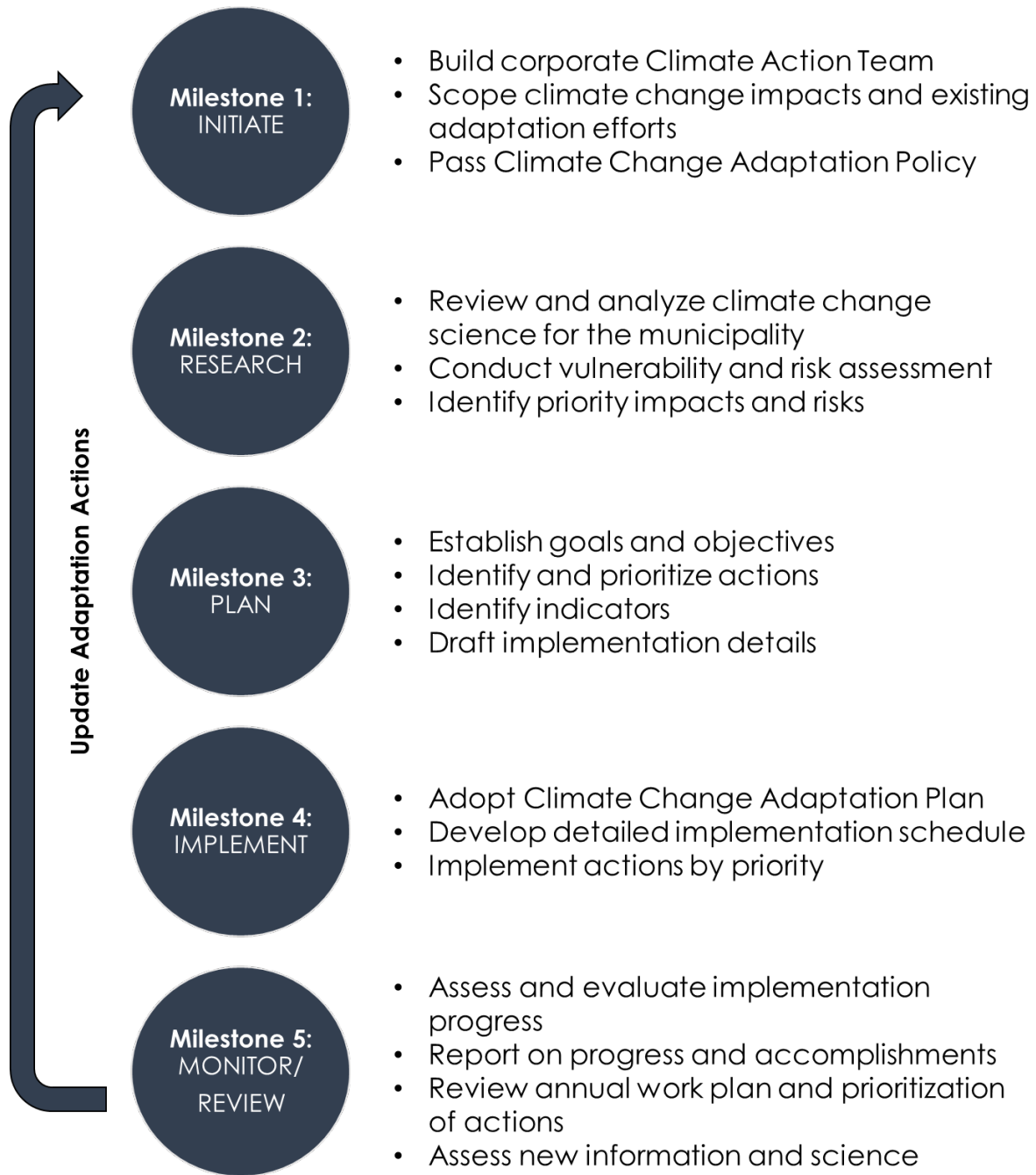
The CAT constitutes as a foundation of expertise which was drawn upon throughout the Town's adaptation efforts and will be responsible for maintaining momentum throughout the implementation and monitoring milestones. The creation of the CAT also represents a step towards building the Town's internal capacity by increasing corporate awareness and understanding of how climate change will impact Orangeville. Extended members of the team were identified and invited to participate at key stages (i.e. vulnerability assessment; action prioritization) of the process to ensure representation across each corporate division.

---

<sup>20</sup> ACT. (2020). "Climate Change, Equity, and COVID-19: Considerations in a Changing World". <https://act-adapt.org/wp-content/uploads/2020/10/LearningTogetherWeb.pdf>

<sup>21</sup> ICLEI. 2020. "Building Adaptive & Resilient Communities". <https://icleicanada.org/barc-program/>

Exhibit 5: BARC Framework<sup>22</sup>



<sup>22</sup> ICLEI. 2020. "Building Adaptive & Resilient Communities". <https://icleicanada.org/barc-program/>

## Identifying Impacts and Risks

In order to identify how climate change could affect the Town's assets, operations, and services, a set of impact statements were developed. During the development of the impact statements, the project team was advised to take a systems-thinking approach, as well as consider existing interdependencies and cascading impacts. After reviewing the localized climate data projections for the Town, the project team identified a total of 51 potential climate impacts.

From here, staff members outside of the project team were then given an opportunity to review and add to the list of impacts through an internal staff survey. The feedback gained from the survey resulted in an additional 14 impacts, of which 2 were identified to be out of the project scope and were documented, then removed. A total of 63 climate impact statements were carried forward into the vulnerability assessment. See Appendix B for a complete list of identified climate change impacts in Orangeville.

The climate impact statements were reviewed and validated with localized climate change projections and categorized into five main categories:

- Environment and natural resources;
- Human health and safety;
- Finance and economic growth;
- Infrastructure and assets; and
- Community services.

The complete list of impact statements was assessed for vulnerability and risk, resulting in a total of 24 prioritized impacts that were carried forward for adaptation planning. Exhibit 6 displays an overview of the climate impacts that were identified and prioritized.

## Exhibit 6: Overview of Climate Change Impacts in Orangeville

<b>Environment and Natural Resources</b>	Native species will be unable to adapt to shifting seasons and extreme weather resulting in overall biodiversity loss and decline in ecosystem function.
	Increased prevalence of tree pests, diseases and extreme weather events could result in declining tree survival and reduced canopy cover.
	Increased flooding and runoff during extreme precipitation events could lead to declining quality of surface water resulting in implications for aquatic ecosystems.
	An increase in annual temperature/milder winters could lead to increased spread of invasive species resulting in additional stressors to native species and general decline in local biodiversity.
	Increased erosion from extreme precipitation could result in degradation to natural infrastructure and ecosystems.
	Decreased precipitation in the summer may cause lower water levels in local watercourses and other surface water, resulting in drying or complete loss of local wetlands (reducing/losing important function of these areas).
<b>Health and Safety</b>	An increase in frequency and magnitude of extreme weather events could result in public emergencies, evacuations, displacement, and failure of critical services.
	An increase in extreme heat events could cause heat-related health issues for vulnerable populations and outdoor workers at Town facilities.
	Changing climate conditions will result in local natural hazards (increased prevalence of ticks, flooding, erosion, invasive species etc.), reducing community safety in natural recreation areas.
	Increased risk for accidents/injuries on roads, parking lots, sidewalks and trails during extreme weather events.
	Increased extreme weather events could lead to cascading failures of critical infrastructure (flash flooding, blackouts, telecommunications failure, road washouts etc.) resulting in safety concerns for staff and residents
<b>Infrastructure and Assets</b>	Increased frequency and magnitude of local flooding events could result in damage to Town infrastructure resulting in unplanned reconstruction and retrofitting costs.
	Overburdening of stormwater management infrastructure during extreme precipitation events and rapid snowmelt could result in overland flooding of public and private property.
	Increased extreme rainfall events could result in more frequent road washouts and closures, impacting emergency response, transit routes and community safety.
	Increased freeze-thaw cycles could result in damage and decreased service life of Town-owned assets and infrastructure, resulting in increased maintenance and replacement costs.
	Increased inflow and infiltration during extreme rainfall events into sanitary sewers could cause sewage backups and flooding in residential, commercial and institutional buildings.

## Assessing Vulnerability

For the purpose of this Plan, vulnerability is defined as a function of a system's sensitivity to climate change and its capacity to adapt to the associated impacts. Following the BARC framework, each of the finalized climate impact statements were evaluated for sensitivity and adaptive capacity to identify an overall vulnerability score for each.

### Assessing Sensitivity

Sensitivity measures the degree to which the Town will be affected when exposed to a climate-related impact. When determining sensitivity, participants were asked to consider how the climate impact would affect the identified division's ability to provide its services and whether the division is subjected to any existing stress that could compromise the ability to respond effectively.

### Assessing Adaptive Capacity

Adaptive capacity determines whether a division can adjust to the climate impact with minimal cost or disruption. When determining adaptive capacity, participants were asked to consider the time and resources needed for the division to recover or return to its previous functionality. They were also asked to consider any actions, plans, or policies that are in place within the Corporation that would help mitigate the impacts.





## Identifying Vulnerability

The vulnerability assessment was the first step to prioritizing key impacts. The workshop was used to spark conversation and have staff begin to critically think about how and to what degree the identified impacts could affect the ability of the Town to provide the current levels of service under a changing climate. Staff helped to break down relatively complex climate change vulnerabilities using their expertise gained from daily operations and past experience.

Of the initial 63 impact statements that were assessed, the results revealed that:

- 21 impacts have a **high vulnerability**, meaning that the Town has a high sensitivity and low adaptive capacity to these impacts.
- 17 impacts were assigned a **medium vulnerability**, meaning that the Town has a moderate sensitivity and adaptive capacity to adapt to these impacts.
- 25 impacts were assigned a **low vulnerability**, meaning that the Town has a low sensitivity and/or a high adaptive capacity to respond to these impacts.

See Appendix C for detailed results from the Vulnerability Assessment.

During the workshop, redundancy between impacts was identified by participants. Based on feedback from participants, the impact statements were refined where possible to increase clarity. This resulted in a total of 31 impacts being carried forward and run through a corporate risk assessment.

## Assessing Risk

For the purpose of this risk assessment, likelihood refers to the probability of a projected impact occurring, and consequence refers to the known or estimated outcomes of a particular climate change impact. The project team was asked to assess the likelihood and consequence for each of the 31 impact statements.

### Assessing Likelihood

The first part of the risk assessment involved determining likelihood scores. Likelihood is based on how probable an impact is and the confidence in the climate data. This was informed by downscaled climate data, as well as anecdotal knowledge of current and past conditions from Town staff.

The type of impact was important to consider when assessing likelihood, as some impact statements describe recurrent impacts and others described a single event or slow onset changes.

### Assessing Consequence

Determining consequence scores for each impact was the second portion of the risk assessment. Participants were asked to assign a consequence rating ranging for three different consequence

categories: social, economic, and environmental (see Exhibit 7). Each score was accompanied with justification to ensure transparency and robustness.

**Exhibit 7: Consequence Criteria**

<b>Social Criteria</b>	<b>Economic Criteria</b>	<b>Environmental Criteria</b>
Health and Safety	Property Damage	Air
Displacement	Local Economy and Growth	Soil and Vegetation
Loss of livelihood	Community Livability	Water
Cultural Aspects	Public Administration	Ecosystem Function

The consequence scoring process considered how each impact would impact both corporate operations and service areas. During this process participants were asked to reflect on past events and outcomes, current conditions, areas that are already experiencing pressure and populations that may be affected disproportionately or exhibit existing vulnerability.

**Identifying Overall Risk**

After the completion of the risk assessment each of the 31 impact statements had an assigned vulnerability and risk score. Exhibit 8 summarizes the high-level findings of the risk assessment.

**Exhibit 8: Risk Assessment Findings**

<b>Overall Risk Ranking</b>	<b>Number of Impacts</b>
Medium-High	3
Medium	10
Medium-Low	11
Low	7

The impacts that ranked “medium-low”, “medium” or “medium-high” risk scores were carried forward into adaptation planning. The impacts that ranked “low” in risk will be kept under review, but it is presumed that current operations and plans are adequate and no further mitigative actions are required at this time. See Appendix D for detailed results from the Risk Assessment.

## Identifying and Prioritizing Actions

The Climate Action Team was led through a series of exercises to identify possible actions for each of the high-ranking risks. The Team identified a variety of adaptation actions to respond to local climate change impacts, including both proactive actions and responsive actions.

A total of 53 actions were identified by the Team. Following the action identification process, the Team moved through an action prioritization process. Each action was evaluated across a series of criteria (see Exhibit 9). Scores were assigned based on the set prioritization criteria, resulting in a score indicating the action should be 'investigated further', 'monitored' or 'a must-do'. The actions were then vetted by the Team and a list of 40 actions were finalized to mitigate local risks and impacts associated with climate change. The implementation details for each action were identified and evaluated (see Appendix E for details).

It is important to note that the scope of this Plan identifies actions for the impacts that are considered the most significant based on the corporate vulnerability and risk assessment process. The lower-ranking impacts and risks have been recorded and considerations for additional actions should be pursued moving forward. Additionally, the Town should be moving towards the integration of climate change into all relevant areas of business and decision-making.

**Exhibit 9: Action Prioritization Criteria**

Category	Criteria	1 (Low)	2 (Medium)	3 (High)
<b>Sustainability</b>	<b>Mitigation co-benefits</b>	Result in increased GHG emissions	Would not affect GHG emissions	Would reduce GHG emissions
	<b>Equity</b>	Benefits to few people	Benefits to many people	Significant benefits to many people
	<b>Implementation Cost</b>	Cost is high relative to cost of inaction	Cost is moderate relative to cost of inaction	Cost is low relative to cost of inaction
	<b>Operation and Maintenance Cost</b>	Cost of operation and maintenance is high	Cost of operation and maintenance is moderate	Cost of operation and maintenance is low
	<b>Environmental Impacts</b>	Results in net environment costs	Results in no-net loss of ecosystem services	Results in net environmental benefits
<b>Effectiveness</b>	<b>Robustness</b>	Effective for a narrow range of plausible future scenarios	Effective across many plausible future scenarios	Effective across a wide range of plausible future scenarios
	<b>Reliability</b>	The measure is untested	Experimental but has expert support	The effectiveness of this measure is proven
<b>Risk and Uncertainty</b>	<b>Urgency</b>	Risks are likely to occur in the longer term (10 years)	Risks are likely to occur in the near term (within 5 years)	Risks are already present/impacts already occurring
<b>Opportunity</b>	<b>Ancillary Benefits</b>	Will contribute little if at all to other Town goals	Will contribute somewhat to other Town goals and programs	Will contribute and aligns well with other Town goals and programs
	<b>No Regret</b>	Will have little or no benefits if the anticipated impact does not occur	Will have some benefits regardless of the actual impact	Will result in significant benefits regardless of the climate change impact
	<b>Window of Opportunity</b>	There is no window of opportunity	A window of opportunity could be created	A window of opportunity exists to implement the measure
<b>Implementation</b>	<b>Public Acceptability</b>	Likely to face public opposition	Not likely to receive much public attention	Likely to receive public support
	<b>Capacity (technical, staff, resources)</b>	Current capacity is insufficient, and gaps cannot be easily addressed	Gaps exist in one or more area but can be addressed	Current capacity is sufficient
	<b>Funding Sources</b>	External or internal funding sources are required but not likely to be secured	External or internal funding sources are required and likely to be secured	Funding is available externally or internally
	<b>Institutional</b>	Implementation requires coordination with or action by other jurisdictions	Implementation requires external approvals	Implementation is within local control

# Adaptation Planning

---

## Vision

Establishing a vision for the adaptation plan provides an opportunity to integrate adaptation goals into the broader vision and acts as kind of a higher call to action to help inspire change. Throughout visioning exercises and surveying, the following statement describes the desired future for the Town in terms of climate change adaptation:

**The Town of Orangeville will build resilience to manage, minimize or eliminate the local risks associated with a changing climate, while embracing new opportunities to remain a vibrant, healthy, and sustainable community.**

## Objectives and Actions

Based on the categorization of impacts and risks, the Town will undertake climate adaptation initiatives in the following four areas:

- Environment and Natural Resources
- Public Health and Safety
- Infrastructure and Assets
- Cross-cutting

Within each theme, objectives were developed by the project team and finalized with staff, stakeholder and community input. The objectives outline high-level intentions that the Town will work towards in implementing the Plan. These objectives were identified through internal and external surveys and throughout workshop activities. From here, a total of 39 actions were identified to help minimize or eliminate local risks associated with climate change in Orangeville.



## Environment and Natural Resources

### **Objective 1: Protect and restore natural systems to enhance local biodiversity and build climate resilience.**

- |                  |  |
|------------------|--|
| <b>ENV – 1.1</b> | Promote the planting of native vegetation along lakes, creeks and ravines to reduce erosion risk, maintenance needs, and enhance local biodiversity. |
| <b>ENV – 1.2</b> | Increase inspections and map features of naturalized areas in order to monitor changing conditions.  |
| <b>ENV – 1.3</b> | Increase communications and signage to educate residents on benefits of naturalization.  |
| <b>ENV – 1.4</b> | Support and expand the implementation of the Smart About Salt program and utilize existing equipment to reduce corporate salt use.                   |

### **Objective 2: Increase the uptake of natural infrastructure features in new and existing development.**

- |                  |   |
|------------------|---|
| <b>ENV – 2.1</b> | Update guidelines to mandate the inclusion of low impact development techniques for new and re-development applications.                    |
| <b>ENV – 2.2</b> | Incorporate Town-owned green infrastructure into the Asset Management Plan.   |
| <b>ENV – 2.3</b> | Work with partners to strengthen messaging on lot-level resiliency actions to residents (i.e. green roofs, shade structures, rain gardens). |
| <b>ENV – 2.4</b> | Evaluate and recommend opportunities for increased nature-based stormwater management during park redesign and in new park space.           |
| <b>ENV – 2.5</b> | Implement a corporate policy for the incorporation of green infrastructure into all appropriate capital projects.                           |

### **Objective 3: Expand and increase the resilience of Orangeville’s tree canopy.**

- |                  |  |
|------------------|--|
| <b>ENV – 3.1</b> | Maintain and update the Town’s tree inventory to benchmark changes, flag concerns and prioritize mitigation actions. |
| <b>ENV – 3.2</b> | Develop an Urban Forest Management Plan that incorporates future climate conditions.                                 |

## Public Health and Safety

### **Objective 1: Increase preparedness and work to minimize health and safety risks associated with the changing local climate.**

---

- |                 |   |
|-----------------|---|
| <b>PH – 1.1</b> | Work with partners to raise awareness of climate related health risks, including vector- and water- borne diseases and natural hazards.   |
| <b>PH – 1.2</b> | Map areas vulnerable to heat extremes to inform planning and programming initiatives.   |
| <b>PH – 1.3</b> | Consider extreme heat risks during redesign and retrofits of parks and trails, providing cooling areas equipped with drinking-water stations, water features, shade structures and native trees and vegetation. |

### **Objective 2: Generate awareness of risks and enhance warning and communication systems during extreme weather events.**

---

- |                 |  |
|-----------------|--|
| <b>PH – 2.1</b> | Support partners with education and awareness campaigns on local climate change impacts and preparedness measures residents can make at the household level. |
| <b>PH – 2.2</b> | Undertake a gap analysis of existing communication processes related to local conditions during extreme weather events.                                      |

## Infrastructure and Assets

### **Objective 1: Protect and strengthen the resilience of Town assets, operations and service areas.**

- |                 |  |
|-----------------|--|
| <b>IS – 1.1</b> | Review and upgrade flood proofing measures in Town-owned buildings where possible.   |
| <b>IS – 1.2</b> | Develop and implement a comprehensive maintenance and inspection program for stormwater infrastructure.                            |
| <b>IS – 1.3</b> | Establish a monitoring program to inspect and identify road segments that are susceptible to closures during extreme storm events. |
| <b>IS – 1.4</b> | Work with partners to implement early warning system techniques, utilizing rainfall monitoring stations to determine flood risk.   |

### **Objective 2: Incorporate climate change considerations into infrastructure planning, design and construction.**

- |                 |   |
|-----------------|---|
| <b>IS – 2.1</b> | Develop a Flood Mitigation Plan for at-risk areas of Town considering climate projections.  |
| <b>IS – 2.2</b> | Update the Town’s Inflow and Infiltration Study with climate change projections embedded into programming.                            |
| <b>IS – 2.3</b> | Complete and implement a Stormwater Management Master Plan with guidelines considering local climate projections.                     |
| <b>IS – 2.4</b> | Investigate best practices with updating design standards to reflect the geographic area of the Town and changing climate parameters. |

## Cross-Cutting Actions

### **Objective 1: Build financial capacity for unforeseen impacts of climate change and incorporate climate considerations into corporate budget planning.**

- |                 |   |
|-----------------|---|
| <b>CC – 1.1</b> | Identify potential financial implications and incorporate adaptation considerations into capital and operational budget forecasts.  |
| <b>CC – 1.2</b> | Develop and maintain a database of adaptation funding opportunities available, increasing the number of applications submitted.     |
| <b>CC – 1.3</b> | Investigate financing mechanisms to increase capacity within the Town's stormwater management system to account for climate change. |
| <b>CC – 1.4</b> | Assess new opportunities for different forms of revenue as a result of a changing climate.  |

### **Objective 2: Ensure a coordinated corporate response during extreme weather events.**

- |                 |  |
|-----------------|--|
| <b>CC – 2.1</b> | Review existing cross-divisional response plans in place to ensure informed and efficient responses to extreme weather events and clean-up services. |
| <b>CC – 2.2</b> | Update business continuity planning to incorporate considerations for changing climate conditions.   |

### **Objective 3: Build community resilience to climate change while reducing local greenhouse gas emissions.**

- |                 |  |
|-----------------|--|
| <b>CC – 3.1</b> | Work with community partners and local businesses to share best practices and resources to build climate resilience and reduce local greenhouse gas emissions. |
| <b>CC – 3.2</b> | Promote and support building standards that reflect updated climate projections and energy efficiency standards.   |
| <b>CC – 3.3</b> | Follow energy efficiency best practices, standards and guidelines for all corporate infrastructure projects.   |
| <b>CC – 3.4</b> | Prioritize the electrification of the Town's fleet where possible and expand charging infrastructure.  |

**Objective 4: Incorporate climate change considerations into existing and future Town plans, policies, procedures and operations.**

---

- CC – 4.1** Incorporate climate change mitigation and adaptation into the next update of the Strategic Plan
- CC – 4.2** Incorporate climate change considerations into Town’s Official Plan.
- CC – 4.3** Investigate best practices and update corporate procurement policy to incorporate climate change and sustainability considerations.
- CC – 4.4** Integrate climate change considerations into asset management and provide training to staff as required.
- CC – 4.5** Establish a standardized process for reviewing localized climate projections at regular time intervals.



# Moving Forward

## Plan for Implementation

To ensure that the actions set out in this Plan are implemented in an effective manner, an implementation schedule was developed. This schedule has been developed in consultation with the associated divisions for each action.

The implementation schedule can be found in Appendix E.

The schedule considers various factors that could assist or hinder with implementation. It is important to note that an adaptive management approach will be taken for the implementation of the Plan and will evolve overtime. Exhibit 10 outlines the implementation details that are included with each action to ensure effective and sustained progress overtime.

### Exhibit 10: Considerations for Implementation

Implementation Key				
<b>Capital Cost</b>	<b>\$</b> (> \$25,000)	<b>\$\$</b> (\$25,000-\$100,000)	<b>\$\$\$</b> (\$100,000-\$200,000)	<b>\$\$\$\$</b> (+ \$200,000)
<b>Operating Cost</b>	<b>\$</b> (> \$5,000)	<b>\$\$</b> (\$5,000-\$20,000)	<b>\$\$\$</b> (\$20,000-\$50,000)	<b>\$\$\$\$</b> (+ \$50,000)
<b>Staff Capacity/Level of Effort</b>	<b>Low</b> (Minimal staff time required)	<b>Moderate</b> (Staff time required but existing capacity is sufficient)	<b>High</b> (High level of staff effort required across divisions)	<b>Insufficient</b> (Level of effort required exceeds existing capacity)
<b>Timeline</b>	<b>Short Term</b> (1 – 5 years)	<b>Medium Term</b> (5 – 8 years)	<b>Long Term</b> (8 –10 years)	<b>Ongoing</b> (Immediate and/or sustained overtime)
<b>Mitigation Co-Benefits</b>	<b>Low Impact</b> (Potential for GHG reduction)	<b>Medium Impact</b> (Moderate GHG reduction)	<b>High Impact</b> (Significant GHG reduction)	<b>Not Applicable</b> (Would not affect GHG emissions)
<b>No Regret Opportunity</b>	<b>Minimal</b> (no benefits outside of anticipated impact)	<b>Moderate</b> (some benefits regardless of impact)	<b>Significant</b> (many ancillary benefits regardless of impact)	<b>Must-do</b> (Should implement regardless of climate change)

## **Monitoring and Evaluating**

Climate adaptation is an iterative process that requires ongoing monitoring and long-term management. As new information and data on the local climate becomes available, adaptation efforts should be updated and evaluated for overall effectiveness. The Town's Climate Adaptation Policy supports the Town's ongoing commitment to advancing climate adaptation efforts across the corporation.

It is anticipated that a report to Council will occur every two years, with a review of the Corporate Climate Change Adaptation Plan occurring every five years. This Plan should be monitored and aligned with the implementation of the Town's Sustainability Neighbourhood Action Plan, including internal check-ins with lead and supporting Divisions on a regular basis to measure progress. Lead and supporting Divisions will be responsible for documenting and reporting on the status of action implementation, timelines, costs, action-specific indicators, and other additional reporting details as needed. Appendix F outlines various key performance indicators that will be used to evaluate implementation and effectiveness overtime.

# References

---

ACT. (2020). Simon Fraser University. *Climate Change, Equity, and COVID-19: Considerations in a Changing World*. Retrieved from:

file:///C:/Users/amylen/Downloads/Climate\_Change\_Equity\_and\_COVID-19\_Considerations\_in\_a\_Changing\_World\_2020.pdf

Bush, E. and Lemmen, D.S., editors. (2019). *Canada's Changing Climate Report*. Government of Canada, Ottawa, ON. 444p.

Canada Infrastructure. (2016). *Informing the Future: The Canada Infrastructure Report Card*. Retrieved from:

[http://canadianinfrastructure.ca/downloads/Canadian\\_Infrastructure\\_Report\\_2016.pdf](http://canadianinfrastructure.ca/downloads/Canadian_Infrastructure_Report_2016.pdf)

Climate Data Canada. 2020. Environment and Climate Change Canada (ECCC), Computer Research Institute of Montréal (CRIM), Ouranos, the Pacific Climate Impacts Consortium (PCIC), the Prairie Climate Centre (PCC), and HabitatSeven. [climatedata.ca](http://climatedata.ca).

Council of Canadian Academies, 2019. *Canada's Top Climate Change Risks*, Ottawa (ON): The Expert Panel on Climate Change Risks and Adaptation Potential, Council of Canadian Academies.

Federation of Canadian Municipalities (FCM) and Insurance Bureau of Canada (IBC). 2020 "Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level."

<https://fcm.ca/en/resources/investing-in-canadas-future>

Government of Canada. (2016). *The Paris Agreement*. Retrieved from:

<https://www.canada.ca/en/environment-climate-change/services/climate-change/paris-agreement.html>

Government of Canada. (2020). *Pan-Canadian Framework on Clean Growth and Climate Change*. Retrieved from:

<https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview.html>

Harford, D. and Raftis, C. (2018). ACT and Simon Fraser University. *Low Carbon Resilience: Best Practices For Professionals*. Retrieved from: [https://act-adapt.org/wp-content/uploads/2018/12/lcr\\_best\\_practices\\_final.pdf](https://act-adapt.org/wp-content/uploads/2018/12/lcr_best_practices_final.pdf)

ICLEI Canada. (2010). *Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Change Adaptation*. Retrieved from: <https://icleicanada.org/wp-content/uploads/2019/07/Guide.pdf>

Intergovernmental Panel on Climate Change (IPCC). (2013). Working Group I Contribution to the IPCC Fifth Assessment Report on Climate Change 2013: The Physical Science Basis. Retrieved from: <https://www.ipcc.ch/report/ar5/wg1/>

Intergovernmental Panel on Climate Change (IPCC). (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

Insurance Bureau of Canada (IBC) and Federation of Canadian Municipalities (FCM). 2020. *Investing in Canada's Future: The Cost of Climate Adaptation at the Local Level. Final Report.*

LAMPS Group. (2018). Ontario Climate Data Portal. York University. Retrieved from: [http://lamps.math.yorku.ca/OntarioClimate/index\\_v18.htm](http://lamps.math.yorku.ca/OntarioClimate/index_v18.htm)

Ministry of Natural Resources and Forestry (MNRF). (2017). *Naturally Resilient: MNRF's Natural Resource Climate Adaptation Strategy (2017–2021)*. Toronto, Queen's Printer for Ontario, p. 32. Retrieved from: <https://apps.mnr.gov.on.ca/public/files/er/mnrf-17-313-climate-change.pdf>

National Oceanic and Atmospheric Administration (NOAA). (2020). *Climate at a Glance*. Retrieved from: <https://www.ncdc.noaa.gov/cag/>

Prairie Climate Centre. (2020). *Climate Atlas of Canada*. University of Winnipeg. Retrieved from: <https://climateatlas.ca/>

# **Appendices**

---



## Appendix A: Summary of Climate Data

### Annual Climate Data: Business-as-usual (RCP 8.5)

Variable	Baseline (1976-2005)	2021-2050	2051-2080
<b>Precipitation (mm)</b>	904	960	986
<b>Heavy Precipitation Days (+10mm)</b>	25	27	28
<b>Heavy Precipitation Days (+20mm)</b>	6	7	8
<b>Mean Temperature (°C)</b>	6.0	8.1	10.3
<b>Maximum Temperature (°C)</b>	10.8	12.6	14.7
<b>Minimum Temperature (°C)</b>	1.2	2.8	5.0
<b>Tropical Nights</b>	1	7	20
<b>Very Hot Days (+30°C)</b>	5	19	41
<b>Very Cold Days (-30°C)</b>	0	0	0
<b>Summer Days (25°C)</b>	46	75	100
<b>Warmest Maximum Temperature (°C)</b>	31.3	33.7	36.0
<b>Coldest Minimum Temperature (°C)</b>	-26.2	-22.5	-18.4
<b>Frost Days</b>	163	138	113
<b>Heating Degree Days</b>	4542	3922	3357
<b>Cooling Degree Days</b>	161	323	541
<b>Ice Days</b>	80	60	41
<b>Mild Winter Days (-5°C)</b>	98	78	57
<b>Winter Days (-15°C)</b>	29	16	6
<b>Date of Last Spring Frost</b>	May 11	April 30	April 20
<b>Date of First Fall Frost</b>	October 3	October 18	October 29
<b>Frost-Free Season (days)</b>	142	168	188
<b>Growing Degree Days (+5°C)</b>	1888	2320	2782
<b>Growing Degree Days (+10°C)</b>	1020	1363	1735

Visit the Town's [website](#) for a detailed Local Climate Data Report.

## Seasonal Climate Data: Business-as-usual (RCP 8.5)

### Spring (March – May)

Variable	Baseline (1976-2005)	2021-2050	2051-2080
Precipitation (mm)	220	242	256
Mean Temperature (°C)	4.5	6.4	8.4
Maximum Temperature (°C)	9.2	10.9	13.2
Minimum Temperature (°C)	-0.3	0.8	2.6

### Summer (June – August)

Variable	Baseline (1976-2005)	2021-2050	2051-2080
Precipitation (mm)	235	238	234
Mean Temperature (°C)	18.0	20.1	22.3
Maximum Temperature (°C)	23.4	25.8	28.0
Minimum Temperature (°C)	11.7	13.7	15.8

### Fall (September – November)

Variable	Baseline (1976-2005)	2021-2050	2051-2080
Precipitation (mm)	244	254	254
Mean Temperature (°C)	7.9	10.1	12.1
Maximum Temperature (°C)	12.1	14.5	16.4
Minimum Temperature (°C)	2.9	4.9	6.9

### Winter (December – February)

Variable	Baseline (1976-2005)	2021-2050	2051-2080
Precipitation (mm)	205	226	242
Mean Temperature (°C)	-6.8	-4.4	-1.9
Maximum Temperature (°C)	-2.4	-0.4	1.0

## Appendix B: Climate Impact Statements

ID#	Impact Statement
<b>Environment and Natural Resources</b>	
1	Tree and plant species may be unable to cope with an increase in frequency and magnitude of extreme weather events.
2	Lengthened growing seasons could lead to increased spread of invasive species.
3	Increased agricultural pests and disease will become more prevalent as minimum temperatures increase, resulting in increased pesticide usage in surrounding areas. Deleted – Out of scope
4	Increased road salt usage from more severe winter weather events could result in declining water quality and implications for aquatic ecosystems.
5	Increased prevalence of tree pests and diseases (i.e. Emerald Ash Borer) due to warming temperatures could result in declining tree survival.
6	Increased erosion from extreme precipitation could result in degradation to ecosystems and natural infrastructure (trails, parks, LIDs).
7	Increased runoff from roads and agricultural fields during extreme precipitation and rapid snowmelt, could lead to declining water quality and implications for aquatic ecosystems.
8	Native species will be unable to adapt to shifting seasons and changing conditions resulting in overall biodiversity loss and decline in ecosystem function/stability.
9	Decreased precipitation in the summer may cause lower water levels in local watercourses and other surface water, negatively affecting ecosystems and biodiversity.
10	Freezing rain events and ice storms could adversely impact native tree survival resulting in implications for ecosystems and costs associated with replacement and maintenance.
11	Decreased summer precipitation and higher temperatures may put stress on local food supply and local agricultural industry.
<b>Public Health and Safety</b>	
12	Heat-related health concerns among vulnerable populations (seniors, youth, pre-existing health conditions, outdoor workers, economically marginalized) could increase due to more extreme heat days in summer and the urban heat island effect.
13	Extreme weather events could result in public emergencies, evacuations, displacement and failure of critical services (i.e. power outages, emergency services, hospitals etc.).
14	Increased minimum temperatures could lead to more incidences of vector-borne disease (i.e. Lyme disease and West Nile virus).
15	Extreme precipitation/flooding events could result in potential contamination of wells and increased incidence of water-borne disease.
16	During extreme weather events, likelihood of black outs increases, and failure of communication infrastructure could result in life threatening scenarios.
17	Extreme weather events and heat waves could cause threats to the health and safety of outdoor workers (Town staff), resulting in better training, equipment and potential cancellation of shifts.
18	Power outages during extreme weather events could result in failure of critical services and cascading impacts to public health and safety (i.e. cooling during extreme heat or heating during ice storms).
19	Increased risk for accidents/injuries on roads, parking lots, sidewalks and trails during extreme weather events (i.e. ice storms, freezing rain etc.), resulting in staff injury and/or liability on the Town.
20	Increased temperatures in the shoulder seasons could result in health and safety issues for schools unequipped with air conditioning. Deleted – Out of scope
21	A decrease in precipitation and increased heat events may affect groundwater reserves and could lead to potable water shortages and/or restrictions on water use resulting in health implications.
22	Implications to drinking water quality due to increased runoff from roads and agricultural fields.
<b>Finance and Economic Growth</b>	
23	Increased frequency and duration of extreme heat events will result in increased energy use and associated costs to cool Town-owned facilities.
24	Increased emergency services costs associated with responding during extreme weather events.
25	Requirement for increased road maintenance during extreme weather events and freezing rain will result in greater costs for the Town.
26	Increase in taxes to cover municipal damages following extreme weather events.
27	Decline in winter tourism and recreational activities from warming temperatures.
28	Increased freeze-thaw cycles could cause damage and increased maintenance on transportation infrastructure (road degradation, potholes etc.).
29	Flooding events could result in damage to Town infrastructure, resulting in reconstruction and retrofitting costs.
30	Extreme weather events and overland flooding could lead to increased damage to electrical infrastructure and cause cascading damages and costs.
31	Increased liability claims from injury and damages during extreme weather events resulting in costs to the Town.
32	Loss of revenue in local businesses during extreme weather events and recovery periods could result in business closures.
33	Town-owned infrastructure and assets in the floodplain need to be relocated, resulting in significant construction costs for the Town.
34	Increased need for staff resources and response during extreme weather events, resulting in greater costs to the Town.

35	Decreased staff productivity due to increased absentees and efficiency during extreme weather events.
<b>Infrastructure and Assets</b>	
36	Increased temperatures in the summer can increase demand on electricity grid for air conditioning, increasing potential for power interruption/outages.
37	Increased need for redundancy in the Town's water supply network and emergency preparedness (additional storage infrastructure) as likelihood of drought conditions during the summer increases.
38	Increased frequency and duration of extreme heat events could result in increased damage to asphalt/pavement (roads, culverts, sidewalks and parking lots).
39	Town buildings not equipped with cooling systems or in need of upgrades could become vulnerable as extreme heat events increase in frequency and duration.
40	Water damage and mould issues to Town buildings as a result of increased flooding events.
41	Overburdening of stormwater management facilities during extreme precipitation events and rapid snowmelt could result in overland flooding, requiring retrofits for increased capacity and management.
42	Damage to wastewater treatment facilities during extreme precipitation events/overland flooding causing failure of service/could lead to wastewater treatment plant bypass discharges to local watercourses.
43	Increased salt use could result in accelerated deterioration of Town fleet and infrastructure.
44	Increased freeze-thaw cycles could result in damage and decreased service life of Town-owned assets and infrastructure (i.e. damages to building foundations, potholes etc.) resulting in increased maintenance and replacement costs.
45	Increased inflow and infiltration into sanitary sewers could cause sewage backups and flooding.
46	Potential damage and closures to Town-owned transportation infrastructure (i.e. wash-out of roads, shoulders, bridges) from flooding will result in increased demand for maintenance and higher issues of liability.
47	Increased tree branches and other debris blocking catch basins and culverts during extreme weather events, leading to flood risks and increased Town maintenance requirements.
48	Increased freezing rain and extreme weather events may increase damage to power lines resulting in prolonged power interruptions.
49	Potential overburdening/contamination of water treatment facilities and municipal wells as water inflows will be of lesser quality during extreme precipitation events.
<b>Community Services</b>	
50	Increased frequency and duration of extreme heat events could lead to increased demand for indoor facilities (with AC) and outdoor recreational water facilities (public pools, splash pads etc.).
51	Reduced productivity of outdoor workers/services during hot days (potential need for cancellation of shifts).
52	Greater prevalence of vector-borne diseases from warming weather could result in more complaints from residents on maintaining naturalized areas (Lyme disease) and areas with stagnant water (West Nile virus).
53	Increased complaints and compliance issues with odours from waste (garbage bins, dumpsters) during extreme heat events.
54	Increased complaints from residents during requirements to restrict water usage and consumption rates during dry spells in the summer (could result in conflict between residents and Town staff).
55	Changing climatic conditions will result in declined tree survival (pests, disease, dry conditions) and will result in a greater demand for these services.
56	Road closures during flooding events will result in required detours for buses.
57	Increased requirement for communications with residents during extreme heat and weather events and on Town policies (i.e. periods of water restrictions).
58	Increased frequency and duration of extreme heat events will result in demand for cooling centres outside of regular business hours.
59	Increased winter temperatures can lead to decline of winter recreation and tourist opportunities at the Town.
60	Increased flooding events will impede the operations and maintenance of cemetery.
61	Inundation of parks and sports fields from overland flooding could lead to temporary loss of facilities, increased maintenance requirements, and need to reconstruct and/or engineer drainage systems.
62	Loss of community trust in local government as a result of failure to deliver critical services and resources/tax increases to cover damage costs.
63	Temporary loss of Town facilities from extreme rainfall/flooding events.
64	Reduction in community accessibility to natural recreation areas (trails, parks etc.) due to natural hazards (increased prevalence of ticks, flooding, erosion, invasive species etc.).
65	Increased damage and compaction of turf and grass surfaces from drought conditions, leading to increased sport field closures.

## Appendix C: Summary of Vulnerability Assessment Results

### Environment and Natural Resources

ID	Impact Statement	Divisions	Sensitivity	Rationale	Adaptive Capacity	Rationale	Vulnerability
5	Increased erosion from extreme precipitation could result in degradation to ecosystems and natural infrastructure (trails, parks, LIDs).	-F&P -Planning (stricter zoning needed)	S4	-Already dealing with erosion issues on trail ways along water bodies	AC1	-Significant costs, currently no plan in place, existing policy in place but should be scaled up immediately	V5
7	Native species will be unable to adapt to shifting seasons and changing conditions resulting in overall biodiversity loss and decline in ecosystem function/stability.	-PW -Environment	S4	-Ecosystem stability already declining in streams and local woodlands	AC1	-No expertise at town level, will require additional staffing to mitigate impacts	V5
8	Decreased precipitation in the summer may cause lower water levels in local watercourses and other surface water, negatively affecting ecosystems and biodiversity.	-Environment -PW	S4	-Negative impacts to aquatic ecosystem will have cascading effects on water quality, therefore magnitude of this impact will be significant; already saw a very dry summer event couple of years ago	AC1	-Highly integrated to drinking water quality and quantity; no plan in place, no policy	V5
1	Tree and plant species may be unable to cope with an increase in frequency and magnitude of extreme weather events.	-F&P -PW -Environment	S4	-Town trees are already seeing impacts, more trees around town not surviving due to increased ice storms resulting in less shade cover, decreased road and pedestrian safety due to deteriorating condition of trees	AC2	-Need to significantly expand maintenance program and budget to deal with impacts already being seen to tree canopy -Significant costs associated	V4
2	Lengthened growing seasons could lead to increased spread of invasive species.	-F&P -PW	S4	-Already seeing spread of invasive in recreation areas and trails around Town -Already having capacity issues dealing with maintenance requirements	AC2	-No current programs in place to deal with invasives, would need additional expertise and funding to implement program	V4
4	Increased prevalence of tree pests and diseases due to warming temperatures could result in declining tree survival.	-F&P -PW -Environment	S4	-Significant impacts on trees from pests already being seen, tree canopy already significantly impacted	AC2	-Program in place to replace trees but requires significant increase in funding and capacity to deal with increasing frequency of canopy die-off	V4
6	Increased runoff from roads and surrounding agricultural fields during extreme precipitation and rapid snowmelt, could lead to declining water quality and implications for aquatic ecosystems.	-Environment -PW -CVC	S3	-Runoff from roads already an issue and impairing water quality	AC1	-Currently no plans or policy in place, would require considerable cost as mitigation measures to deal with impacts are expensive	V4
9	Freezing rain events and ice storms could adversely impact native tree survival resulting in implications for ecosystems and costs associated with replacement and maintenance.	-PW -F&P -HR (due to safety and damage to equipment, skills to navigate etc.), Orangeville hydro	S4	-Already seeing costs associated with tree replacement go up, availability of replacement trees will decline, and it will be harder to obtain replacement trees at volume needed. Maintenance costs associated with tree replacement have gone up significantly	AC2	-Require new staff with expertise on how to transition and to adapt town canopy to face climate impacts; currently no plans or policies in place to transition town, significant cost to transition	V4
3	Increased road salt usage from more severe winter weather events could result in declining water quality and implications for aquatic ecosystems.	-Environment -PW	S3	-Significant ice events and frequency freeze- thaw events have already increased in frequency, water quality implications are already being seen, high chloride levels already present and an issue, seeing impairment of surface waters already	AC3	-Staff have implemented salt management plan and are committed to altering operations, however significant funds needed to upgrade road salt infrastructure and fleet vehicles in order to implement measures committed to in salt management plan.	V3
10	Decreased summer precipitation and higher temperatures may put stress on local food supply and surrounding agricultural industry.	-Environment -Community Services -Economic Development	S3	-Regional approach required, not as many corporate Town services affected by this	AC2	-Need place at "regional" table to support local farmers and agriculture; no current programs or funds set aside to deal with these impacts	V2



## Public Health and Safety

ID	Impact Statement	Divisions	Sensitivity	Rationale	Adaptive Capacity	Rationale	Vulnerability
19	A decrease in precipitation and increased heat events may affect groundwater reserves and could lead to potable water shortages and/or restrictions on water use resulting in health implications for residents.	-All divisions	S4	-Magnitude of impact is significant on human health and economic impacts	AC1	- Currently do not have a significant viable backup reserve at this moment, existing system is ill -equipped to handle any additional stress -Town required to build resiliency and build additional reserves/storage capacity/redundancy into existing system. -Significant costs to upgrading infrastructure/ finding additional reserves	V5
11	Heat-related health concerns among vulnerable populations (seniors, youth, pre-existing health conditions, outdoor workers, economically marginalized) could increase due to more extreme heat days in summer and the urban heat island effect.	-Community services -Library -Communications -HR -IT	S4	-Increase use of indoor facilities, risk management for HR -Stress on outdoor workers	AC3	-Some facilities and programs already in place -Cost for human resources in terms of equipment required for staff to deal with health concerns	V4
12	Extreme weather events could result in public emergencies, evacuations, displacement and failure of critical services (i.e. power outages, emergency services, hospitals etc.).	-All divisions	S4	-Already have emergency plan in place; generators in place, but b/c frequency of emergency will increase will put more strain on corporation to keep up response	AC3	-Have emergency system in place, however significant funds would be required to increase capacity of the emergency management program to deal with more frequent events	V4
16	Extreme weather events and heat waves could cause threats to the health and safety of outdoor workers (Town staff), resulting in better training, equipment and potential cancellation of shifts.	-HR -F&P	S4	-Impacts cost on WSIB, will be required to cancel direct service to public	AC3	-HR has capacity to provide training but will require funding for additional training and equipment	V4
17	Power outages during extreme weather events could result in the failure of critical services and cascading impacts to public health and safety (i.e. cooling during extreme heat or heating during ice storms).	-Community Services -Fire -F&P	S4	- Magnitude of impacts significant to Town residents	AC2	- As frequency increases, we do not have the capacity to deal with more frequent events, would also require more equipment -Have plans and policies in place but as frequency of events increases will need more funding	V4
13	Increased minimum temperatures could lead to more incidences of vector-borne disease (i.e. Lyme disease and West Nile virus).	-HR -Communications	S3	-Training for staff would need to be upgraded, equipment for staff need to be upgraded	AC3	-Will need to train staff to deal with increasingly risky conditions	V3
14	Extreme precipitation/flooding events could result in potential contamination of wells and increased incidence of water-borne disease.	-Environment -PW	S3	-GUDI wells quality could be impacted	AC3	-Will require significant funds to upgrade treatment equipment and treatment standards	V3
15	During extreme weather events, the likelihood of blackouts increases, and failure of communication infrastructure could result in life threatening scenarios and/or liability concerns for the Town.	-All divisions	S3	-Emergency communications program in place for communication outages	AC3	-Existing emergency communications plan is in place but could be expanded	V3
18	Increased risk for accidents/injuries on roads, parking lots, sidewalks and trails during extreme weather events (i.e. ice storms, freezing rain, and wind etc.), resulting in staff injury and/or liability concerns for the Town.	-Infrastructure Services -All staff	S3	-Have abilities to mitigate by providing staff with required resources	AC3	-Have ability to mitigate by providing staff with required resources	V3
20	Implications to drinking water quality due to increased runoff from roads and agricultural fields.	-Environment -PW	S3	-Runoff from roads already impairing drinking water quality	AC2	-Adapting would require significant upgrades to treatment facilities; currently no plans in place to deal with degrading water quality	V3

### Finance and Economic Growth

ID	Impact Statement	Divisions	Sensitivity	Rationale	Adaptive Capacity	Rationale	Vulnerability
27	Flooding events could result in damage to Town infrastructure, resulting in reconstruction and retrofitting costs.	-F&P -PW -IT	S4	-Functionality and levels of service will decrease (road closures, facility shutdowns, IT failures)	AC1	-Costs would be significant to repair -No finances available to use (haven't planned for these impacts)	V5
22	Increased emergency service costs associated with responding during extreme weather events.	-Fire -PW -IT	S4	-Not enough staff capacity to continue providing same level of service and functionality during emergency events	AC3	-Staff can respond but extra costs are anticipated	V4
24	Increase in taxes overtime or cuts to other programs to cover municipal damages following extreme weather events.	-All divisions	S4	-To cover costs residents will be complaining over either increased taxes or cuts to services	AC2	-Budget constraints and potential staff cuts across the corporation	V4
31	Town-owned infrastructure and assets in the floodplain need to be relocated, resulting in significant construction costs for the Town.	-Fire -Building -PW -Planning	S3	-Would be planned to relocate before functionality would be impacted	AC1	-Nothing currently in budget to relocate buildings	V4
32	Increased need for staff resources and response during extreme weather events, resulting in greater costs.	-F&P -Fire -IT -Planning -Building	S4	-Functionality would be impacted on service levels as staff would be at capacity responding to emergencies	AC4	-One staff member on call for certain departments but not others -Would need to increase capacity of on-call staff	V3
33	Decreased staff productivity due to increased absentees and efficiency during extreme weather events.	-All divisions	S4	-Functionality during those days would be significantly reduced but only for limited time	AC4	-No formal "work from home" policies in place for this type of event but would be able to manage -Local staff could pick up extra tasks	V3
26	Increased freeze-thaw cycles could cause damage and increased maintenance on transportation infrastructure (road degradation, potholes etc.) resulting in additional costs for Town.	-PW -F&P	S2	-Required to maintain level of service/Town must keep the same level of functionality	AC3	-We would have to cover the increased costs of maintenance and staff time	V2
21	Increased frequency and duration of extreme heat events will result in increased energy use and associated costs to cool Town-owned facilities.	-IT -F&P -PW	S2	-Would be able to provide services but would be an added cost for the Town	AC3	-Not significant costs but increased operating costs subject to Council approval -Additional equipment needs	V2
29	Increased liability claims from injury and damages during extreme weather events resulting in costs to the Town.	-Finance -Clerks -PW -F&P	S1	-Functionality would stay the same/maintain level of services	AC3	-Staff capacity to deal with claims, pay outs and insurance rate increase	V2
30	Loss of revenue in local businesses during extreme weather events and recovery periods could result in business closures.	-Planning -Economic Development -Tourism and Culture -Building	S1	-Would not directly impact Corporate revenue or Town services	AC4	-Town would be able to manage impacts with minimal costs -Zoning amendments and building permits -More recruiting for business	V1
25	Decline in winter tourism and recreational activities from warming temperatures (revenue loss).	-Recreation and events -Culture and tourism	S2	-Could leverage warmer seasons to increase revenue in those months -Recoup revenue through new events	AC5	-Have the capacity to accommodate to changing conditions to recover lost revenue	V1

### Infrastructure and Assets

ID	Impact Statement	Divisions	Sensitivity	Rationale	Adaptive Capacity	Rationale	Vulnerability
35	Increased need for redundancy in the Town's water supply network and emergency preparedness (additional storage infrastructure) as likelihood of drought conditions during the summer increases.	-PW -Environment	S3	-Water restrictions would be enabled -Would be unlikely to occur as capacity exists in the system	AC1	-Significant costs associated with building new storage facilities and/or supply	V4
40	Damage to wastewater treatment facilities during extreme precipitation events/overland flooding causing failure of service/could lead to wastewater treatment plant bypass discharges to local watercourses.	-PW -Environment	S4	-Impacts on level of service of water treatment -Cascading impacts on other areas	AC2	-Expansion project has increased ability to handle peak flows, but further improvements may be required	V4
43	Increased inflow and infiltration during extreme rainfall events into sanitary sewers could cause sewage backups and flooding.	-PW -Environment	S4	-Level of service would decline -People would be unable to flush toilets in these events	AC3	-We would be able to adjust (operators would respond to it) but significant costs would still be associated with it	V4
23	Increased extreme rainfall events could result in more frequent road washouts and closures, impacting emergency response, transit routes and community safety.	-PW -T&D -F&P	S4	-Levels of service will decline/failure of service -Washouts already occur somewhat frequently	AC2	-It will result in additional costs -More capacity needed in stormwater systems	V4
39	Overburdening of stormwater management facilities during extreme precipitation events and rapid snowmelt could result in overland flooding, requiring retrofits for increased capacity and management.	-PW -T&D -Building -Planning	S3	-Functionality will get worse with increased flooding	AC2	-Significant costs associated with increasing stormwater capacity and maintenance costs -Developers currently only put in minimal requirements for stormwater storage	V4
38	Water damage and mould issues to Town buildings as a result of increased flooding events.	-All divisions	S4	-Potential for functionality to get worse if mould was found in Town buildings -Staff would need to be relocated	AC3	-There are costs associated with the damages if mould were to be found	V3
42	Increased freeze-thaw cycles could result in damage and decreased service life of Town-owned assets and infrastructure (i.e. damages to building foundations, potholes etc.) resulting in increased maintenance and replacement costs.	-PW -F&P -Building	S3	-Functionality will get worse as conditions get worse -Water mains are vulnerable to increased breaks	AC3	-Costs and staff capacity needed -Water main breaks would require immediate action and costs	V3
47	Potential overburdening/contamination of water treatment facilities and municipal wells as water inflows will be of lesser quality during extreme precipitation events.	-PW -Environment	S3	-Might have to shut down wells -Wells 2, 8 and 5 are more vulnerable to contamination	AC3	-Manually sampling every week would have to increase the frequency of sampling and staff capacity -Aware of vulnerable sites	V3
34	Increased temperatures in the summer can increase demand on electricity grid for air conditioning, increasing potential for power interruption/outages.	-All divisions	S2	-Back-up generators in place for most buildings	AC4	-Most buildings have generators and would be able to remain open during event	V2
36	Increased frequency and duration of extreme heat events could result in increased damage to asphalt/pavement (roads, culverts, sidewalks and parking lots).	-PW -F&P	S3	-Might not be able to keep up with the damages and maintain the levels of service	AC4	-Added costs as requirement for more contractors	V2
37	Town buildings not equipped with cooling systems or in need of upgrades could become vulnerable as extreme heat events and humidity increase in frequency and duration.	-PW -F&P	S2	-Risks to equipment and wells -Humidity damage equipment function	AC4	-No buildings are in need of immediate upgrades -Most facilities are equipped with AC and generators	V2
41	Increased salt use could result in accelerated deterioration of Town fleet and road infrastructure.	-PW -F&P -Buildings	S1	-Functionality would stay the same	AC3	-Current life cycle of vehicles will be reduced -Maintenance costs on roads and bridges	V2
44	Potential damage and closures to Town-owned transportation infrastructure (i.e. wash-out of roads, shoulders, bridges) from flooding will result in increased demand for maintenance and higher issues of liability.	-PW -T&D	S3	-Short time period of closures but would have to respond	AC4	-Some slight costs associated with maintenance and needed to ensure safety	V2

<b>45</b>	Increased tree branches and other debris blocking catch basins and culverts during extreme weather events, leading to flood risks and increased Town maintenance requirements.	-PW	<b>S3</b>	-Some issues with functionality/decline in level of service	<b>AC4</b>	-We have some programs in place -Contractors on-call	<b>V2</b>
<b>46</b>	Increased freezing rain and extreme weather events may increase damage to power lines resulting in prolonged power interruptions.	-All divisions	<b>S2</b>	-Back-up generators in place	<b>AC4</b>	-More equipment and upgrades -No major staff interventions needed	<b>V2</b>

### Community Services

<b>ID</b>	<b>Impact Statement</b>	<b>Divisions</b>	<b>Sensitivity</b>	<b>Rationale</b>	<b>AC</b>	<b>Rationale</b>	<b>Vulnerability</b>
<b>55</b>	Reduction in community safety natural recreation areas (trails, parks etc.) due to natural hazards (increased prevalence of ticks, flooding, erosion, invasive species etc.).	-PW -P&F -Recreation	<b>S3</b>	-Currently re-designing trails to deal with impacts	<b>AC1</b>	-Significant funds required to undertake upgrades	<b>V4</b>
<b>52</b>	Increased frequency and duration of extreme heat events will result in demand for public cooling centres outside of regular business hours and requirement for these services to be communicated.	-Library -Community services -Communications	<b>S3</b>	-Have centers set up already	<b>AC3</b>	-Will require more staff and extended hours	<b>V3</b>
<b>58</b>	Changing climatic conditions will result in declined tree survival (pests, disease, dry conditions) and will result in a greater demand for these services.	-PW -F&P -T&D	<b>S3</b>	-Current stress on maintenance and removal level of service	<b>AC3</b>	-More staff capacity to cover the increase -Some additional costs	<b>V3</b>
<b>63</b>	Riverine or overland flooding, resulting in disruption or temporary loss of Town-owned assets (e.g. buildings, roads, underground infrastructure, etc.).	-All division	<b>S3</b>	-There would be loss of functionality in some service areas	<b>AC3</b>	-Temporary services relocated, some costs -Need to communicate with residents	<b>V3</b>
<b>28</b>	An increase in extreme rainfall leading to localized flooding could cause damages/failure to critical infrastructure resulting in temporary loss of Town services and closures of facilities.	-All divisions	<b>S4</b>	-Would impact all divisions with shut down of facilities	<b>AC4</b>	-Some revenue would be lost during the event -Activate Business Continuity Plan -Plan to relocated employees during power outages	<b>V3</b>
<b>48</b>	Increased frequency and duration of extreme heat events could lead to increased demand for indoor facilities (with AC) and outdoor recreational water facilities (public pools, splash pads etc.) from residents.	-F&P -Recreation -Communication -Library	<b>S3</b>	-Increased demand on recreational facilities likely to increase stress on town's capacity to provide services	<b>AC4</b>	-Most buildings are equipped with AC -Plans to expand splash pads	<b>V2</b>
<b>49</b>	Reduced productivity of outdoor workers/services during extreme heat events (potential need for cancellation or rescheduling of shifts).	-HR -PW -F&P -Recreation	<b>S3</b>	-Can mitigate with processes in place	<b>AC4</b>	-Some plans and processes already in place	<b>V2</b>
<b>50</b>	Greater prevalence of vector-borne diseases from warming weather could result in more complaints from residents on maintaining naturalized areas (Lyme disease) and areas with stagnant water (West Nile virus).	-PW -Communication -F&P	<b>S3</b>	-Already seeing complaints from residents	<b>AC4</b>	-Town not directly responsible for responding -May need slight increase in staff capacity to communicate risks	<b>V2</b>
<b>53</b>	Increased winter temperatures could lead to decline of winter recreation and tourist opportunities at the Town.	-Economic Development -F&P -Recreation -Culture and Tourism	<b>S2</b>	-No major implications for Town directly	<b>AC3</b>	-Town should be able to adapt and offer other activities according to changing climate	<b>V2</b>
<b>54</b>	Inundation of parks and sports fields from overland flooding could lead to temporary loss of facilities, increased	-P&F -Recreation	<b>S3</b>	-Have plans in place to deal with impacts through implementing alt. engineering and design measures for fields	<b>AC4</b>	-Already implementing alternative designs in engineering of fields	<b>V2</b>

	maintenance requirements, and need to reconstruct and/or engineer drainage systems.						
<b>56</b>	Increased damage and compaction of turf and grass surfaces from drought conditions, leading to increased sport field closures.	-P&F -Recreation -Communications	<b>S2</b>	-Artificial turf is more resilient -Minor implications and likely short-term	<b>AC4</b>	-Plans in place for this impact	<b>V2</b>
<b>57</b>	Increased complaints from residents during requirements to restrict water usage and consumption rates during dry spells in the summer (could result in conflict between residents and Town staff).	-Corporate services -PW -Environment	<b>S2</b>	-Increase in calls could impact other levels of service	<b>AC4</b>	-Staff interventions and loss of some productivity	<b>V2</b>
<b>59</b>	Road closures during flooding events will result in staff capacity to communicate closures, setup required detours, reroute buses etc.	-PW -T&D -Communications	<b>S2</b>	-Functionality would remain the same as long as staff capacity remains the same	<b>AC4</b>	-Minimal staff capacity and changes to bus routes	<b>V2</b>
<b>60</b>	Increased requirement for communications with residents during extreme heat and weather events and on Town policies (i.e. periods of water restrictions).	-Communications -Customer Service -By-law -PW -IT	<b>S2</b>	-Should be able to communicate and remain the same level of services	<b>AC4</b>	-Potential for increase in staff capacity	<b>V2</b>
<b>61</b>	Increased flooding events will impede the operations and maintenance of cemetery.	-Infrastructure Services	<b>S1</b>	-Delayed burials during summer months	<b>AC5</b>	-No needed resources	<b>V1</b>
<b>62</b>	Loss of community trust in local government as a result of failure to deliver critical services and resources/tax increases to cover damage costs.	-All divisions	<b>S1</b>	-Staff would keep doing our jobs/BAU	<b>AC4</b>	-Improve communication and invest in strategies to gain trust	<b>V1</b>
<b>51</b>	Increased complaints and compliance issues with odours from waste (garbage bins, dumpsters) during extreme heat events.	-Customer Service -Communications -Waste Services	<b>S1</b>	-Magnitude on residents relatively minor	<b>AC4</b>	-Slight increase in staff capacity	<b>V1</b>



## Appendix D: Summary of Risk Assessment Results

ID	Theme	Impact Statement	Vulnerability Score	Likelihood Ranking	Social		Economic		Environmental		Total Consequence Score (Social + Econ + Env) /60	Overall Risk Score /300 (Likelihood x Total Consequence)
					Social Consequence /20	Social Consequence x Likelihood /100	Economic Consequence /20	Economic Consequence x Likelihood /100	Environment Consequence /20	Environment Consequence x Likelihood /100		
7	Environment and Natural Resources	Native species (including wildlife and vegetation) will be unable to adapt to shifting seasons and extreme weather resulting in overall biodiversity loss and decline in ecosystem function/stability within and surrounding the Town.	V5	5	9	45 (Medium)	11	55 (Med/High)	15	75 (High)	35	175 (Med/High)
39	Infrastructure and Assets	Overburdening of stormwater management infrastructure during extreme precipitation events and rapid snowmelt could result in overland flooding of public and private property.	V4	5	11	55 (Med/High)	14	70 (High)	10	50 (Medium)	35	175 (Med/High)
55	Community Services	Increased temperatures and extreme weather events will result in local natural hazards (increased prevalence of ticks, flooding, erosion, invasive species etc.), reducing community safety in natural recreation areas (trails, parks etc.).	V4	5	14	70 (High)	12	60 (Med/High)	8	40 (Medium)	34	170 (Med/High)
27	Finance and Economic Growth	Increased frequency and magnitude of local flooding events could result in damage to Town infrastructure and assets resulting in unplanned reconstruction and retrofitting costs.	V5	4	8	40 (Med/Low)	14	70 (High)	7	35 (Med/Low)	29	145 (Medium)
4	Environment and Natural Resources	Increased prevalence of tree pests, diseases and extreme weather events (i.e. ice storms) could result in declining tree survival/reduced canopy and costs associated with replacement and maintenance.	V4	5	7	35 (Med/Low)	12	60 (Med/High)	10	50 (Medium)	29	145 (Medium)
12	Public Health and Safety	An increase in frequency and magnitude of extreme weather events could result in public emergencies, evacuations, displacement and failure of critical services (i.e. power outages, emergency services, water infrastructure etc.).	V4	4	11	44 (Medium)	15	60 (Med/High)	10	40 (Med/Low)	36	144 (Medium)
6	Environment and Natural Resources	Increased flooding and runoff during extreme precipitation events could lead to declining quality of surface water resulting in implications for aquatic ecosystems (i.e. salt runoff, wastewater plant bypasses).	V4	4	7	35 (Med/Low)	9	45 (Medium)	12	60 (Med/High)	28	140 (Medium)
3	Infrastructure and Assets	Increased road salt usage from more severe winter weather events/freezing rain could result in declining water quality in GUDI wells and water infrastructure overtime.	V3	5	7	35 (Med/Low)	13	65 (High)	8	40 (Med/Low)	28	140 (Medium)
40	Infrastructure and Assets	Increased intensity of rainfall events causing localized flooding at the WPCP resulting in inaccessibility and bypass to local watercourses.	V4	5	7	35 (Med/Low)	12	60 (Med/High)	8	40 (Med/Low)	27	135 (Medium)
23	Infrastructure and Assets	Increased extreme rainfall events could result in more frequent road washouts and closures, impacting emergency response, transit routes and community safety.	V4	5	10	50 (Medium)	10	50 (Medium)	4	30 (Med/Low)	26	130 (Medium)
11	Public Health and Safety	An increase in extreme heat events could cause heat-related health issues for vulnerable populations throughout the community (seniors, youth, pre-existing health conditions,	V4	5	9	45 (Medium)	7	35 (Med/Low)	9	45 (Medium)	25	125 (Medium)
5	Environment and Natural Resources	Increased erosion from extreme precipitation could result in degradation to natural infrastructure (trails, parks, LIDs) and ecosystems (stability of stream banks).	V5	5	7	35 (Med/Low)	11	55 (Med/High)	7	35 (Med/Low)	25	125 (Medium)
42	Infrastructure and Assets	Increased freeze-thaw cycles could result in damage and decreased service life of Town-owned assets and infrastructure (i.e. building foundations, roads, sidewalks, parking lots) resulting in increased maintenance and replacement costs.	V3	5	7	35 (Med/Low)	14	70 (High)	4	20 (Low)	25	125 (Medium)
33	Finance and Economic Growth	During extreme weather events the Town may experience limited staff capacity due to absentees resulting in greater inability to provide set levels of services.	V3	4	9	36 (Med/Low)	16	64 (Med/High)	4	16 (Very Low)	29	116 (Med/Low)
22	Finance and Economic Growth	Increase in extreme weather events will result in higher demands on emergency services and resources and therefore additional costs overtime.	V4	5	10	50 (Medium)	7	35 (Med/Low)	4	20 (Low)	21	105 (Med/Low)

2	Environment and Natural Resources	An increase in annual temperature/milder winters could lead to increased spread of invasive species resulting in additional stressors to native species (i.e. trees) and general decline in local biodiversity.	V4	4	8	32 (Med/Low)	9	36 (Med/Low)	9	36 (Med/Low)	26	104 (Med/Low)
43	Infrastructure and Assets	Increased inflow and infiltration during extreme rainfall events into sanitary sewers could cause sewage backups and flooding in residential, commercial and institutional buildings.	V4	4	10	40 (Med/Low)	12	40 (Medium)	4	16 (Very Low)	26	104 (Med/Low)
18	Public Health and Safety	Increased risk for accidents/injuries on roads, parking lots, sidewalks and trails during extreme weather events (i.e. ice storms, freezing rain, and extreme rainfall etc.), resulting in staff injury and/or liability concerns for the Town.	V3	5	7	35 (Med/Low)	9	45 (Medium)	4	20 (Low)	20	100 (Med/Low)
8	Environment and Natural Resources	Decreased precipitation in the summer may cause lower water levels in local watercourses and other surface water, resulting in drying or complete loss of local wetlands (reducing/losing important function of these areas).	V5	4	6	24 (Low)	6	24 (Low)	13	50 (Medium)	22	96 (Med/Low)
14	Public Health and Safety	Increased intensity of rainfall leading to more severe flooding events could result in potential contamination of wells and increased incidence of water-borne disease.	V3	3	12	36 (Med/Low)	13	39 (Med/Low)	6	18 (Low)	31	93 (Med/Low)
24	Finance and Economic Growth	Increase in frequency and magnitude of extreme weather events could cause significant damages or failure of Town infrastructure and assets resulting in requirement to reduce budget/spending in other areas (programming, community services, staff) to cover additional/unplanned costs.	V4	3	13	39 (Med/Low)	13	39 (Med/Low)	5	15 (Very Low)	31	93 (Med/Low)
47	Finance and Economic Growth	Declining water quality overtime from high intensity rainfall events (i.e. increased runoff of pollutants etc.) could overburden/contaminant the Town's drinking water infrastructure/wells resulting in the requirement for increased treatment techniques and therefore additional costs.	V3	3	8	24 (Low)	12	36 (Med/Low)	10	30 (Med/Low)	30	90 (Med/Low)
15	Public Health and Safety	Increased extreme weather events could lead to cascading failures of critical infrastructure (flash flooding, blackouts, telecommunications failure, road washouts, failure of emergency response etc.) resulting in life-threatening situations for staff and residents.	V3	3	11	33 (Med/Low)	15	45 (Medium)	4	12 (Very Low)	30	90 (Med/Low)
28	Community Services	An increase in extreme rainfall leading to localized flooding could cause damages/failure to critical infrastructure resulting in temporary loss of Town services and closures of facilities.	V3	4	6	24 (Low)	11	44 (Medium)	5	20 (Low)	22	88 (Med/Low)
19	Public Health and Safety	Declined precipitation during summer months and increased heat events may impact groundwater reserves and could lead to potable water shortages and/or restrictions on water use for residents.	V5	3	6	18 (Low)	11	33 (Med/Low)	10	30 (Med/Low)	27	81 (Low)
16	Public Health and Safety	Increased extreme weather events causing more hazardous conditions results in greater threats to the health and safety of operations and outdoor workers (Town staff).	V4	4	9	36 (Med/Low)	7	28 (Low)	4	16 (Very Low)	20	80 (Low)
52	Community Services	Increased frequency and duration of extreme heat events will result in increased energy use and costs to cool Town facilities/buildings (potential for extended operating hours).	V3	5	4	20 (Low)	8	40 (Med-Low)	4	20 (Low)	16	80 (Low)
31	Finance and Economic Growth	An increase in extreme precipitation events and flood risk could lead to the requirement for Town-owned infrastructure to be relocated out of the floodplain/risk areas.	V4	4	4	16 (Very Low)	10	40 (Med-Low)	4	16 (Very Low)	18	72 (Low)
35	Infrastructure and Assets	Reduced precipitation in the summer months/drought conditions could increase the need for redundancy in the Town's water supply network and emergency preparedness (additional storage infrastructure).	V4	3	4	12 (Very Low)	13	39 (Med/Low)	6	18 (Low)	23	69 (Low)
32	Finance and Economic Growth	Increased frequency and severity of extreme weather events will require more staff resources and response (i.e. on-call employees), resulting in greater costs and capacity needs for the Town.	V3	4	4	16 (Very Low)	8	32 (Med/Low)	4	16 (Very Low)	16	64 (Low)
13	Public Health and Safety	Increased annual minimum temperatures could lead to local incidences of vector-borne disease (i.e. Lyme disease and West Nile virus) overtime resulting in public fear of naturalized areas.	V3	4	8	32 (Med/Low)	5	20 (Low)	4	16 (Very Low)	17	51 (Low)



## Appendix E: Implementation Schedule

Action #	Action	Description	Lead and Supporting Divisions	Potential Partners	Supporting Documents	Capital Cost	Operating Cost	Staff Capacity	Timeline	Co-Benefits	No-Regret Opportunity
<b>Environment and Natural Assets</b>											
<b>Objective 1: Protect and restore natural systems to enhance local biodiversity and build climate resilience.</b>											
EN-1.1	Promote the planting of native vegetation along lakes, creeks and ravines to reduce erosion risk, maintenance needs, and enhance local biodiversity.	Increasing corporate standards for planting vegetation on Town property can increase resilience to extreme heat and flooding as well as enhance local biodiversity. Increased vegetation surrounding streams, particularly reaches that have been identified as vulnerable to erosion and washouts would increase stability and ecosystem resilience.	Parks and facilities, Infrastructure services	CVC, Sustainable Orangeville; Community Groups	Urban Forest Policy, SNAP, Subwatershed-19 Plan	\$	\$\$\$	Moderate	Immediate	Medium	Significant
EN-1.2	Increase inspections and map features of naturalized areas in order to monitor changing conditions.	By increasing frequency of staff inspections and utilizing Data Orangeville, changing conditions such as presence of invasive species or declining survival of native species could be monitored closely, allowing for proactive interventions. Community partner involvement could also increase the amount and quality of observed data.	Parks and facilities; Environment; IT	CVC; Sustainable Orangeville; Community Groups	Data Orangeville, SNAP	\$	\$	Moderate	Short	Medium	Moderate
EN-1.3	Increase communications and signage to educate residents on benefits of naturalization.	Climate change is not only increasing the risk and survival of invasive species, but invasive species are also resulting in reduced capacity of natural systems to respond to direct climate impacts. Therefore, increasing community awareness on the importance of naturalized areas across Town would increase local acceptance.	Parks, Environment, Communications	CVC	SNAP	\$	\$	Low	Short	Not Applicable	Moderate
EN-1.4	Support and expand the implementation of the Smart About Salt program and utilize existing equipment to reduce corporate salt use.	Increase the uptake of the program among Town employees and investigate opportunities for Town to host training for business owners and residents to ensure salt is being applied responsibly and considers future use with changing climate conditions. Encouraging the pre-treatment of roads (using brine or alternatives) to reduce the amount of salt used during freezing rain/snow events will also be considered. Evaluate the potential reduction in salt usage that may be achieved by implementing alternatives methods and utilizing existing and developing technologies.	Environment, Public Works; Communications	CVC; Sustainable Orangeville	Salt Management Plan; Source Water Protection Program	\$	\$\$	Moderate	Short	Not Applicable	Moderate
<b>Objective 2: Increase the uptake of natural infrastructure features in new and existing development.</b>											
EN-2.1	Update guidelines to mandate the inclusion of low impact development (LID) techniques for new development and re-development applications.	LID techniques assist with mitigating flood risk and enhancing green space. If requirements are unable to be met on-site, the applicant should incorporate measures at another location within the watershed.	Planning; Buildings; Environment	CVC, Developers	Water Conservation Plan; Official Plan	\$	\$	Moderate	Ongoing	Medium	Moderate
EN-2.2	Incorporate Town-owned green infrastructure into the Asset Management Plan.	Green infrastructure (assets consisting of natural elements that provide ecological and hydrological functions and processes) would be appropriately accounted for and managed within the Asset Management Plan. This will build understanding across the corporation and community of the value natural assets and services they provide.	Environment	MNAI; County	Asset Management Plan; SNAP; Water Conservation Plan	\$	\$	Moderate	Ongoing	Medium	Moderate
EN-2.3	Work with partners to strengthen messaging on lot-level resiliency actions to residents.	Developing a communications campaign would not only engage residents in local climate action but also increase household and individual level actions (i.e. green roofs, shade structures, rain gardens) to mitigate climate risks and impacts.	Environment; Communications	CVC; Property Owners (target those with large impervious surfaces)	Source Water Protection Plan; Water Conservation Plan	\$	\$	High	Short	Low	Moderate
EN-2.4	Evaluate and recommend opportunities for increased storm water management during park	The Town will plan for changing climatic conditions when redesigning park space and trail redevelopment (i.e. increase permeable surfaces/LIDs in park spaces).	Parks; Transportation and	CVC	Current inspection practices/routines	\$\$\$	\$\$	Moderate	Medium	High	Moderate

	redesign and in new park space to reduce flood risk.		Development, Environment								
<b>EN-2.5</b>	Implement a corporate policy for the incorporation of LID infrastructure and naturalization techniques into all appropriate capital projects.	Implement green infrastructure features on Town property/ROW and in new development to improve stormwater management (i.e. treatment train approach). By updating Town development standards accordingly (i.e. all capital projects over a certain budget must include portion of LID/naturalization design), the integration of LIDs in Town infrastructure projects will be effectively increased.	Infrastructure Services	CVC, Developers	SNAP, Water Conservation Plan	\$\$\$\$	\$	Moderate	Short	Medium	Low
<b>Objective 3: Expand and increase the resilience of Orangeville's tree canopy</b>											
<b>EN-3.1</b>	Maintain and update inventory of tree species and tree quality to benchmark changes, flag concerns and prioritize mitigation actions.	The Town has recently developed a tree inventory database using ArcGIS. This inventory should be prioritized and maintained with details added overtime. By actively maintaining this inventory, risks and concerns associated with the Town's tree canopy will become apparent early on, allowing time for intervention.	Environment: IT/GIS	CVC, County (Forest Manager)	Urban Forest Policy; SNAP	\$\$	\$\$	High	Medium	High	Significant
<b>EN-3.2</b>	Develop an Urban Forest Management Plan that incorporates future climate conditions and outlines specific guidelines for best practices to be followed by the Town and developers.	By incorporating climate considerations into planting practices, replacement species and maintenance guidelines, the canopy should have an increased survival rate and increase the resilience. Considerations for specific greening strategies for areas of the Town where tree canopy/greenspace is low should also be included. Continue to expand the Town's tree canopy through purchasing and partnerships with CVC and consider offering incentives for increased tree planting.	Parks; Environment, Public works	CVC, Developers, Contactors, County (Forest Manager)	Urban Forest Policy, Orangeville's Tree Inventory	\$\$	\$\$	High	Medium	High	Significant
<b>Public Health and Safety</b>											
<b>Objective 1: Increase preparedness and work to minimize health and safety risks associated with the changing local climate</b>											
<b>PH-1.1</b>	Partner with and support the WDG Public Health Unit with increasing awareness of climate-related health risks, including vector- and water-borne diseases and natural hazards.	Informing residents on the health and safety risks associated with natural areas and climate change including vector-borne diseases (i.e. West Nile Virus, Lyme Disease), invasive species, extreme heat and flooding would build resilience and minimize community risks.	Infrastructure Services	WDG PHU	NDMP flood modelling; SNAP	\$	\$	Low	Medium	Not Applicable	Low
<b>PH-1.2</b>	Map areas vulnerable to heat extremes to inform planning and programming initiatives.	By mapping areas vulnerable to heat extremes, the Town will be able to identify areas that would benefit from additional tree planting, shade structures, parkland, site-specific planning policy, or outreach programming.	IT, Environment, Planning	County, Community Groups	Data Orangeville	\$\$	\$	High	Medium	Not Applicable	Moderate
<b>PH-1.3</b>	Consider extreme heat risks during redesign and retrofits of parks and trails, providing cooling areas that include water stations, water features, shade structures and native trees and vegetation.	Upon time of redesign, retrofits or expansion, climate change should be considered in the planning and design of natural spaces, parks, trails and recreational areas to ensure resiliency measures are included.	Parks, Planning	CVC, County	SNAP, Official Plan, Tree and naturalization policy, Parks Master Plan, Cycling and Trails Master Plan	\$\$\$	\$\$	Low	Medium	Low	Low
<b>Objective 2: Generate awareness of risks and enhance warning and communication systems during extreme weather events.</b>											
<b>PH-2.1</b>	Support Dufferin County and WDG Public Health Unit with education and awareness of local climate change impacts and emergency measures residents can make at the household level.	Assist with education initiatives to encourage awareness of climate change impacts and risks. By improving personal and household preparedness practices, risks during extreme events will be minimized (i.e. educating residents on how to make household emergency kits)	Environment, Communications	County; PHU	Emergency Management Plan	\$	\$	Moderate	Short	Not Applicable	Moderate
<b>PH-2.2</b>	Undertake a gap analysis of existing communication processes related to extreme weather conditions.	Through a gap analysis, the Town could identify current practices (what is communicated to who and how) and identify gaps and opportunities for improvement. The following will be considered during the process: internal and external communications; external extreme weather announcements/road closures and updates communicated through social media and website; and internal communications procedure during emergency event.	Communications, Human Resources, IT	External media/communication outlets	Business Continuity Plan	\$	\$	Moderate	Short	Not Applicable	Low

**Infrastructure and Assets**

<b>Objective 1: Protect and strengthen the resilience of Town assets, operations and service areas.</b>											
<b>IN-1.1</b>	Review and upgrade flood-proofing measures on Town-owned buildings in the regulatory floodplain where possible.	The Town will review the extent to which existing Town-owned buildings in the regulatory floodplain are flood-proofed and identify opportunities for improvement (i.e. apply flood-proofing measures at WPCP).	Parks and Facilities; Public Works; T&D	NA	Asset Management Plan; NDMP Flood Modelling	\$	\$\$\$	Moderate	Short	Not Applicable	Minimal
<b>IN-1.2</b>	Develop and implement a comprehensive maintenance and inspection program for stormwater infrastructure, utilizing ArcGIS software.	Increased stormwater drainage area inspections could identify areas of potential risk for debris blockage and dams and therefore minimize flood and erosion risk. Currently areas are maintained on an as-needed-basis. Developing a digital database in an ArcGIS application would increase the Town's understanding of the condition of SWM features and their operating capacities. The availability of this information would also be utilized for funding opportunities as increased capacity in the Town's SWM system will be required with increased rainfall intensity.	Public Works; Transportation and Development; Environment; IT	CVC	Data Orangeville; Existing Inspection Protocol	\$	\$	Moderate-High	Short	Not Applicable	Moderate
<b>IN-1.3</b>	Establish a monitoring program to inspect and identify road segments that are susceptible to closures during extreme storm events.	By gaining information on the road segments that are historically impacted by flooding, the Town can use this information to support the implementation of flood mitigation techniques in these prioritized areas.	Public Works; T&D; Environment	CVC; County	Road Needs Study, Data Orangeville, historic records	\$	\$	Moderate	Medium	Not Applicable	Moderate
<b>IN-1.4</b>	Partner with CVC and implement early warning techniques, utilizing rainfall monitoring stations to determine flood potential.	By developing a formal protocol with CVC, Town staff can be more prepared to respond to floods, as well as identify the extent expected which can be used to be communicated to Town partners and residents.	Infrastructure Services	CVC	Existing flood line maps, CVC flood studies, local knowledge of flooding	\$\$	\$	High	Medium	Not Applicable	Moderate
<b>Objective 2: Incorporate climate change considerations into infrastructure planning, design, and construction.</b>											
<b>IN- 2.1</b>	Develop Flood Mitigation Plan for at risk areas of Town utilizing future climate projections.	Using NDMP flood modelling results, a Flood Mitigation Plan would highlight the areas in Town that are prone to flooding from high-intensity rainfall events and snowmelt and identify both structural and nature-based measures to reduce flood risk.	T&D; Environment	CVC	NDMP Modelling	\$\$	\$	Moderate	Short	Not Applicable	Moderate
<b>IN- 2.2</b>	Update inflow and infiltration study to consider climate change projections in programming.	Changes in current programming could avoid continued increases in I&I under a changing climate	Public Works; T&D	CVC	Water Conservation Plan; Source Water Protection Plan	\$	\$	Moderate	Short	Not Applicable	Moderate
<b>IN- 2.3</b>	Complete and implement a Stormwater Management Master Plan with guidelines that consider changing climatic conditions.	A Stormwater Management Master Plan could provide the Town with a preferred stormwater management strategy to identify, protect, and enhance natural features, ecological functions, and biophysical integrity. The plan would assist staff and our partners in appropriately managing risks through the establishment of environmental targets for water quality, water quantity, erosion, infiltration (water balance) and guidance with respect to the protection of natural features. The plan would also address infrastructure issues, such as flooding, and form part of the overall asset management program. The plan could establish a stormwater management policy and guidelines for stormwater infrastructure and identify and prioritize identified works.	Transportation and Development, Environment	CVC	Asset Management Plan, NDMP Modelling	\$\$	\$\$	Moderate	Short	Not Applicable	Moderate
<b>IN- 2.4</b>	Investigate best practices with existing IDF curve and design standards to reflect the geographic area of the Town and changing climate parameters.	Analyze current IDF curve with modelled IDF curves under a changing climate. Identify protocol for future design standards to incorporate climate change considerations.	Transportation and Development, Environment	CVC	NDMP Modelling	\$	\$	Moderate-High	Short	Not Applicable	Moderate

**Cross-Cutting**

<b>Objective 1: Build financial capacity for unforeseen impacts of climate change and incorporate climate considerations into corporate budget planning.</b>											
<b>CC-1.1</b>	Identify potential financial implications and incorporate adaptation considerations into budget, capital, and operational planning.	The Town will integrate adaptation-related costs into capital projects and operating estimates, as appropriate, to help guide short and long-term implementation of adaptation measures. Conducting proactive financial planning around climate change will reduce municipal vulnerability and costs in the long term.	Treasury, Environment	NA	Asset Management Plan, Long Term Capital Plan	\$\$\$\$	\$\$\$	Moderate	Medium-Long	Not Applicable	Low
<b>CC-1.2</b>	Develop and maintain a database of climate change adaptation funding opportunities available, increasing number of applications submitted.	By maintaining a resource on funding opportunities and associated deadlines, more funding/grants can be accessed by the Town.	Environment	CVC, County	Water Conservation Plan, SNAP	\$	\$	Moderate	Short	Not Applicable	Moderate
<b>CC-1.3</b>	Investigate feasibility of financing stormwater management (SWM) through fee/rate system to increase capacity of Town's SWM system to account for climate change.	Other municipalities have incorporated SWM fee/rates in order to ensure a sustained budget for SWM upgrades and retrofits. As flood risk increases overtime, SWM systems will need to be upgraded and expanded in high-risk areas. A SWM rate system could be considered by the Town to address this gap in funding. Fee system can be formed by Flat fee or tiered flat fee; total property area or impervious area coverage.	Infrastructure Services; Corporate Services	NA	Water Conservation Plan; SNAP	\$	\$	Moderate-High	Medium	Not Applicable	Moderate
<b>CC-1.4</b>	Assess new opportunities for different forms of revenue as a result of a changing climate.	The Town could include tourism opportunities that consider how the Town can begin planning for the future climate (i.e. taking advantage of lengthened warm months, plan for reduced snow cover/ice). This planning could also incorporate mitigation and sustainability considerations to ensure events and activities planned by the Town are minimizing GHG emissions and waste.	Economic Development	BIA	Tourism Strategy	\$	\$	Low	Medium-Long	Moderate	Moderate
<b>Objective 2: Ensure a coordinated corporate response during extreme weather events.</b>											
<b>CC- 2.1</b>	Review existing cross-divisional response plans in place to ensure informed response to extreme weather events and provide efficient clean-up services.	Developing a response and communication plan to ensure divisions are covering required duties after an extreme weather event would increase resilience and continuity of services (review roles and responsibilities of each division during emergency events). Assess training needs on a division-specific basis to determine if existing training programs need to be modified to incorporate climate change considerations. Through this process, the following will be considered: Day-to-day operations (i.e. training related to heat and cold related illnesses) and extreme circumstances (e.g. crowd management and weather-based emergency situations); cross-divisional coordination; climate change fundamentals to increase awareness.	Corporate Services; All divisions	County	Existing procedures and protocols	\$	\$	Moderate	Short	Low	Moderate
<b>CC- 2.2</b>	Update business continuity planning to incorporate consideration for increased extreme weather events and changing climate conditions.	The Town will update business continuity planning to incorporate climate change using an all-hazards approach to address daily operations, roles and responsibilities, critical activities (i.e. emergency shelters, emergency staffing), critical interdependencies with non-municipal infrastructure/facilities), along with other key items.	Corporate Services; All divisions	County	Existing continuity planning	\$	\$	Moderate	Short	Not Applicable	Moderate
<b>Objective 3: Build community resilience to climate change while reducing local greenhouse gas emissions.</b>											
<b>CC- 3.1</b>	Work with community partners and local businesses to share best practices and resources to build climate resilience and reduce local GHG emissions.	Working with Dufferin County, a network would be developed with key community partners to increase knowledge and capacity to adapt to climate impacts.	Environment; Economic Development; Communications	County; CVC; BIA; Town Stakeholders	NA	\$	\$	Moderate	Short-Medium	Medium	Moderate
<b>CC- 3.2</b>	Promote higher local building standards which reflect newest climate projections and energy efficiency standards, guidelines and best practices.	The Town could develop guidelines that reflect localized climate data that suggest building standards/development guidelines to increase resiliency as well as regulate energy efficiency standards.	Infrastructure Services	NA	Existing standards	\$	\$	Moderate	Short	High	Significant

<b>CC- 3.3</b>	Follow energy efficiency (LEED) best practices, standards and guidelines for appropriate capital projects.	All appropriate capital projects should follow LEED standards and include considerations for renewable energy sources and other low-carbon options.	Community Services; Infrastructure Service	NA	Existing standards	\$\$	\$\$	Low	Short	High	Significant
<b>CC- 3.4</b>	Prioritize the electrification of the Town's fleet where possible and expand charging infrastructure.	The transition to EVs for the Town's light-duty passenger vehicles can be used as a pilot to determine the feasibility of deploying EVs across the Town's fleet and ensure compatible charging infrastructure is installed at suitable locations. Options for electric medium- and heavy-duty vehicles are currently limited, however ongoing monitoring of these developments will identify opportunities to transition as the technology becomes accessible and reliable.	Environment; Transit; All divisions	County	Asset Management Plan	\$\$	\$	Low	Short	High	Significant
<b>Objective 4: Incorporate climate change considerations into existing and future Town plans, policies, procedures, and operations.</b>											
<b>CC-4.1</b>	Incorporate climate change mitigation and adaptation into the next update to the Strategic Plan.	Ensure that climate change mitigation and adaptation priorities of the Town are reflected in the next Strategic Plan update.	Corporate-wide	NA	Strategic Plan update	\$	\$	Low	Medium	Moderate	Must-do
<b>CC-4.2</b>	Incorporate climate change considerations into Town's Official Plan.	The Town will incorporate both climate change mitigation and adaptation considerations into the Town's OP update.	Planning; Environment	County	Official Plan	\$	\$	Moderate	Short	High	Must-do
<b>CC-4.3</b>	Investigate best practices and update corporate procurement policy to incorporate climate change and sustainability considerations.	The implementation of this policy would support the Town's commitment to sustainability by requiring the procurement of goods and services that will minimize the Town's impact on the environment and provide best value for the corporation. It would also consider GHG emissions, impact to natural environment, and potential future impacts that from climate change.	Environment; Corporate Services	NA	Existing Procurement Policy	\$	\$	Moderate	Short	High	Significant
<b>CC-4.4</b>	Incorporate climate change considerations into asset management and provide training to staff as required (i.e. lifecycle costing, asset level of service, accelerated deterioration rates).	To improve the resilience and adaptive capacity of assets, the Town will incorporate climate change considerations into its asset management planning. Through this process, the following will be considered: integrating climate change into risk management; implementing a cost analysis for investment decision-making processes, considering the change in lifecycle events based on climate change/environmental factors; assessing the financial impacts of climate change on upholding levels of service; undertaking these actions through upcoming asset management activities and discussions.	Environment; Corporate Services	NA	Asset Management Plan	\$	\$	Moderate-High	Short-Medium	Moderate	Significant
<b>CC-4.6</b>	Establish a process for reviewing localized climate projections at regular time intervals.	Projections are developed using a combination of climate models, historical weather data, and greenhouse gas emission trajectories. The Town will develop a process for reviewing and obtaining localized, dynamically downscaled climate projections on a regular basis. This will ensure that Town decisions are considering up-to-date projections.	Environment	CVC; Canadian Centre for Climate Services	Climate Data Report	\$	\$	Moderate	Short	Not Applicable	Moderate



## Appendix F: Evaluation and Performance Indicators

Environment and Natural Assets		
Objective	Indicators	Reporting Department/Division
<b>Objective 1: Protect and restore natural systems to enhance local biodiversity.</b>	# of native plantings (trees/vegetation) on Town property % of re-naturalized area % of invasive species present in Town's natural areas # of trained staff on Smart About Salt	- Parks and facilities - Public Works
<b>Objective 2: Increase the uptake of natural infrastructure features in new and existing development.</b>	\$ allocated to green infrastructure/LIDs in Town projects % of uptake in LID features in re-development and new development projects % of natural assets included in Asset Management Plan	- Parks and facilities - Planning/Building - Corporate Services
<b>Objective 3: Expand and increase the resilience of Orangeville's tree canopy.</b>	% of total tree canopy within municipal properties/right-of-way # of trees planted and replaced annually Average local tree survival rate of new plantings	- Parks and facilities - Public Works
Public Health and Safety		
Objective	Indicators	Responsible Division
<b>Objective 1: Raise awareness and work to minimize health and safety risks associated with changing local climate</b>	# of residents reached in awareness campaigns # of app downloads \$ allocated to thermal comfort designs in Town projects	- Parks and facilities - IT - Communications
<b>Objective 2: Increase preparedness across the community and enhance warning and communication systems during extreme weather events.</b>	# of information releases and alerts related to extreme weather events # of "push" alerts delivered to residents via Town webpage	- Communications - IT
Infrastructure and Assets		
Objective	Indicators	Responsible Division
<b>Objective 1: Protect and strengthen the resilience of Town assets, operations and service areas.</b>	# of reported properties experiencing flooding # of events that disrupt Town facilities and/or services # of facility inspections that consider the impact from climate change # of road closures from extreme weather events	- Infrastructure Services
<b>Objective 2: Incorporate climate change considerations and related data into future land use, development and construction projects and planning across departments.</b>	# of new properties inquiring about lot-level stormwater control features during development # of existing properties inquiring about incorporating lot-level stormwater control features # of LID features incorporated into Town infrastructure projects	- Planning/Building - Transportation and Development - Parks and facilities
Cross-Cutting Actions		
Objective	Indicators	Responsible Division
<b>Objective 1: Identify corporate financial implications of climate risks and incorporate adaptation-related costs into budget forecasts</b>	% of annual municipal expenditures directly related to climate adaptation # of grant applications submitted for climate change adaptation efforts	- Treasury - Infrastructure Services
<b>Objective 2: Ensure a coordinated response and protocols across corporation during extreme weather events</b>	Average response time (minutes or hours) for municipal staff to respond during extreme weather events # of climate change considerations integrated into communication and contingency plans	- Corporate Services - Public Works
<b>Objective 3: Increase community resilience to climate change while also reducing local greenhouse gas emissions</b>	# of LEED certified Town facilities and buildings # of EVs in Town fleet \$ allocated to energy efficiency measures in Town's capital projects % of corporate and community GHG emissions reduction from baseline	- Parks and facilities - Public Works
<b>Objective 4: Incorporate climate change considerations into existing and future Town plans, policies, procedures and operations</b>	# of plans, policies, projects and strategies that include climate adaptation considerations # of projects that consider climate change in the procurement process # of staff reports that are categorized under energy and climate change SNAP goals	- All divisions

## Appendix G: Summary of Engagement Activities

Activity	Time Period	Description	Outcome
<b>Corporate Engagement – Council and Staff</b>			
Staff team meetings	Ongoing	<ul style="list-style-type: none"> <li>Staff directly involved in the development of the Plan met regularly throughout the time period</li> </ul>	<ul style="list-style-type: none"> <li>Project management</li> </ul>
Senior Management Updates/Presentations	Ongoing	<ul style="list-style-type: none"> <li>Senior staff were given updates and presentation on the progress of the Plan</li> </ul>	<ul style="list-style-type: none"> <li>Inform and discuss goals of the Plan and staff position</li> </ul>
Climate Action Team Meetings	Ongoing	<ul style="list-style-type: none"> <li>The project team met regularly throughout the development of the Plan and in-between workshops and surveys</li> </ul>	<ul style="list-style-type: none"> <li>Findings from activities analyzed and discussed; identified impacts, risks and actions</li> </ul>
Presentation to Council	Summer 2019	<ul style="list-style-type: none"> <li>Reviewed local projections and impacts</li> <li>Presented objectives and goals of the Plan</li> </ul>	<ul style="list-style-type: none"> <li>Inform and discuss goals of the Plan</li> </ul>
Online Staff Survey #1	Fall 2019	<ul style="list-style-type: none"> <li>Identify goals and view of climate change and how it has and will impact Orangeville</li> <li>Total of 22 responses collected</li> </ul>	<ul style="list-style-type: none"> <li>Collect local information and inform staff of the Plan</li> </ul>
Vulnerability Assessment Workshop	Fall 2019	<ul style="list-style-type: none"> <li>Town staff were led through a half-day workshop on vulnerability and asked to identify vulnerability scores for each impact in small groups</li> </ul>	<ul style="list-style-type: none"> <li>Staff discussion on impact statements and vulnerabilities</li> <li>Vulnerability scores for each impact</li> </ul>
Risk Assessment Workshop	Winter 2020	<ul style="list-style-type: none"> <li>Town staff were led through 2 half-day workshops on assessing risk and asked to score each impact for likelihood and consequence in small groups</li> </ul>	<ul style="list-style-type: none"> <li>Staff discussion on level of risk for each impact</li> <li>Risk scores for each impact</li> </ul>
Online Staff Survey #2	Spring 2020	<ul style="list-style-type: none"> <li>Staff were asked to rank level of agreement on the results of the vulnerability and risk assessment</li> <li>Asked to identify specific goals of the Plan</li> <li>Total of 16 responses collected</li> </ul>	<ul style="list-style-type: none"> <li>Consulted on findings from assessment work</li> <li>Preliminary goals and objectives of the Plan</li> </ul>
Update to Council	Spring 2020	<ul style="list-style-type: none"> <li>Vulnerability and Risk Assessment report to Council summarizing findings to date and next steps</li> </ul>	<ul style="list-style-type: none"> <li>Informed Council of progress and findings</li> </ul>
Virtual Workshop on Visioning and Goals	Summer 2020	<ul style="list-style-type: none"> <li>Worked through visioning and goal-setting exercises utilizing online platforms</li> <li>Reviewed and analyzed results from surveys</li> </ul>	<ul style="list-style-type: none"> <li>Revised vision statement and list of goals</li> </ul>
Virtual Workshop on Identifying Actions	Summer 2020	<ul style="list-style-type: none"> <li>Participants were led through exercise on identifying actions to address climate risks and impacts at the Town</li> </ul>	<ul style="list-style-type: none"> <li>4-6 Actions were identified for each impact</li> </ul>
Virtual Workshop on Prioritizing Actions	Fall 2020	<ul style="list-style-type: none"> <li>Actions were analyzed and prioritized from the previous workshop using a prioritization matrix</li> </ul>	<ul style="list-style-type: none"> <li>Each action was given a prioritization score</li> <li>List of priority actions for the Plan</li> </ul>
<b>Committees, Community and Stakeholder Engagement</b>			
Creation of climate change webpage	Spring 2019	<ul style="list-style-type: none"> <li>Overview of plan and process</li> <li>Updated throughout process</li> </ul>	<ul style="list-style-type: none"> <li>Create general awareness about the development of the plan</li> </ul>
Send awareness email to stakeholders	Spring 2019	<ul style="list-style-type: none"> <li>Sent to key stakeholders</li> <li>Details on our plan</li> </ul>	<ul style="list-style-type: none"> <li>Create awareness of the Plan</li> <li>Inform about future engagement opportunities</li> </ul>
Information Booth at Community Events	Spring and Summer 2019	<ul style="list-style-type: none"> <li>Flyers/handouts and presentation board with overview of adaptation planning and timeline</li> <li>Attended 4 community events</li> </ul>	<ul style="list-style-type: none"> <li>Raise awareness</li> <li>Educate public on the Plan</li> </ul>
Sustainable Orangeville Meeting Updates	Ongoing	<ul style="list-style-type: none"> <li>Provided brief update presentations to the committee at key stages of the Plan</li> <li>Asked for feedback</li> </ul>	<ul style="list-style-type: none"> <li>Gain feedback from committee</li> <li>Ask for community-perspective</li> </ul>
Committee Survey	Summer 2020	<ul style="list-style-type: none"> <li>Gain general feedback from committee on preliminary goals and vision</li> <li>Ask for ranking of vulnerability and risk assessment results</li> </ul>	<ul style="list-style-type: none"> <li>Identified additional areas of focus from committee perspective</li> </ul>
Stakeholder Online Survey	Winter 2021	<ul style="list-style-type: none"> <li>Release draft goals and actions for stakeholder feedback</li> </ul>	<ul style="list-style-type: none"> <li>Allow for insights from key stakeholders to be incorporated into planning and implementation</li> </ul>
Virtual Public Information Notice	Winter 2021	<ul style="list-style-type: none"> <li>Present draft of the plan</li> <li>Allow for residents to rank and comment on the findings</li> </ul>	<ul style="list-style-type: none"> <li>Identify gaps and barriers from residents</li> <li>Allow for feedback on actions and implementation needed to drive the plan and fulfil the vision</li> </ul>



