

Climate Risk and Vulnerability Assessment

July 24, 2026



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Executive Summary

The Town of Collingwood (Collingwood) declared a Climate Crisis in 2019 and has since taken steps to integrate climate considerations into municipal planning and decision-making. Building on the *Greener Collingwood Corporate Climate Action Plan*, Collingwood is now developing a Climate Change Adaptation Plan to better understand and prepare for the local impacts of climate change.

Climate projections indicate that Collingwood will experience continued warming, changing precipitation patterns, increased rainfall intensity, evolving winter conditions, and ongoing variability in Great Lakes water levels. These changes are expected to increase the likelihood of extreme heat events, severe storms, heavy rainfall, and compounding climate hazards such as rain-on-snow events and high lake levels coinciding with storms. These climate drivers have the potential to affect infrastructure performance, ecosystem health, public safety, and economic stability across the community.

Collingwood is following ICLEI Canada's Building Adaptive and Resilient Communities (BARC) framework, a nationally recognized methodology, to develop its climate adaptation plan. This framework applies a systems-based approach to translate climate hazards into locally relevant impact statements across four interconnected systems: built, natural, sociocultural, and economic. A facilitated workshop process with the Resilient Collingwood Task Force (RCTF) brought together municipal staff and community partners to incorporate local knowledge and lived experience in the adaptation planning process.

The RCTF developed sixty-seven climate impact statements for Collingwood based on projected climate hazards. Each climate impact was assessed for vulnerability based on its sensitivity to the hazards and the community's capacity to adapt. This vulnerability assessment identified twenty-five climate impacts with High vulnerability, twenty-five impacts with Medium vulnerability, and seventeen impacts with Low vulnerability. Impacts rated as Low vulnerability were screened out of the subsequent risk assessment processes, allowing the analysis to focus on the climate pressures most likely to affect municipal services and community resilience.

The risk assessment evaluated the likelihood of climate hazards alongside their potential consequences for sociocultural, economic, and natural systems. In the near term (2021-2050), most climate risks fall within the Low and Medium priority categories (**Figure ES-1**), with a smaller number of High Priority risks associated primarily with intense precipitation, hotter summers, and changing winter conditions (**Table ES-1**). These risks reflect existing climate pressures that are already affecting infrastructure performance, emergency response capacity, and community safety.

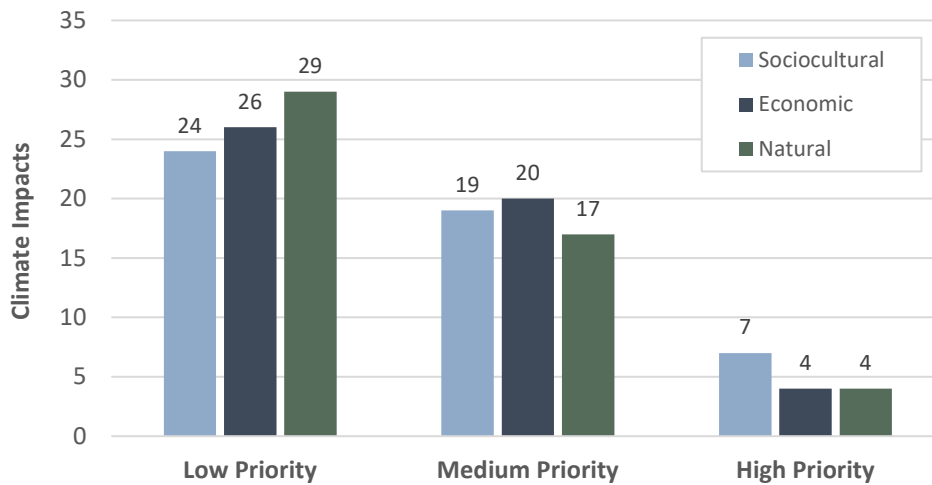


Figure ES-1 Risk Distribution by Sociocultural, Economic and Natural Factors: Near Term (2021-2050)

Table ES-1 Key Climate Risk Themes Identified Through the Risk Assessment

Climate Driver	Key Near-Term Risks	Key Long-Term Risks
Severe Storms & Intense Rainfall	Increased pressure on emergency response and municipal services; localized flooding and water quality impacts	Greater infrastructure damage; flooding of homes; shoreline erosion; wastewater bypass events and declining receiving-water quality
Hotter Summers & Extreme Heat	Higher electricity demand for cooling; increased heat-related health risks; early signs of water quality decline	Expanded heat-related health risks; poor air quality; housing overheating; infrastructure deterioration; increased pressure on shaded and cooled public spaces; vegetation stress and declining aquatic habitat and water quality
Changing Winter Conditions	Structural damage from heavy snow events	Rain-on-snow events and meltwater exceeding drainage capacity; increased exposure to vector-borne and other climate-sensitive infectious diseases
Seasonal Shifts	No High Priority risks identified	Increased pests and invasive species pressure on native ecosystems and biodiversity
Lake Level Variability	No High Priority risks identified	Shoreline changes and reduced access to waterfront areas; stormwater and wastewater operational challenges
Cumulative Effects	No High Priority risks identified	Reduced recovery time between events and increased stress on communities

In the long term (2051-2080), the risk profile shifts significantly as climate hazards become more frequent and severe (**Figure ES-2**). Near term High Priority risks will increase and expand to include

extreme heat impacts, air quality degradation, shoreline erosion, ecosystem stressors, and increasing strain on infrastructure and community services (**Table ES-1**). These findings indicate that climate risk in Collingwood is dynamic and expected to increase over time, highlighting the importance of integrating climate considerations into infrastructure planning, land-use decisions, and community development.

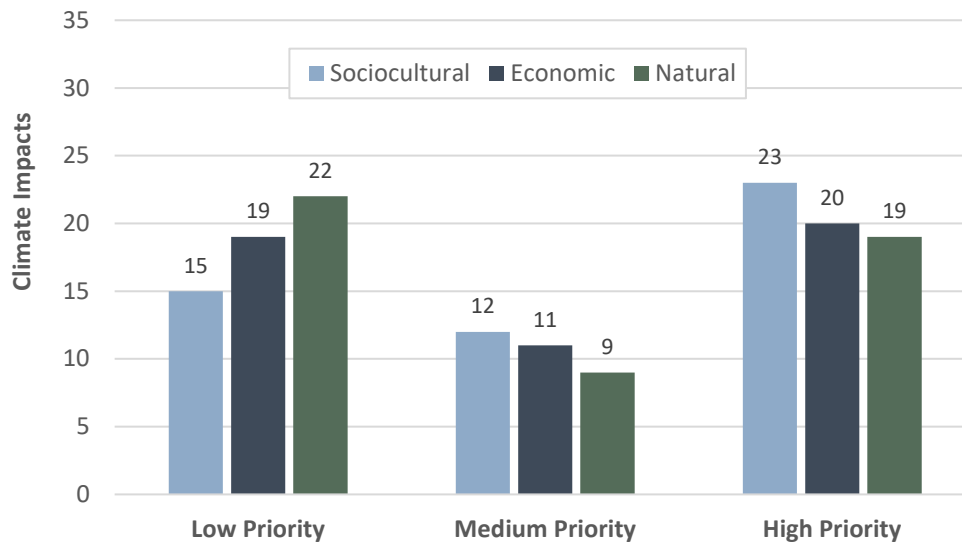


Figure ES-2 Risk Distribution by Sociocultural, Economic and Natural Factors: Long Term (2051-2080)

The results of the risk assessment also highlight that climate impacts are not experienced equally across the community. Vulnerable and equity-denied populations, including older adults, children, individuals with chronic health conditions, lower-income households, renters, outdoor workers, and those without access to cooling or transportation, may experience disproportionate impacts from extreme heat, flooding, and service disruptions. Recognizing these differential impacts will be an important consideration in the development of adaptation strategies.

Consistent with the BARC framework, climate impacts identified as High Priority risks will be advanced to the adaptation planning phase, where specific actions will be developed to reduce vulnerability and strengthen resilience. Medium and Low Priority risks will continue to be monitored and may also be considered where they align with community priorities or emerging climate trends.

The results of this assessment provide a transparent and evidence-based foundation for Collingwood's Climate Change Adaptation Plan. The next phase of the project will involve public engagement and collaboration with community partners to validate the findings of this assessment, refine adaptation priorities, and identify practical actions that support a resilient and sustainable future for Collingwood.

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1 Introduction

The Town of Collingwood (Collingwood) declared a Climate Crisis in 2019 and has since taken a series of steps to integrate climate considerations into municipal decision-making and community planning. Building on the *Greener Collingwood Corporate Climate Action Plan* adopted in 2023, Collingwood is now developing a Climate Change Adaptation Plan to better understand and prepare for the local impacts of climate change. This work aligns with Collingwood’s *Community Based Strategic Plan* (2019–2023 and 2024–2028), which identifies sustainability as a core priority and calls for growth that supports a livable community and building resilience for future generations.

1.1 Purpose and Scope

This report presents the results of the climate risk and vulnerability assessment, which was undertaken to improve understanding of how projected climate conditions may affect Collingwood’s infrastructure, natural systems, economic activity, and community well-being. The assessment integrates climate projections with local expertise and community perspectives to identify priority climate risks and support informed decision-making.

The findings of the risk and vulnerability assessment are intended to increase awareness of climate risks among residents and staff, strengthen Collingwood’s preparedness for climate-related hazards, and provide a foundation for the development of adaptation actions that protect the natural environment, support vulnerable populations, and enhance the long-term resilience of the community. While the municipality’s corporate operational risks are considered where they influence service delivery, the primary lens of the assessment is community resilience rather than the municipality’s corporate continuity planning.

1.2 Methodology

The Climate Change Adaptation Plan for Collingwood is being developed using ICLEI Canada’s Building Adaptive and Resilient Communities (BARC) framework, a nationally recognized methodology used by municipalities across Canada to assess climate risks and inform adaptation planning. BARC applies a structured, systems-based approach to adaptation planning that integrates climate science with local knowledge and municipal service delivery considerations (**Figure 1**). Completion of this risk and vulnerability assessment includes the following key components of the BARC framework:

Climate Hazard Identification – Review of local climate projections and regional studies to identify climate drivers relevant to Collingwood, including temperature increases, precipitation intensity, lake level variability, and extreme weather events.

Systems-Based Impact Identification – Development of climate impact statements describing how climate hazards may affect four interconnected systems: Built, Natural, Sociocultural, and Economic.

Vulnerability Assessment – Evaluation of climate impacts based on sensitivity and adaptive capacity to determine overall vulnerability.

Risk Assessment – Evaluation of the likelihood and consequences of medium- and high-vulnerability impacts to establish a prioritized climate risk profile.

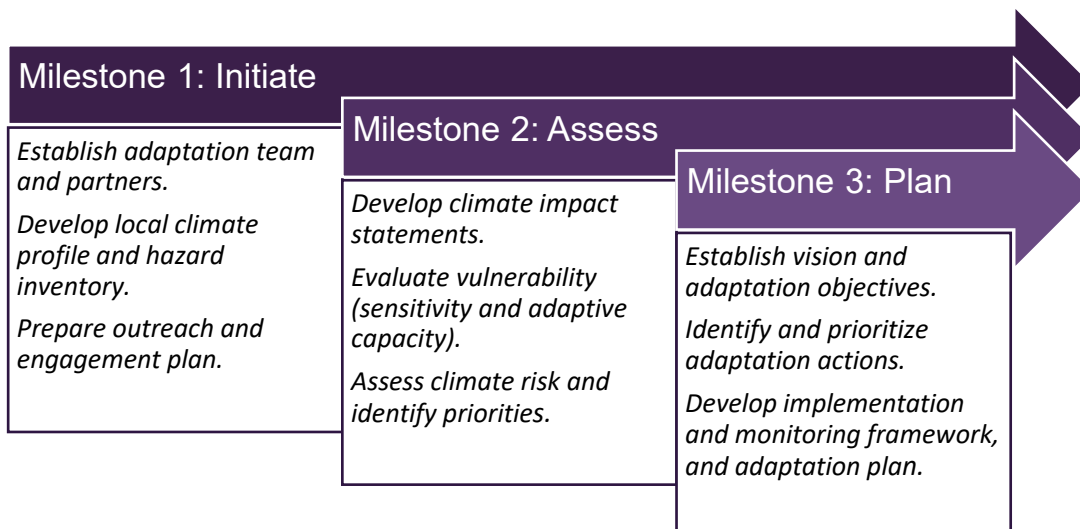


Figure 1 Climate Change Adaptation Planning Process Aligned with the BARC Framework

To support this process, the Resilient Collingwood Task Force (RCTF) was established during project initiation. The RCTF brings together municipal staff, community partners, Indigenous Rights Holders and partners, and representatives of vulnerable and equity-denied populations to contribute local expertise and lived experience. Through a series of facilitated workshops, the RCTF validated assumptions, identified climate impacts, and provided input to the vulnerability and risk assessments. This approach helps ensure that the assessment results are transparent, repeatable, and grounded in both climate science and local knowledge.

2 Climate Profile

Collingwood's climate is strongly influenced by its location along the southern shore of Georgian Bay within the Great Lakes basin. The Town experiences cold winters, warm summers, and year-round precipitation, with lake-modified weather patterns that influence snowfall, wind, temperature variability, and seasonal transitions.

Consistent with broader trends across Ontario and Canada, Collingwood is experiencing a warming climate. Climate projections indicate that warming will continue, accompanied by changes in seasonal precipitation patterns, more frequent heat events, evolving winter conditions, increasing rainfall intensity, and more frequent storm events. To capture a range of possible futures, climate projections from the Climate Atlas of Canada (Prairie Climate Centre, 2026) were evaluated using both RCP4.5, a moderate greenhouse gas emissions scenario that assumes global emissions stabilize through mitigation efforts, and RCP8.5, a high emissions scenario representing continued growth in greenhouse gas emissions. A detailed technical analysis of the local climate projections supporting this discussion is provided in **Appendix A**.

2.1 Temperature: Warming Patterns and Seasonal Shifts

Collingwood is projected to experience warming across all seasons, with the most significant increases occurring during winter months. Average annual temperatures are expected to rise by 2.1°C by 2050 and by 4.0°C by 2080 under the RCP8.5, or high carbon, emission scenario (**Figure 2**).

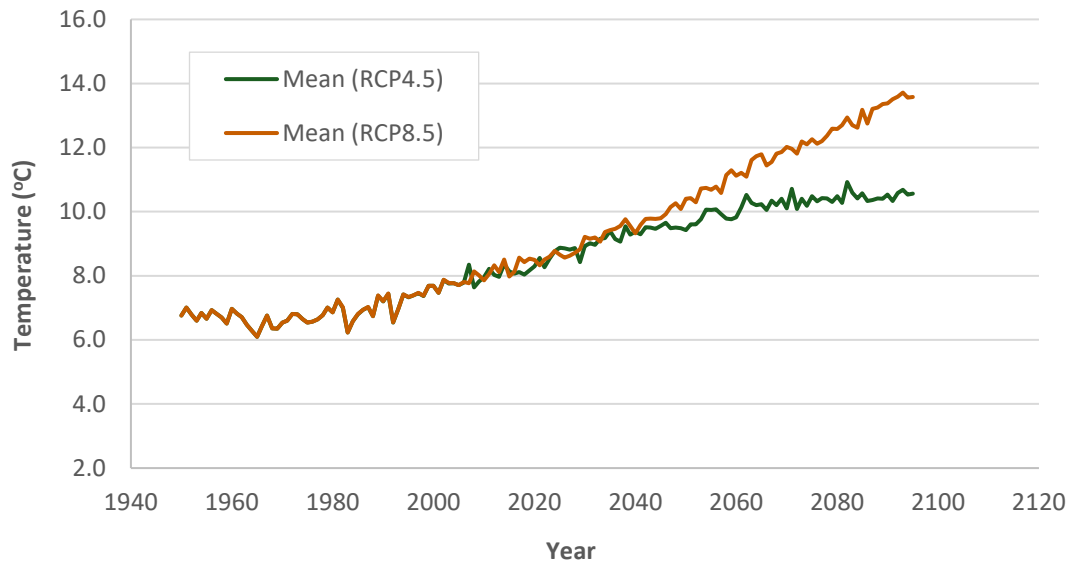


Figure 2 Annual Mean Temperature – Historical and Projected

In addition to rising averages, temperature extremes are projected to shift substantially. Projected temperature-related changes for Collingwood include:

- Increase in average annual temperature across all seasons.
- More very hot days ($\geq 30^{\circ}\text{C}$).
- Increase in tropical nights ($> 20^{\circ}\text{C}$).
- Longer and more frequent heat waves.
- Increase in cooling degree days.
- Decrease in ice days ($< 0^{\circ}\text{C}$).
- Decrease in extreme cold days.
- Changes in freeze-thaw cycle frequency and timing.
- Longer frost-free season.
- Decrease in duration and extent of winter lake ice cover.
- Warmer summer water temperatures in Georgian Bay.

2.2 Precipitation: More Rain and Greater Variability

Total annual precipitation is projected to increase modestly in both the near term and long term, with more significant changes occurring seasonally. Winter and spring are expected to become wetter, with warming temperatures contributing to a shift from snowfall toward more frequent rain and mixed precipitation events, while summer conditions may become more variable. In addition to changes in total precipitation, rainfall intensity is projected to increase (**Figure 3**).

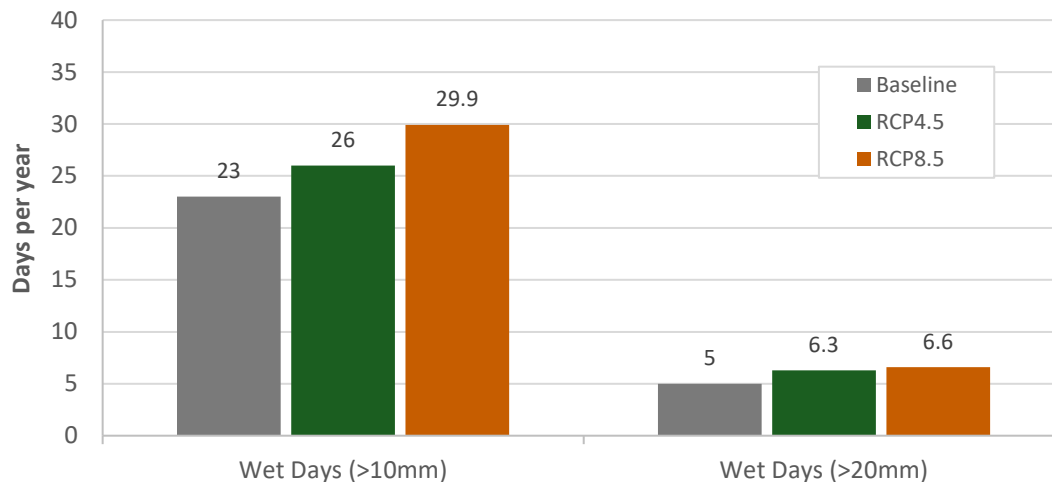


Figure 3 Projected Increase in Heavy Rainfall Days (2051-2080)

Projected precipitation-related changes for Collingwood include:

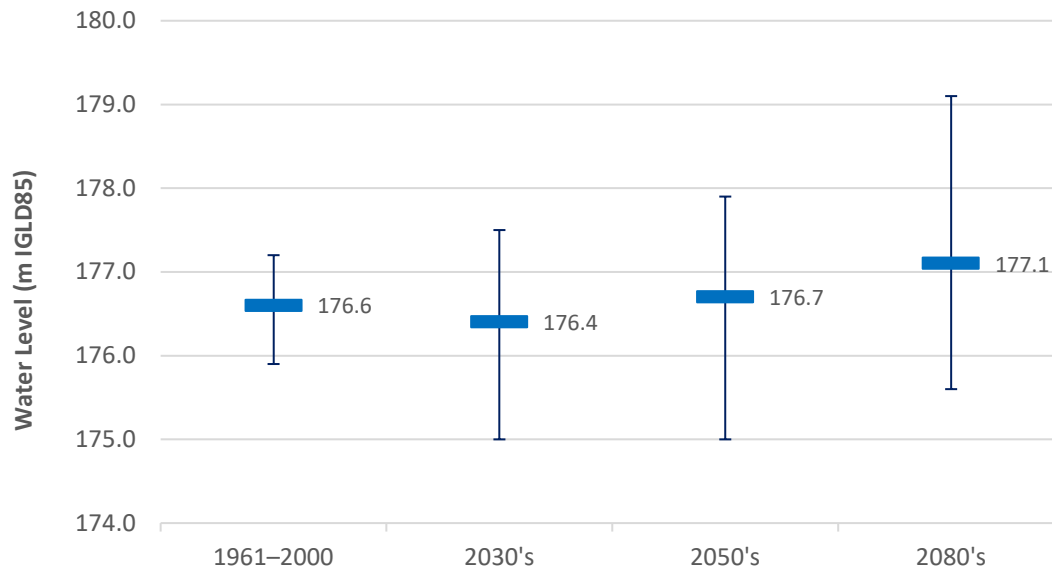
- Increase in total annual precipitation (from approximately 906 mm historically to at least 980 mm by 2050 and 994 mm by 2080 under the high emissions scenario).
- Increased winter and spring precipitation.
- More frequent heavy rainfall events (≥ 10 mm and ≥ 20 mm days).
- Increased maximum rainfall amounts in one day.
- Warmer winter conditions contributing to a higher proportion of winter precipitation falling as rain rather than snow.
- Increased likelihood of mixed precipitation events, including freezing rain and wet, heavy snows.
- Increasing atmospheric moisture content associated with rising temperatures and leading to heavier rainfall and humidity.

Regional and national studies indicate that atmospheric moisture content is increasing as the climate warms (Bush & Lemmen, 2019), contributing to heavier rainfall events and higher humidity levels across Canada. While projections of relative humidity at the local scale carry greater uncertainty, increasing atmospheric moisture is a well-established trend associated with global warming and is expected to be experienced in Collingwood as well.

2.3 Extreme Weather: Increasing Frequency and Intensity

While there is greater uncertainty in climate projections for increasing wind speeds at a local scale, there is stronger confidence in projections for increasing heat extremes and heavier precipitation events in Collingwood. Regional and national assessments also indicate that extreme weather events are expected to increase in frequency and intensity across southern Ontario. *Canada's Changing Climate Report* (Bush & Lemmen, 2019) and the *Regional Perspectives Report* for Ontario (Douglas & Pearson, 2022) both identify rising heavy rainfall intensity and more frequent extreme heat events as key trends affecting the Great Lakes region. The *Ontario Provincial Climate Change Impact Assessment* (Climate Risk Institute, 2023) further highlights increasing risks associated with compound events, such as heavy

rainfall occurring during higher lake levels (**Figure 4**) or rain falling on frozen or saturated ground. Collingwood's location along Georgian Bay also introduces additional variability associated with lake-influenced weather systems (Lam & Dokoska, 2022).



Note: IGLD85 refers to the International Great Lakes Datum 1985, the standard elevation reference system used for reporting Great Lakes water levels

Figure 4 Projected Range of Annual Average Lake Levels (Georgian Bay/Lake Huron) under a High Carbon Emissions Scenario (RCP8.5)

Projected extreme weather trends for Collingwood include:

- Longer and more frequent heat waves.
- Increased intensity of rainfall events.
- Greater frequency of storm events (rain, lightning, hail, windstorms).
- Increased likelihood of mixed precipitation and rain-on-snow events.
- Increased variability in Great Lakes water levels.
- Increased likelihood of high-water levels coinciding with storm events.
- Increased wave energy and storm surge potential during extreme events.

3 Climate Impacts

The climate projections described in **Section 2** indicate that Collingwood will experience continued warming, shifting seasonal precipitation patterns, increased rainfall intensity, evolving winter conditions, and ongoing variability in Great Lakes water levels. In some cases, these projected climate variables interact to produce secondary or compounding hazards, such as rising air temperatures contributing to warmer lake temperatures and longer lake stratification periods, or increased rainfall intensity and seasonal shifts contributing to greater runoff and snowmelt events. Together, these drivers need to be

considered to understand how climate change will be experienced locally and how public infrastructure, natural systems, economic activity, and community well-being may be affected.

The BARC Framework uses climate impact statements to translate projected climate hazards into locally relevant consequences, describing how built, natural, sociocultural and economic systems may be affected over time. They are forward-looking and consider both potential negative impacts and, where appropriate, beneficial opportunities.

Climate impact statements were developed through a facilitated workshop process with members of the RCTF. Participants reviewed climate hazards of concern based on Collingwood’s climate profile and collaboratively identified impact pathways across the four systems. Draft impact statements were subsequently refined to ensure clarity, consistency, and alignment with the BARC framework.

Climate impacts will not be experienced equally across communities, with certain populations, including older adults, children, individuals with pre-existing health conditions, lower-income households, and those with limited access to cooling or transportation, expected to experience disproportionate effects from extreme heat, flooding, and service disruptions. Workshop participants were encouraged to consider these differential impacts when developing climate impact statements for Collingwood.

The following section summarizes projected climate impacts across the built, natural, sociocultural, and economic systems in Collingwood. A comprehensive list of climate impact statements developed for this project is provided in **Appendix B**.

3.1 Built System

Collingwood’s built system includes municipal infrastructure, public facilities, transportation networks, utilities, and shoreline protection works that support essential community services. Projected increases in temperature, changing precipitation patterns, and continued variability in Great Lakes water levels are expected to influence the performance, reliability, and service life of these assets (**Table 1**).

Table 1 Summary of Built System Climate Impacts

Climate Hazard	Outcome
Extreme Heat	Increased cooling demand in municipal facilities; thermal stress on infrastructure; increased electricity demand; water demand pressures.
Drought & Water Stress	Reduced water supply reliability; treatment challenges due to changing source water quality; water demand pressures.
Lake Level Variability & Shoreline Erosion	Changes in hydraulic head (water level and pressure) create operational challenges for stormwater and wastewater outfalls and drinking water intake; increased wastewater surcharge risk; erosion of shoreline infrastructure; reduced reliability of shoreline facilities.
Severe Storms	Damage to public infrastructure; power outages affecting municipal services; debris blocking transportation routes.
Freeze-Thaw Variability	Accelerated deterioration of pavement and buried infrastructure, such as buried pipes; increased maintenance requirements.

Climate Hazard	Outcome
Warmer Winters & Winter Variability	Increased demand for winter maintenance; greater winter runoff and inflow into stormwater and wastewater systems; ice accretion impacts to utilities; altered lake ice conditions affecting shoreline exposure; lower heating demands in some facilities; extended construction season.
Surface Flooding	Stormwater and wastewater system exceeding pipe capacity; localized flooding of public facilities and transportation routes.
Riverine Flooding	Flooding of infrastructure and municipal assets located within floodplains.
Air Quality & Wildfire Smoke	Increased HVAC filtration demands; reduced indoor air quality in public facilities.
Cumulative Effects	Increased reliance on backup equipment; reduced lifespan of public assets through wear and tear; reduced operational capacity and reliability.

Individual and compounding climate hazards contribute to an increased likelihood of flooding and surcharge events in both stormwater and wastewater systems, operational constraints at stormwater and wastewater outfalls during high lake levels, increased cooling and electricity demand during extreme heat, deterioration of pavement and buried utilities due to freeze-thaw variability, and increased strain on energy and communication systems during storm events. These impacts highlight the potential for both gradual and ongoing asset degradation as well as critical service disruptions under future climate conditions.

3.2 Sociocultural System

Collingwood's sociocultural systems encompass public health, community well-being, recreation and cultural activities, social services, household conditions, and emergency response capacity. Increases in extreme heat, heavier rainfall events, winter variability, and deteriorating air quality will influence how residents experience the changing climate in their homes and communities (**Table 2**).

Table 2 Summary of Sociocultural Climate Impacts

Climate Hazard	Outcomes
Extreme Heat	Increased risk of heat-related illness, particularly for outdoor workers and populations without access to mechanical cooling; reduced outdoor activity; increased demand for public cooling spaces and public health services; increased need for drinking water access; reduced sleep quality and overall well-being.
Drought & Water Stress	Water use restrictions affecting households; reduced access to recreational water-based amenities.
Lake Level Variability & Shoreline Erosion	Reduced access to waterfront spaces; increased safety risks near unstable shorelines; disruption of recreation and community gathering areas.
Severe Storms	Safety risks from wind and debris; disruption of essential services; damage to spaces used for cultural, community and recreational activities; temporary displacement and recovery challenges.

Climate Hazard	Outcomes
Freeze–Thaw Variability	Increased slip-and-fall injuries; reduced accessibility of sidewalks and public spaces, particularly for seniors and individuals with mobility challenges.
Warmer Winters & Winter Variability	Hazardous travel conditions; increased mobility challenges and health and safety risks from slips and falls; reduced reliability of winter events, seasonal activities and cultural traditions (e.g. ice fishing); increased winter flooding from rain-on-snow; reduced extreme cold exposure.
Surface Flooding	Flooding of homes and community spaces; sewer backups affecting private residences; temporary displacement of people; disruption of daily life and emergency services.
Riverine Flooding	Risks to life and safety during flood events, increased displacement risk in flood-prone areas; disruption of access to essential services and cultural spaces.
Air Quality & Wildfire Smoke	Elevated respiratory and cardiovascular health risks; reduced usability of outdoor spaces for recreation; deteriorating community connection with reduced outdoor community events and cultural activities; disproportionate impacts on sensitive populations.
Cumulative Effects	Deteriorating mental health and well-being; temporary displacement and housing instability; increased public safety risks during service outages; increased risk of exposure to contagious disease.

Individual and compounding climate hazards may contribute to increased risk of heat-related illness, respiratory health concerns, flooding and sewer backups at private residences, property damage from wind and ice storms, and disruption to community gathering spaces and recreational amenities. More frequent or overlapping extreme events could also place additional demands on emergency response services and social support systems, potentially affecting response capacity and recovery timelines. These impacts highlight the potential strain on the resilience of individual households as well as the potential for severe disruptions that can affect safety, mental health, and overall community well-being.

Certain populations, including older adults, young children, individuals with chronic health conditions, lower-income households, renters, and outdoor workers were identified as facing disproportionate sociocultural impacts. For example, residents in rental housing or older buildings may have limited control over indoor cooling or building upgrades, and individuals with pre-existing health conditions may be more sensitive to heat stress, wildfire smoke, and air quality degradation. Repeated or compounding climate events can also contribute to cumulative stress, mental health impacts, and reduced community resilience over time.

3.3 Economic System

Collingwood’s economic systems are influenced by tourism, recreation, municipal services, local businesses, and climate-sensitive seasonal activity. Increases in the intensity of storms, extreme heat, winter variability, and shoreline changes will affect operating costs for businesses, workforce productivity, property values, and overall business continuity (**Table 3**).

Table 3 Summary of Economic Climate Impacts

Climate Hazard	Projected Impacts
Extreme Heat	Increased energy costs; reduced workforce productivity; disruption to outdoor tourism and events.
Drought & Water Stress	Increased operational costs and disruptions for water-dependent businesses, including agriculture; reduced reliability of water-based tourism and recreation.
Lake Level Variability & Shoreline Erosion	Increased shoreline protection and repair costs; disruption to waterfront-dependent businesses and tourism.
Severe Storms	Business interruption due to power outages and access limitations; increased repair and recovery costs.
Freeze–Thaw Variability	Higher infrastructure lifecycle costs (shorter service life); higher municipal maintenance expenditures; disruption to local commerce.
Warmer Winters & Winter Variability	Increased winter maintenance costs; business disruptions due to access limitations; reduced reliability of winter tourism and seasonal economic activity; increased costs to repair and insure private properties from winter flood events; longer growing season could benefit some agricultural production.
Surface Flooding	Property damage and cleanup costs; insurance claims; temporary business closures; increased emergency response costs.
Riverine Flooding	Prolonged business disruption; reduced property values in flood-prone areas; increased long-term recovery costs.
Air Quality & Wildfire Smoke	Disruption to outdoor work and tourism; increased health-related costs and protective expenditures.
Cumulative Effects	Escalating cost increases for emergency response and recovery; reduced capacity for businesses to recover from repeated interruptions; reduced property value in areas known for recurring climate hazards; increased insurance costs and reduced insurance coverage.

Individual and compounding climate drivers will contribute to increased repair and recovery costs for homeowners and businesses following flooding or storm damage as well as higher insurance claims and premiums, and potential business interruptions from power outages or access limitations. The reduced reliability of winter recreation and tourism-based economic activity is a notable concern with the Collingwood economy’s close ties to nearby ski resorts. These economic impacts will be both gradual and ongoing with increases in operating and maintenance costs along with periodic significant disruptions, all of which could affect local economic stability.

3.4 Natural System

Collingwood’s natural systems include wetlands, nearshore and aquatic habitats, groundwater resources, forests, and other ecological features that support biodiversity and provide essential ecosystem services. Projected increases in temperature, shifting precipitation patterns, longer frost-free seasons, and increased variability in Great Lakes water levels are expected to influence habitat conditions, species composition, water quality, and overall ecosystem resilience (**Table 4**). The ability of native species and ecosystems to adjust to changing conditions will also depend on the health, diversity,

and connectivity of local habitat, as fragmented or isolated natural areas may limit species movement and ecological recovery.

Table 4 Summary of Natural System Climate Impacts

Climate Hazard	Projected Impacts
Extreme Heat	Thermal stress on terrestrial and aquatic species; increased risk of algal blooms; altered habitat conditions, loss of biodiversity, and reduced ecosystem resilience to disease and pests.
Drought & Water Stress	Reduced groundwater recharge; increased stress on aquatic ecosystems (wetlands, surface water); vegetation stress and loss of biodiversity and increased wildfire susceptibility.
Lake Level Variability & Shoreline Erosion	Loss or degradation of coastal wetlands and nearshore habitat; altered sediment transport; reduced natural buffering capacity along shorelines.
Severe Storms	Tree loss and habitat disturbance; erosion of natural shorelines and riparian areas; reduced ecosystem stability following storm damage.
Freeze–Thaw Variability	Soil instability and altered infiltration patterns; stress on vegetation and root systems; increased vulnerability to invasive species.
Warmer Winters & Winter Variability	Altered snowpack accumulation and melt timing; disruption of wildlife cycles; increased pest and invasive species pressure; reduced lake ice cover; deteriorating lake water quality; extended growing season.
Surface Flooding	Increased sediment and contaminant transport to streams and water bodies; degradation of aquatic habitat quality.
Riverine Flooding	Altered channel morphology and sediment transport; impacts to fish spawning and riparian ecosystems; stress on floodplain wetlands.
Air Quality & Wildfire Smoke	Vegetation and wildlife stress from prolonged smoke exposure; ecosystem degradation following wildfire events.
Cumulative Effects	Weakened habitats and reduced habitat functionality over time; biodiversity loss.

Individual and compounding climate drivers contribute to increased shoreline erosion and wetland stress during high-water events, increased nutrient and sediment loading from intensified runoff, greater risk of algal blooms and thermal stress in aquatic systems due to warmer lake temperatures, shifts in vegetation communities associated with changing precipitation patterns and longer growing seasons, and increased invasive species pressure. These pressures may alter habitat quality and species composition, reduce biodiversity, and weaken the ability of natural systems to recover from repeated disturbances. Changes in biodiversity and ecosystem condition may also reduce the reliability of ecosystem services provided by wetlands, forests, shorelines, and aquatic habitats, including flood storage, shoreline stabilization, water-quality protection, groundwater recharge, shade, pollination, recreation, and cultural connection. Reduced ecosystem function can, in turn, transfer risk to infrastructure, public health, municipal operations, and the local economy.

4 Vulnerability Assessment

Before assessing climate risk, it is important to understand how exposed and prepared Collingwood is in relation to projected climate impacts. A vulnerability assessment provides this foundation by examining

Collingwood’s ability to anticipate, respond to, and recover from climate-related impacts. While risk is often described as a combination of likelihood and consequence, a high risk impact may be manageable in practice if strong plans, infrastructure, and coordination mechanisms are already in place.

By assessing vulnerability first, Collingwood can distinguish between impacts that are currently manageable and those that have underlying system weaknesses. This ensures that the subsequent risk analysis focuses attention and resources where they will have the greatest benefit, and not simply where hazards are most apparent.

4.1 Approach

Consistent with the BARC methodology, vulnerability was assessed as a function of sensitivity and adaptive capacity:

Sensitivity - the degree to which a system, service, or population is affected by a given climate impact, considering the severity, duration, and persistence of the impact.

Adaptive Capacity - the ability to anticipate, respond to, and recover from climate impacts, including existing policies, resources, operational practices, infrastructure, and coordination across departments and partner organizations.

A facilitated workshop was held with members of the RCTF, where participants reviewed each climate impact statement and assigned qualitative ratings of Low, Medium, or High for both sensitivity and adaptive capacity considering anticipated conditions over the planning horizon. Vulnerability ratings were then determined using the matrix shown in **Table 5** (Sensitivity × Adaptive Capacity), consistent with BARC guidance.

Table 5 Vulnerability Assessment Matrix

	Low Sensitivity	Medium Sensitivity	High Sensitivity
Low Adaptive Capacity	Medium Vulnerability	High Vulnerability	High Vulnerability
Medium Adaptive Capacity	Low Vulnerability	Medium Vulnerability	High Vulnerability
High Adaptive Capacity	Low Vulnerability	Low Vulnerability	Medium Vulnerability

While assessing Collingwood’s vulnerability to each climate impact, the workshop participants were also asked to

- Document the rationale for each rating;
- Identify considerations related to equity-denied or vulnerable populations, external coordination requirements, and any regulated services; and
- Assign a qualitative confidence level to each vulnerability rating.

This approach helps ensure that the results of the assessment are transparent and traceable, with documented rationale supporting each rating. It also helped identify community partners and service areas that may need to be engaged during adaptation planning, and integrated both technical expertise and operational knowledge across departments.

4.1.1 Post-Workshop Review and Refinement

Following the workshop, the project team reviewed all vulnerability ratings and supporting notes to ensure consistency in interpretation and alignment with BARC definitions. In select cases, refinements were made to:

- Ensure sensitivity ratings reflected the magnitude of potential service disruption or recovery costs (independent of likelihood);
- Clarify distinctions between vulnerability and likelihood;
- Incorporate broader system-level implications; or
- Address overlaps between similar impact statements.

Adjustments to scoring primarily related to refining adaptive capacity where existing measures were reactive rather than proactive, or where financial and coordination constraints limited the Town's ability to respond effectively.

4.2 Results

Sixty-seven climate impact statements were assessed and assigned vulnerability scores by the workshop participants (**Appendix C**). The distribution of the results across the vulnerability matrix demonstrates that impacts are concentrated in the Medium (37%) and High (37%) vulnerability categories (**Figure 5**). Notably, no impacts were rated as combining low sensitivity with low adaptive capacity, and no impacts were rated as combining high sensitivity with high adaptive capacity. This suggests that less disruptive impacts are generally supported by adequate existing capacity, and more disruptive impacts are not fully offset by established plans, funding, or long-term mitigation strategies.

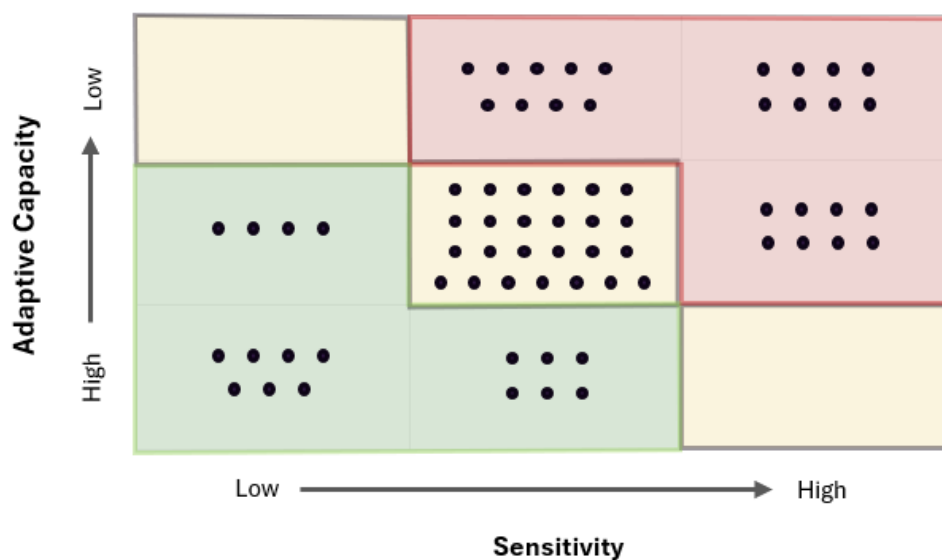


Figure 5 Vulnerability Rating Distribution

The concentration of medium and high vulnerability ratings reflects climate pressures that are expected to increasingly strain existing services, budgets, and coordination across departments and partner organizations as conditions become more frequent or severe. In many of these cases, current responses to climate events tend to be reactive rather than proactive, and many supporting plans or procedures remain informal rather than formally documented. In addition, funding is not consistently secured for long-term solutions, and responsibilities are often distributed across multiple departments or agencies, which can complicate coordinated planning and implementation.

When vulnerability is examined with a system lens, the distribution of climate impacts across the primary systems is not evenly balanced between High, Medium, and Low vulnerability ratings (**Figure 6**). Climate impacts primarily affecting the built and sociocultural systems account for most of the High vulnerability ratings, reflecting the exposure of public infrastructure, municipal services, and community well-being to projected climate hazards. Natural-system impacts are more evenly distributed across the vulnerability levels. This should not be interpreted to mean that natural systems are less vulnerable to climate change. Healthy and connected ecosystems may be able to adjust to some gradual changes, but their resilience can be weakened by habitat loss, pollution, invasive species, development pressure, and repeated climate impacts. Some ecological changes may also take time to become visible or may be difficult to reverse. The economic system includes fewer total climate impacts and correspondingly fewer High vulnerability ratings, reflecting the more indirect ways in which climate hazards influence economic activity.

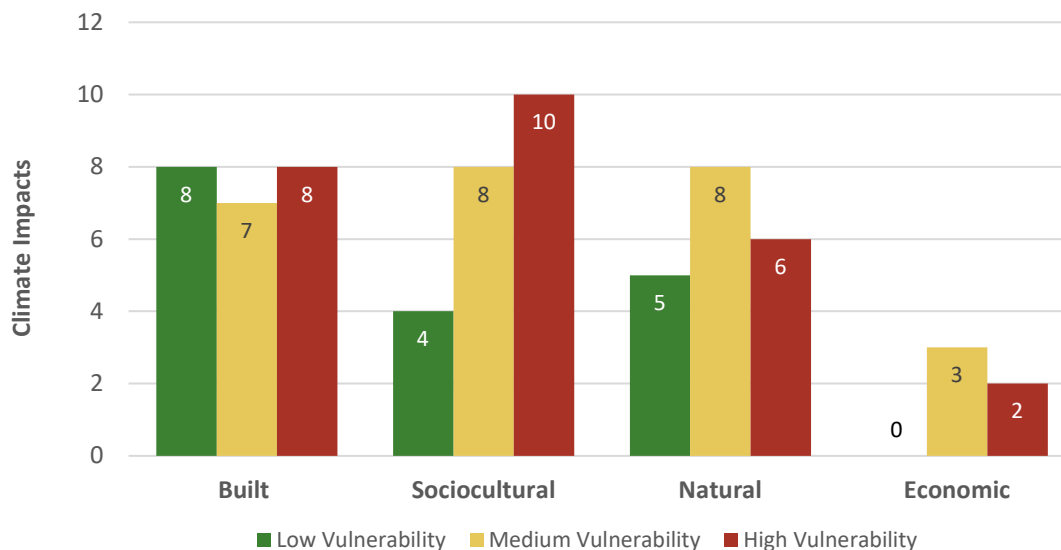


Figure 6 Distribution of Vulnerability Ratings Across Primary Systems

While climate impacts were categorized according to the system most directly affected, impacts are inherently interconnected and secondary effects across other systems are common. For example, disruptions to built infrastructure can lead to sociocultural and economic consequences, such as

reduced emergency response capacity or increased costs for residents and businesses. Similarly, changes in natural systems can influence infrastructure performance and community well-being. As a result, economic impacts may appear underrepresented in **Figure 6**, as they often arise as secondary effects of direct impacts to infrastructure, the workforce, or the natural environment.

The results of the vulnerability assessment indicate that there are opportunities for Collingwood to strengthen preparedness for climate change through improved coordination, policy refinement, capital planning alignment, and targeted investments.

4.2.1 Screening for Risk Assessment

In accordance with the BARC framework, impacts rated as Medium or High vulnerability are advanced to the risk assessment stage. Screening out Low vulnerability impacts allows communities to focus on climate risks that are most challenging to manage in current conditions while continuing to monitor other identified climate vulnerabilities over time.

Seventeen climate impacts identified for Collingwood were assigned a Low vulnerability rating and were not carried forward to the risk assessment. For natural-system impacts, a Low vulnerability rating should not be interpreted to mean that ecological change is unimportant or necessarily easy to reverse. Some ecological responses develop gradually, may not be evident without long-term monitoring, and can become more difficult to address once significant change has occurred. These screened impacts will therefore remain part of the monitored risk set and may be reconsidered as local ecological information improves.

The screening process also considered the confidence ratings assigned by workshop participants, with four impacts receiving Low or Medium confidence ratings. Workshop notes indicated that the lower confidence reflected limited subject matter input during the assessment rather than disagreement with the vulnerability rating outcome. These areas may warrant future engagement with external agencies, sector experts, or rights-holders to validate or refine the findings.

Since Low vulnerability ratings generally indicate that existing policies, infrastructure capacity, or operational practices are currently well aligned with the projected hazards, only the fifty Medium and High vulnerability climate impact statements were carried forward to the detailed risk assessment.

5 Risk Assessment

Building on the vulnerability assessment, the risk assessment integrates the likelihood of climate hazards with the consequences of associated impacts to determine the overall risk. As climate conditions continue to change, the likelihood of certain hazards, such as extreme heat, heavy rainfall, and high lake levels, is expected to increase, changing Collingwood's climate risk profile.

Consistent with the BARC framework, risk is assessed as a function of:

$$\text{Risk (R)} = \text{Likelihood (L)} \times \text{Consequence (C)}$$

Rather than focusing solely on an individual asset failure, the BARC risk assessment considers the broader consequences to municipal services, public health and safety, ecological systems, and economic

activity and how they cascade across systems as the climate changes. This approach provides a structured and defensible basis for prioritizing adaptation actions across the community.

5.1 Approach

Risk ratings were developed through a facilitated workshop with the RCTF. Building on the fifty climate impacts previously identified as Medium or High vulnerability, participants used standardized scoring criteria aligned with the BARC framework to:

1. Validate draft likelihood scoring for climate hazards.
2. Assign consequence scores for Sociocultural, Economic, and Natural factors.
3. Document rationale and identify affected vulnerable populations.
4. Assign confidence ratings for the overall risk rating.

5.1.1 Likelihood Assessment

Likelihood reflects how often a climate impact is expected to occur within the defined planning horizon and is informed by observed local trends, climate projections, and the historical and projected frequency patterns of the associated hazard.

In accordance with the BARC Framework, likelihood is rated on a five-point scale, with a score of 5 indicating the impact is almost certain to occur and a score of 1 indicating the climate impact is very unlikely to occur (**Appendix D**). Likelihood scores for both the Near Term (2021-2050) and Long-Term (2051-2080) climate impacts were developed by the project team in advance of the workshop for discussion and validation by the workshop participants. These likelihoods were based on projected changes for climate variables based on the climate profile established for Collingwood and considered other publicly available likelihood ratings (ICLEI Canada, 2026).

5.1.2 Consequence Assessment

Consistent with the BARC framework, consequences were evaluated across three interconnected factors: Sociocultural, Economic, and Natural (**Table 6**). Rather than focusing solely on physical asset damage, this approach considers how climate impacts affect people, services, ecosystems, and the broader functioning of the community.

Table 6 Consequence Assessment Factors

Factor	Evaluate Impacts To
Sociocultural	Public health and safety concerns; Displacement; Disruptions to daily life; Loss of identity, traditions and cultural practices
Economic	Property damage; Local economy and growth; Livability and cost of living; Loss of public services
Natural	Air; Water; Land; Biodiversity and ecosystem function

For each of Medium and High vulnerability climate impacts, participants assessed the severity and duration of consequences within each factor using a five-point scale (**Appendix D**). Subcategory scores were then combined to determine a unique consequence score for Sociocultural (C_S), Economic (C_E), and Natural (C_N) factors. If multiple consequence assessments were completed by workshop participants for an individual climate impact, the highest (worst case) evaluation was carried forward to calculate the risk score. By evaluating sociocultural, economic and natural consequences separately, the assessment captures both direct impacts and the cascading and compounding effects that climate hazards can produce.

Workshop participants were also encouraged to document their consequence scoring rationale and identify populations that could experience disproportionate impacts (i.e. low-income households, seniors, children, outdoor workers, Indigenous communities, unhoused populations, and individuals with mobility challenges).

5.1.3 Risk Calculation

The total (T) risk for each climate impact was calculated as:

$$R_T = L \times (C_S + C_E + C_N)$$

Where:

L = Likelihood score

C_S = Sociocultural consequence score

C_E = Economic consequence score

C_N = Natural consequence score

This formulation combines the probability of occurrence with the cumulative consequences across interconnected systems, ensuring that total risk reflects both how often an impact may occur and how broadly it may affect the community.

In addition to calculating a cumulative total risk score, system-specific risk scores were also calculated:

$$R_S = L \times C_S$$

$$R_E = L \times C_E$$

$$R_N = L \times C_N$$

This step ensures that significant impacts to individual systems are not diluted within the aggregate risk score. For example, a climate impact with severe sociocultural consequences but limited economic or natural effects would still be clearly identified as high risk within the sociocultural system.

Risk scores were calculated separately for Near-Term (2021-2050) and Long-Term (2051-2080) planning horizons to reflect the evolution of risk with projected changes in climate hazard frequency. The resulting numerical values were categorized into qualitative priority levels using the appropriate BARC risk spectrums (**Appendix D**):

Low Priority – Very Low, Low, Medium Low Risk

Medium Priority – Medium Risk

High Priority – Medium High, High, Very High, Extreme Risk

These priority categories provide a structured approach for identifying which climate impacts advance to the adaptation planning phase.

5.1.4 Confidence and Validation

For both likelihood and total risk scores, workshop participants assigned qualitative confidence ratings and documented areas of uncertainty. Following the workshop, the project team reviewed the results to confirm consistent application of rating scales and alignment with climate projections.

Participants expressed lower confidence in certain likelihood ratings where observed local conditions suggested more frequent or severe impacts than reflected in the draft scoring. These observations were compared against available projections and regional trend data. As a result, likelihood ratings were increased for near-term precipitation-related impacts, as well as some long-term extreme heat, warmer-winter and storm-related hazards. Mid- to late-century likelihood ratings for elevated lake level impacts were also adjusted to reflect recent high-water conditions and projected increases in lake variability.

All adjustments were made within the projected likelihood ranges and documented to maintain transparency and methodological consistency with the available data. This review process strengthens confidence in the resulting risk profile by integrating both climate science and local operational experience.

5.2 Results

5.2.1 Near Term Risk

In the near term (2021-2050), most climate impacts fall within the Low and Medium Priority risk categories (**Appendix E, Figure 7**). Twenty-three impacts (46%) were rated as Very Low, Low, or Medium Low risk, and twenty-three impacts (46%) were rated as Medium risk. Only four impacts (8%) fall within the High Priority category, and all of these were categorized as Medium High risk (i.e. no near-term climate impacts were rated as high, very high, or extreme risk). This distribution of risk suggests that, while severe or catastrophic disruption is not anticipated in the near term, climate pressures are expected to strain municipal services, infrastructure performance, and community systems.

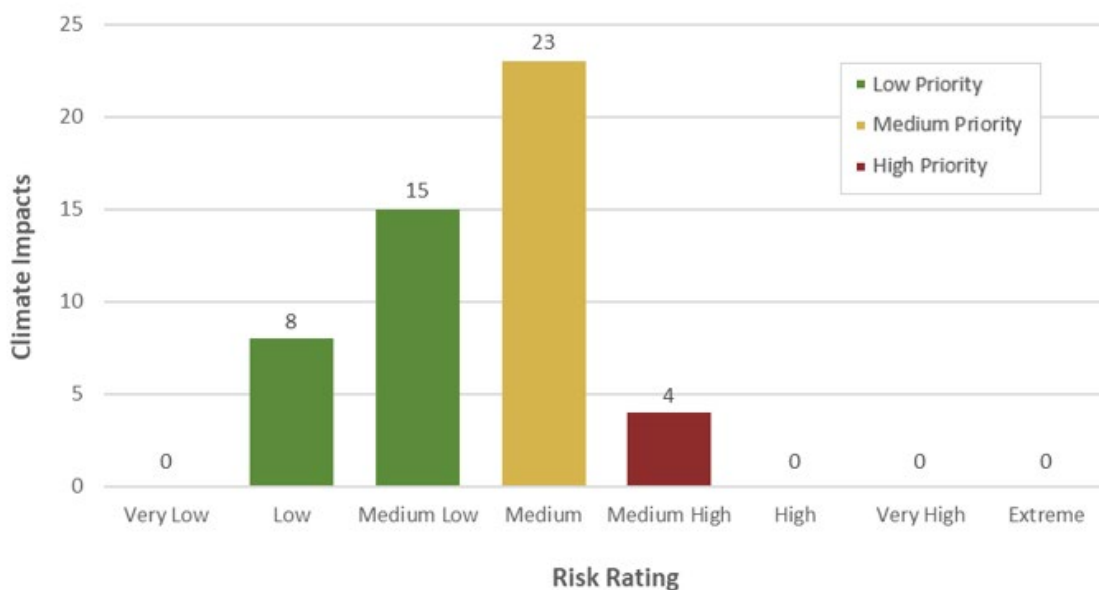


Figure 7 Total Risk Distribution: Near Term (2021-2050)

When the near-term risks are examined by consequence category, risks to natural systems are predominantly rated as Low Priority, indicating that many environmental impacts received comparatively lower risk scores in the near term (**Figure 8**). However, this does not mean that ecological pressures are absent. Near-term concerns for natural systems include contaminant and nutrient runoff, declining lake water quality, algal growth, and other effects that may require continued monitoring. In contrast, sociocultural risks form a substantial proportion of the Medium and High Priority categories, indicating near-term climate pressures are most likely to affect public health, safety, and community well-being. Economic risks account for a large share of the Medium Priority risks but represent a smaller proportion of the High Priority risks, suggesting financial pressures on local businesses and households may emerge gradually over time rather than through immediate large-scale disruption.

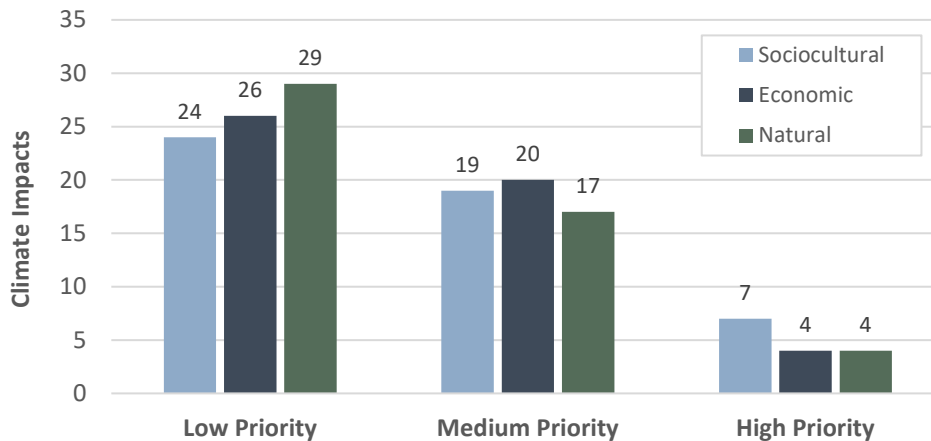


Figure 8 Risk Distribution by Sociocultural, Economic and Natural Factors: Near Term (2021-2050)

Although Medium Priority risks are not pre-screened as immediate priorities for adaptation planning, they provide an indication of areas where risk could escalate as climate conditions continue to evolve. Many of these impacts are associated with climate hazards that are projected to intensify over time, suggesting that they may represent future High Priority risks.

In addition, several Medium Priority impacts were identified as having heightened implications for vulnerable or equity-denied populations, where disproportionate effects may occur at the household or community scale. For this reason, Medium Priority risks can be retained as a “monitoring” or “watch list” category to inform future updates, equity-focused decision-making, and ongoing capital and policy reviews.

5.2.2 Long Term Risk

The risk distribution shifts significantly in the long term (2051-2080), with thirteen impacts (26%) falling within the Low Priority risk category, seventeen impacts (34%) rated as Medium Priority risk, and twenty impacts (40%) falling within the High Priority risk category (**Appendix E, Figure 9**). Unlike the near term assessment, High Priority risks represent the second largest proportion of impacts in the long term horizon. This shift in risk distribution reflects the projected increases in the frequency and severity of climate hazards, including extreme heat, heavy precipitation, lake level variability, and compounding events. As likelihood scores increase over time, impacts that are currently moderate move into higher risk categories, signalling a transition from incremental system pressures to more sustained and potentially disruptive conditions.

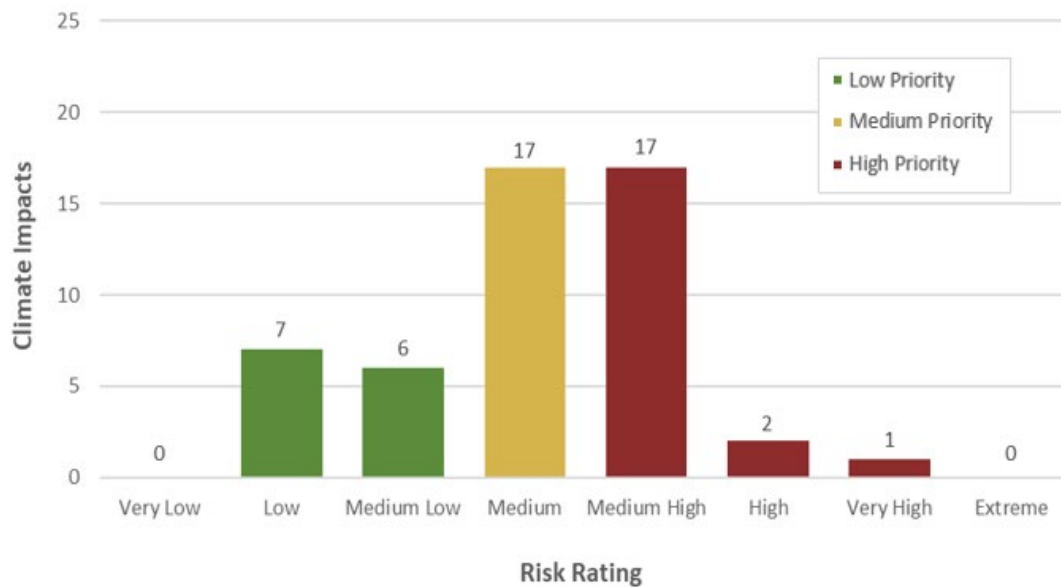


Figure 9 Total Risk Distribution: Long Term (2051-2080)

Although High Priority risks increase substantially in the long-term planning horizon, Medium Priority risks also remain significant. In many cases, these Medium Priority risks represent areas of transition, where uncertainty in climate projections and variability in emissions pathways can influence how quickly risk escalates. Continued monitoring of these risks, along with periodic reassessment of likelihood and consequence assumptions, will be important to ensure that emerging pressures are identified early and incorporated into future planning updates.

When examined by consequence category (**Figure 10**), the long-term risk results demonstrate a broadening of risk across all systems. High Priority risks are most prominent within sociocultural and economic systems, suggesting increasing impacts to public health, community well-being, service continuity, and financial stability. Natural system risks also increase in severity, reflecting vegetation stress, declining aquatic habitat and water quality, shoreline and watercourse erosion, increasing pest and invasive species pressure, and the potential for cumulative changes in biodiversity and ecosystem function. Compared to the near-term profile, long-term risks are more evenly distributed across systems, reinforcing the interconnected nature of climate impacts.

These findings have important implications for infrastructure planning and asset management, as many municipal assets, including water and wastewater systems, stormwater infrastructure, shoreline works, and public facilities, have service lives extending well into the latter half of the century. As a result, infrastructure designed or rehabilitated in the near term will operate under long-term climate conditions. Incorporating updated design standards, climate allowances, and forward-looking planning assumptions into capital programs is therefore critical to ensuring long-term service reliability.

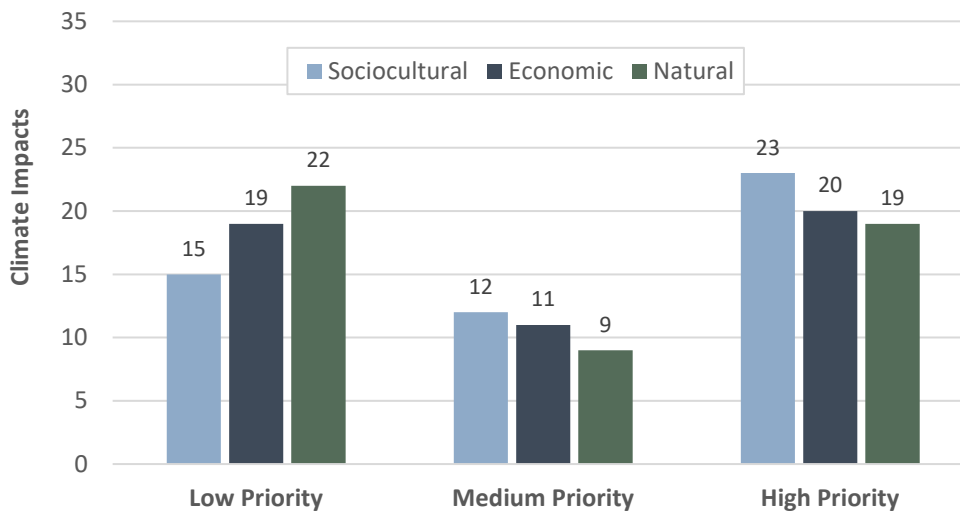


Figure 10 Risk Distribution by Sociocultural, Economic and Natural Factors: Long Term (2051-2080)

The long-term risk assessment results demonstrate that climate risk is dynamic and trending upward over time. While near-term impacts are largely manageable within existing systems, projected increases in hazard frequency and severity shift a growing number of impacts into higher risk categories in the latter half of the century. This trend highlights the importance of proactively integrating climate considerations into infrastructure design, land use planning, capital investment, and policy development to moderate future risk levels and reduce the likelihood of costly retrofits, compounding failures, or critical service disruptions.

5.2.3 Key Observations

A review of High Priority impacts across both near-term and long-term planning horizons reveals several clear patterns. In the near term, High Priority risks are primarily associated with recurrent hazards, particularly intense precipitation, hotter summers, and changing winter conditions that strain infrastructure systems and emergency response capacity. In the long term, the risk profile broadens to include shifting seasons, air quality degradation, shoreline erosion, and ecosystem stressors such as vegetation stress and increasing pest and invasive species pressure, reflecting both increasing hazard likelihood and compounding effects across interconnected systems.

Table 7 High Priority Climate Impacts by Climate Hazard and Time Horizon

Climate Hazard	Near-Term High Priority Risks	Long-Term High Priority Risks
Storm Events	Increased demand on emergency and municipal services	Increased demand on emergency services; damage to property, vegetation, and infrastructure; shoreline and watercourse erosion

Climate Hazard	Near-Term High Priority Risks	Long-Term High Priority Risks
Intense Precipitation	Surface water contamination from runoff; flooding and property damage	Surface water contamination from runoff and wastewater bypass events; declining aquatic habitat and receiving-water quality; increased flood damage to homes
Hotter Summers & Extreme Heat	Increased electricity demand for cooling; heat-related health risks; declining lake water quality (algal growth)	Increased cooling demand; increased heat-related health risks; declining lake water quality; poor air quality; pressure on shaded and cooled public spaces; vegetation stress; housing overheating; infrastructure deterioration
Warmer, Wetter Winters	Structural damage from snow loading	Structural damage from snow loading; increased meltwater overwhelming stormwater and wastewater systems; increased exposure to vector-borne and other climate-sensitive infectious diseases
Seasonal Shifts	No High Priority risks identified	Increased pest and invasive species pressure on native ecosystems and biodiversity
Lake Level Variability	No High Priority risks identified	Reduced access to beaches and waterfront areas; operational challenges for stormwater and wastewater systems
Cumulative Effects	No High Priority risks identified	Reduced recovery time between events and cumulative stress on infrastructure and communities

Many High Priority impacts are associated with hazards that disproportionately affect vulnerable and equity-denied populations. This reinforces that climate risk escalation is not solely an infrastructure challenge but, increasingly, a public health, housing stability, and community well-being concern.

The interaction between vulnerability and likelihood is also evident in the results. In the near term, most High Priority risks are associated with Medium vulnerability ratings, indicating that elevated risk is driven primarily by hazard likelihood. In the long term, High Priority risks are more evenly distributed between Medium and High vulnerability ratings, reflecting both increasing hazard frequency and cumulative system sensitivity. Several impacts move into High Priority categories as increasing likelihood amplifies previously moderate vulnerabilities. This underscores the importance of periodic reassessment of vulnerability, risk, and adaptive capacity as climate drivers intensify over time.

5.2.4 Priority Risks for Adaptation Planning

Consistent with the BARC framework, climate impacts categorized as High Priority (Medium High, High, Very High, or Extreme risk) are automatically advanced to the adaptation planning phase. This includes impacts with High Priority total risk scores, as well as impacts where individual consequence categories

(sociocultural, economic, or natural) are rated as High Priority, ensuring that significant risks to specific systems are not diluted through cumulative scoring.

Impacts categorized as Medium and Low Priority will be retained as a monitored set of risks. These “parking lot” risks may be advanced where they align with community priorities, asset management planning, regulatory requirements, or where evolving climate conditions warrant reassessment.

In addition to quantitative risk scores, disproportionate impacts to vulnerable or equity-denied populations will be considered when confirming priorities. Where climate impacts elevate risks to these groups, these impacts may be advanced to the adaptation planning phase even if total risk scores fall within Low or Medium Priority categories.

This approach provides a transparent and structured basis for prioritization while maintaining flexibility to respond to local priorities, equity considerations, and emerging climate trends.

6 Next Steps

This vulnerability and risk assessment provides a structured and defensible foundation for adaptation planning in Collingwood. The identification of High Priority risks establishes a clear starting point for the development of targeted adaptation actions, while Medium and Low Priority risks will continue to be monitored as climate conditions evolve.

As the project transitions into the adaptation planning phase, public engagement will help validate the findings of the risk assessment and ensure there is broader input on the vision, guiding principles, and priorities for the Climate Change Adaptation Plan. Engagement activities will build on the work completed with the RCTF and other partners, while expanding participation to include additional stakeholders and community members who may be affected by the prioritized climate impacts. This expanded engagement process will help ensure that adaptation actions are grounded in local experience, responsive to community values, and reflective of the needs of vulnerable and equity-denied populations.

Additional technical input will also be important for some areas of adaptation planning. In particular, the natural-system findings represent a strategic, community-scale assessment rather than a detailed ecological or species-level evaluation. Development of natural-system adaptation actions should therefore draw on available watershed, wetland, forestry, shoreline, species-at-risk, invasive-species, and water-quality information, supported by input from conservation authorities, Indigenous partners, environmental organizations, and ecological specialists, where appropriate.

Ongoing collaboration and periodic reassessment of climate projections, vulnerability, and risk will support adaptive management as climate conditions and community priorities evolve over time.

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Appendix A – Climate Profile: Collingwood, Ontario



To: Nicole Yardy
From: Heather McGinnity, P.Eng., ENV SP
cc:
Date: July 24, 2026
Subject: Climate Profile: Collingwood, Ontario

1 Introduction

Collingwood is a vibrant and growing community on the southern shore of Georgian Bay, valued for its natural setting, distinctive downtown, and active waterfront. With the population expected to increase significantly over the coming decades, the Town is planning for a future that maintains its livability, economic vitality, and strong sense of place (Town of Collingwood, 2024). As Collingwood grows, understanding how the local climate is changing becomes increasingly important to support evidence-based decisions that protect community well-being, natural assets, and municipal services.

Developing a climate profile is the first step in this process. A climate profile summarizes reliable historical and projected climate data to establish the scientific foundation needed to interpret how climate variables are expected to change over time. This information is essential for anticipating how a warming and increasingly variable climate may affect people, infrastructure, natural systems, and municipal operations, and it will guide the Town in developing targeted and actionable adaptation strategies that strengthen long-term resilience.

This climate profile has been developed in alignment with ICLEI Canada's Building Adaptive and Resilient Communities (BARC) framework, supporting Milestone 1 activities that build shared understanding of local climate conditions. The information will serve as a key resource for the risk and vulnerability assessment in BARC Milestone 2, where Town staff and partners will explore how projected climate changes intersect with community systems, services, and people. These insights will then inform the development and prioritization of adaptation actions in BARC Milestone 3.

2 Methodology

2.1 Data Sources

Climate science models and publicly accessible data portals have advanced significantly in recent years, enabling communities to access reliable local-scale climate information through user-friendly online platforms. For this project, the climate profile draws primarily on the historical data and climate

projections available for Collingwood through ClimateAtlas.ca, which is widely used across Canada for municipal adaptation planning.

ClimateAtlas.ca provides a localized summary of climate projections for Collingwood, generated from the Pacific Climate Impacts Consortium's (PCIC) statistically downscaled dataset of 24 CMIP5 global climate models. By using an ensemble of 24 models, they incorporate a broad range of scientific approaches that increases confidence in climate projections by showing areas of agreement across multiple simulations. PCIC corrected systematic biases (e.g. an individual model that underestimates precipitation extremes) in the global climate models using the BCCAQv2 method (Bias Correction with Constructed Analogues and Quantile Mapping), producing localized projections of temperature and precipitation at a 10 km × 10 km resolution that is suitable for community-scale assessment. Historical values for the 1976-2005 baseline period in ClimateAtlas.ca are based on Natural Resources Canada observational data, aligned to the same 10 km grid system as the downscaled projections. ClimateAtlas.ca also presents 30-year mean values for both historical and projected periods, consistent with climate science conventions that distinguish long-term climate trends from short-term variability.

While ClimateAtlas.ca provides reliable projections for temperature and precipitation at a local scale, some climate variables, such as extreme wind and precipitation intensity, are more difficult to model with high confidence or are not available through climateatlas.ca. To supplement this information, broader regional studies such as *Canada's Changing Climate Report* (Bush & Lemmen, 2019), the *Ontario Regional Perspectives Report* (Douglas & Pearson, 2022), and the *Ontario Provincial Climate Change Impact Assessment* (Climate Risk Institute, 2023) were reviewed. These reports incorporate the latest research on extreme weather, Great Lakes influences, and compound climate events (e.g. heavy rain on frozen or saturated ground, rapid snowmelt combined with rainfall, or heatwaves intensified by humidity), providing additional context where local-scale projections are less certain. Integrating these regional insights alongside local projections and data helps build a more complete picture of Collingwood's future climate.

Given the scope, schedule, and budget of this project, the combination of local downscaled projections and authoritative regional studies provides a robust, holistic, and fit-for-purpose foundation for understanding Collingwood's changing climate and informing the risk and vulnerability assessment and adaptation planning in BARC Milestones 2 and 3.

2.2 Emissions Scenarios

ClimateAtlas.ca provides climate projections under two Representative Concentration Pathways (RCPs). RCPs are standardized greenhouse gas emissions trajectories that have been developed for global climate modeling and describe how concentrations of carbon dioxide and other heat-trapping gases may change over time based on different societal, technological, and policy choices. RCPs are not predictions, but rather scenarios used to explore a range of plausible climate futures.

This climate profile for Collingwood uses RCP4.5 and RCP8.5, referred to by the Atlas as the "Low Carbon" and "High Carbon" scenarios, respectively. RCP4.5 represents a future in which global emissions peak and then decline, while RCP8.5 represents a continued rise in emissions. The scenarios diverge

beginning in 2006, enabling the projections to reflect different long-term warming pathways relevant to adaptation planning. Although PCIC also computes RCP2.6, it is not included in this climate profile because it represents an unlikely future reality (Prairie Climate Centre, 2025).

Consistent with BARC guidance, the climate profile for Collingwood emphasizes the higher-emissions scenario (RCP8.5) to support risk-averse, resilience-focused decision-making, while still presenting RCP4.5 to assess the sensitivity of projections to differing global emissions trajectories. Using both scenarios provides a more complete understanding of the range of future climate conditions Collingwood may experience.

2.3 Time Horizons

The climate projections used in this memo follow the standard 30-year time periods on climateatlas.ca, which align with international climate science conventions. The three time periods included are:

Historical Baseline (1976–2005) – Represents past climate conditions simulated by climate models and validated against observed data.

Near Future (2021–2050) – The primary planning horizon for municipal adaptation, capturing climate changes already underway.

Mid-Century to Late Century (2051–2080) – Illustrates longer-term trends relevant for major infrastructure planning and long-term policy decisions.

Using 30-year averages minimizes the influence of short-term fluctuations and enables a clearer understanding of sustained changes in temperature, precipitation, and extreme weather indicators. These time horizons support a consistent foundation for comparing historical and projected conditions.

2.4 Limitations

Climate projections provide a valuable foundation for understanding how Collingwood’s climate may change, but they come with important limitations:

Statistically Downscaled Data – The projections used in this climate profile rely on statistically downscaled data from an ensemble of global climate models, which are appropriate for municipal-scale planning but should be interpreted as plausible ranges rather than precise predictions.

Variable-Specific Data – Temperature projections tend to be more reliable than precipitation projections, which are harder to simulate, especially for short-duration or localized extremes such as thunderstorms. As a result, heavy precipitation indicators may underestimate the frequency or intensity of future events. In addition, the 10 km × 10 km resolution used by [ClimateAtlas.ca](https://climateatlas.ca) does not fully capture local microclimates or lake-modified weather patterns influenced by Georgian Bay.

Compound Events – Compound events, such as rain falling on frozen ground, rapid snowmelt combined with heavy rain, or extreme heat intensified by high humidity, carry greater uncertainty and are not well represented in local-scale models.

Time Horizon – There is generally higher confidence in projections for the near future (2021–2050), as these changes are already emerging in the climate system. Confidence decreases for mid- and late-century projections (2051–2080), especially for precipitation, because uncertainty increases the further into the future the models attempt to simulate.

Table 1 summarizes the relative confidence associated with the climate variables considered in this climate profile. The level of confidence associated with each variable has been categorized as Tier 1 (high confidence), Tier 2 (medium confidence) and Tier 3 (low confidence) in accordance with the *Climate Resilient Buildings and Core Public Infrastructure (CRBCPI) Report* (Cannon et al., 2020).

Table 1 Summary of Confidence of Climate Variable Projections

Climate Variable	Tier (CRBCPI)	Relative Confidence
Mean Temperature (annual & seasonal)	Tier 1	High
Heating & Cooling Degree Days	Tier 1	High
Temperature Extremes (hot days, cold days)	Tier 1	High (direction) / Moderate (magnitude)
Total Annual & Seasonal Precipitation	Tier 2	Medium
Heavy Rainfall Days	Tier 2	Low-Medium
Maximum 1-Day Rainfall	Tier 2	Medium (direction)
Freeze–Thaw Cycles	-	Moderate
Frost Dates / Frost-Free Season	-	High
Snow Load / Rain-on-Snow	Tier 3	Low
Extreme Wind Speeds	Tier 3	Very Low
Driving Rain Wind Pressure	Tier 3	Very Low
Relative Humidity	Tier 3	Very Low

Despite these limitations, the datasets used in this climate profile are considered appropriate for the scope of this project and provide a scientifically defensible basis for Collingwood’s climate adaptation planning. More detailed or specialized modelling can be explored by the Town in future studies or asset-specific projects where higher resolution or event-scale analysis is required.

3 Collingwood Climate Profile

Collingwood’s climate is strongly shaped by its location along the southern shore of Georgian Bay, within the Great Lakes basin. The Town experiences a humid climate characterized by cold winters, warm summers, and year-round precipitation, with lake-modified weather patterns that influence snowfall, wind, temperature variability, and seasonal transitions. The presence of Georgian Bay moderates extreme temperatures in some seasons while contributing to localized lake-effect snowfall and rapid weather shifts. In recent decades, consistent with broader trends observed across Ontario and Canada, Collingwood has experienced warming average temperatures, longer warm seasons, more frequent heat events, more severe wind and storm events, and changes in precipitation patterns. These emerging

trends provide some insights into how the climate projections may further change local climate conditions.

This section summarizes the key climate trends projected for Collingwood based on data available through ClimateAtlas.ca (Prairie Climate Centre, 2026). A consolidated table of baseline values and projected changes under both emissions scenarios is provided in **Attachment A**. A series graphs for the climate variables are also included in **Attachment A** to allow a review of the underlying modelled trends in greater detail. Definitions of the climate variables presented in the climateatlas.ca data are provided in **Attachment B**.

3.1 Overall Warming Trend

Collingwood's climate projections show a clear and consistent warming trend across all seasons and emissions scenarios. During the baseline period (1976-2005), the Town's average annual mean temperature was approximately 7.2°C. Under both emissions scenarios, temperatures are projected to rise in the near term (2021-2050), increasing to 9.1-9.3°C. This represents an average warming of approximately 2°C compared to the historical baseline, with similar projections under both RCP4.5 and RCP8.5 during this period (**Figure 1**).

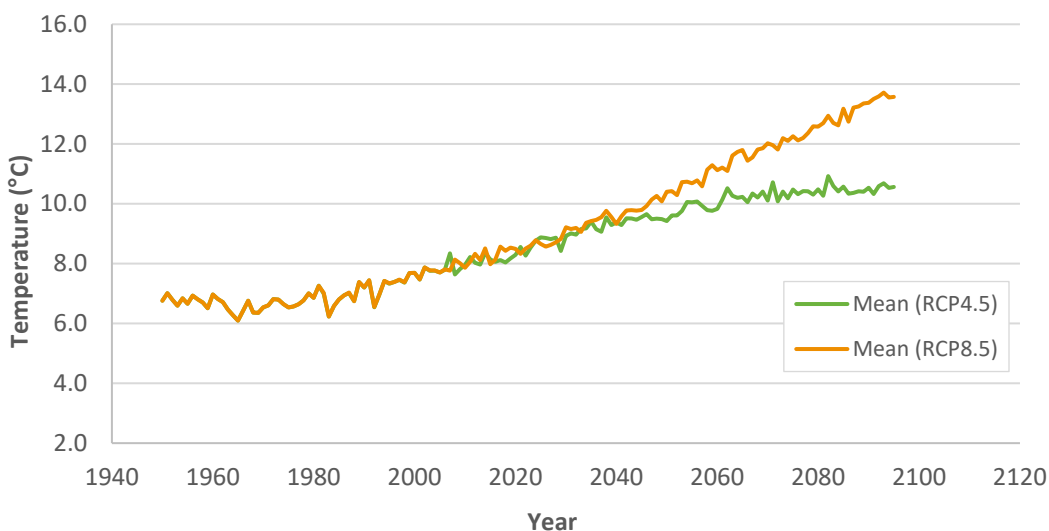


Figure 1 Annual Mean Temperature – Historical and Projected

By mid- to late-century (2051-2080), the two emissions scenarios diverge more significantly. Under RCP4.5, average annual temperatures are projected to reach 10.2°C, reflecting continued but moderate warming. Under RCP8.5, temperatures rise more significantly, reaching 11.5°C by 2051-2080. This represents an overall increase of more than 4°C relative to the historical baseline.

Seasonal analysis indicates that warming is projected across all seasons, with winter temperatures showing some of the largest relative increases (**Figure 2**). Average winter temperatures are projected to rise from -5.4°C historically to between -3.1°C and -2.9°C in the near term, and to as high as -0.3°C under

the high-emissions scenario by mid-century. Summer temperatures are also projected to increase, rising from an historical average of 19°C to between 20.8°C (RCP4.5) and 21.9°C (RCP8.5) by 2051–2080.

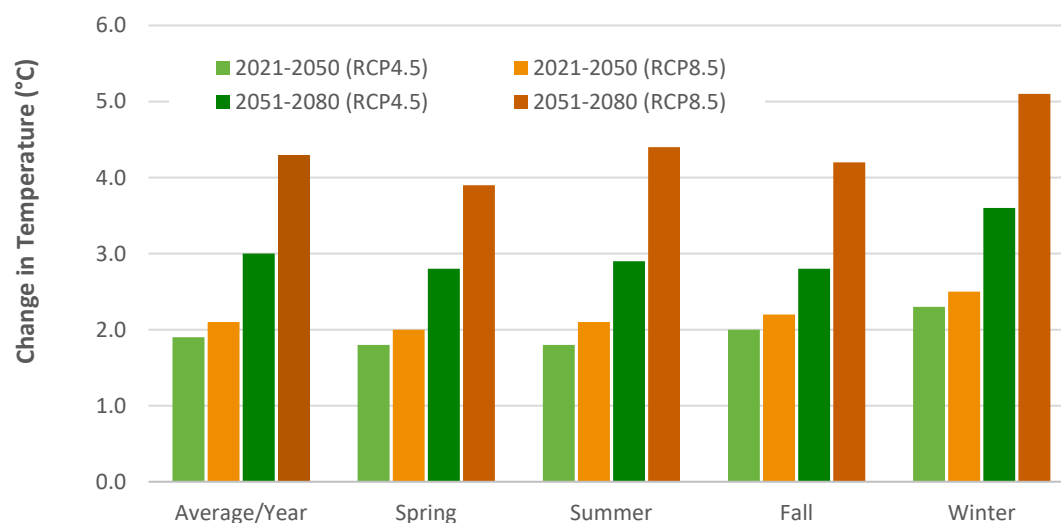


Figure 2 Projected Change in Average Temperature Above 1976-2005 Baseline

This overall warming trend is also reflected in a decline in cold days and an increase in warm-weather indicators. The number of days per year below -5°C and -15°C declines under both scenarios (**Figure 3**), while Cooling Degree Days increase and Heating Degree Days decrease. These shifts indicate not only warmer average conditions, but a noticeable change in seasonal temperature patterns.

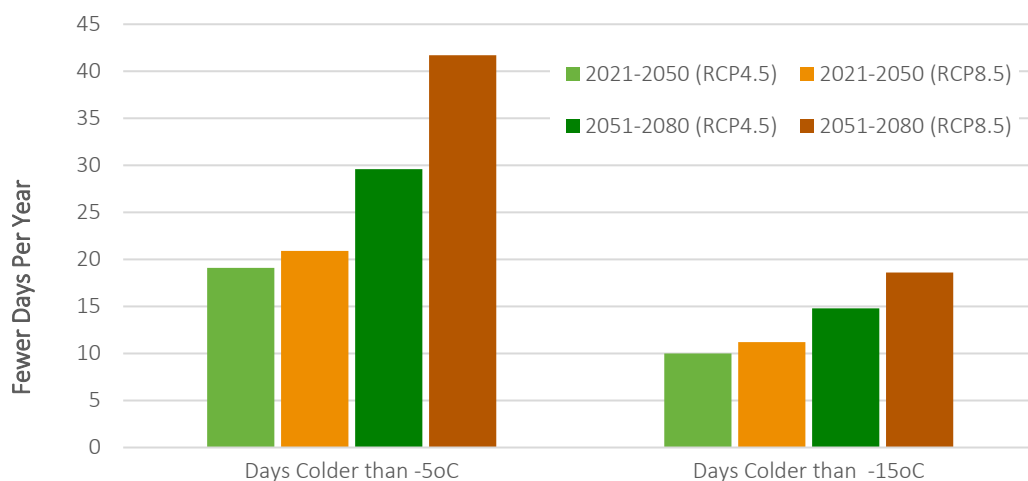


Figure 3 Projected Reduction in Cold Weather Days from Baseline 1976-2005

In the near term, projections under both emissions scenarios are generally similar, but in the longer term the differences between RCP4.5 and RCP8.5 become more pronounced. This highlights how the global emissions trajectories will influence the magnitude of warming experienced locally.

3.2 Changing Winter Conditions

Building on the overall warming trend described above, winter conditions in Collingwood are projected to shift in both duration and nature. As noted in Section 3.1, average winter temperatures increase significantly under both emissions scenarios. This warming trend also translates to the frost-free season increasing by 21-23 days in the near term and by 29-47 days by mid-century. This expansion reflects last spring frosts occurring approximately 9-20 days earlier and first fall frosts occurring approximately 12-27 days later. Together, these shifts indicate a shorter period of sustained winter conditions and longer shoulder seasons.

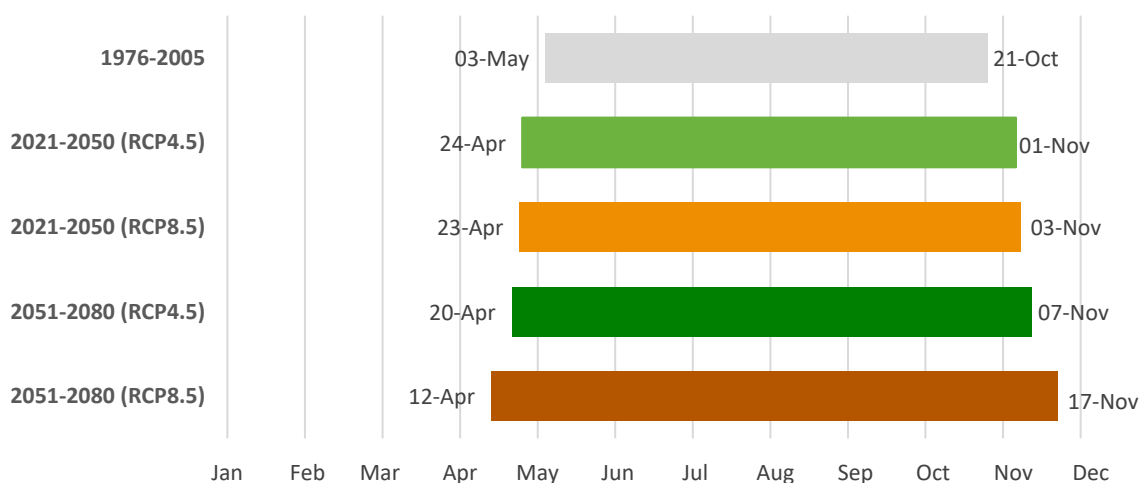


Figure 4 Projected Shift in Frost Free Season (1976-2080)

Consistent with these changes, the number of frost days and ice days ($<0^{\circ}\text{C}$) declines substantially. Ice days decrease by approximately 27% by 2021-2050 and by as much as 56% by mid-century. When considered alongside the projected reduction in cold and very cold days, these trends demonstrate that extended periods of deep freeze are expected to become less frequent and shorter in duration over time.

Historically, Collingwood experienced approximately 65 freeze-thaw cycles per year. Projections indicate a decline of 5-6 freeze-thaw cycles in the near term and up to 9-14 fewer cycles by mid-century (**Figure 5**). Although the total number of freeze-thaw cycles decreases, this is reflecting a broader reduction in sustained freezing rather than more stable winter conditions. Warmer average temperatures and fewer ice days suggest Collingwood's winter will be characterized by shorter freezing intervals and longer durations near the freezing point, particularly during late fall and early spring.

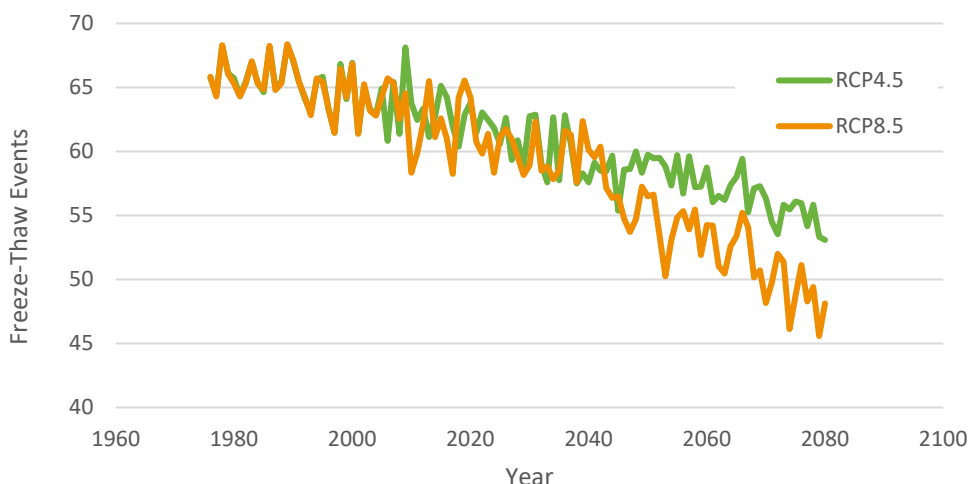


Figure 5 Projected Change in Freeze-Thaw Cycles

At the same time as winter warming occurs, total winter precipitation will also increase. Average winter precipitation rises by approximately 9-10% in the near term and by 13-18% by mid-century. While ClimateAtlas.ca does not directly quantify changes in snowfall fraction, regional analyses provide insight into how winter precipitation type is expected to evolve. Provincial-scale projections of winter rain-to-snow ratios indicate that southern Ontario is projected to experience a substantial increase in the proportion of winter precipitation falling as rain rather than snow by the 2080's under RCP8.5 (Climate Risk Institute, 2023). For Collingwood, this shift suggests that a growing share of winter precipitation may fall as rain or mixed precipitation, particularly during late fall and early spring.

While total winter precipitation is projected to increase, the reliability of sustained snow cover is also expected to decline, with increased mid-winter melt events and a higher likelihood of rain-on-snow or rain-on-frozen-ground events.

As overall winter conditions become milder, periods that remain below freezing may still support heavy snowfall events. A warmer atmosphere can hold more moisture, increasing the potential intensity of individual snowfall events even as the duration of consistent snow cover declines. Significant snowfall events are explored further in Section 3.5.

Taken together, these projections point to an overall shift in winter conditions in Collingwood. The expansion of the frost-free season, decline in persistent cold and ice days, evolving freeze-thaw dynamics, and increasing winter precipitation indicate that winter is projected to become shorter, milder, wetter, and more variable over time. While near-term changes are broadly similar under both emissions scenarios, differences will become more pronounced by mid-century.

3.3 Extreme Heat and Cold

While average temperatures provide important context, changes in extreme heat and cold conditions often drive the most significant impacts on infrastructure, ecosystems, and public health. Climate projections indicate that Collingwood will experience a notable shift in temperature extremes under

both emissions scenarios. The number of very cold days in Collingwood (colder than -15°C) will decline by 66-83% by 2080 (**Figure 6**) while maximum summer temperatures will increase by $3.3\text{--}4.9^{\circ}\text{C}$ to between 36°C and 37.6°C in the same timeframe.

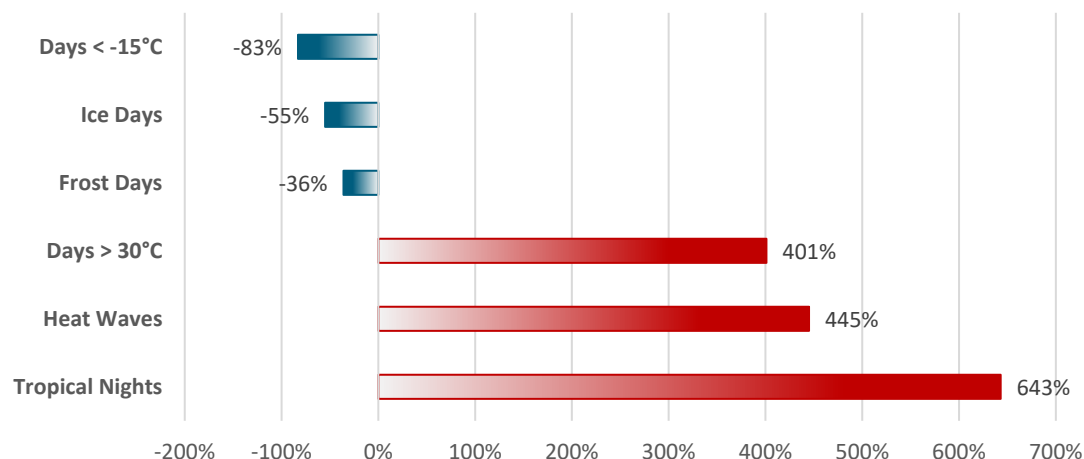


Figure 6 Projected Percent Change in Extreme Temperature Indicators (2051–2080, RCP8.5)

Historically, Collingwood experienced approximately 10 days per year above 30°C . In the near term, this is projected to increase to 25 days per year, and by mid-century, to 49 days per year under the High Carbon emissions scenario. The number of heat waves per year is projected to more than triple in the near term and more than quadruple by mid-century. In addition, the average duration of heat waves is expected to more than double, and the number of tropical nights (minimum temperatures above 20°C) is projected to become almost a regular occurrence by mid-century.

These projections indicate that Collingwood’s climate is not warming uniformly across all seasons and that the distribution of temperature extremes is shifting. Cold extremes will become less frequent while hot extremes will become more frequent, longer, and more intense. Similar to other climate variables, the differences between emissions scenarios for temperature extremes are limited in the near term but become more significant by mid-century which could have implications on public health, energy demands, worker safety and infrastructure performance.

3.4 Precipitation Patterns

In addition to rising temperatures, Collingwood is projected to experience changes in total precipitation, seasonal distribution, and precipitation intensity.

Total annual precipitation is projected to increase in Collingwood under both emissions scenarios. From a historical baseline of approximately 906 mm per year, projections indicate increases of 5-6% in the near term (2021-2050) and 8-10% by mid-century (2051-2080) (**Figure 7**). While the percentage increases appear modest, even incremental growth in annual precipitation can influence stormwater system capacity, erosion patterns, groundwater recharge, and water levels within local watersheds and Georgian Bay.

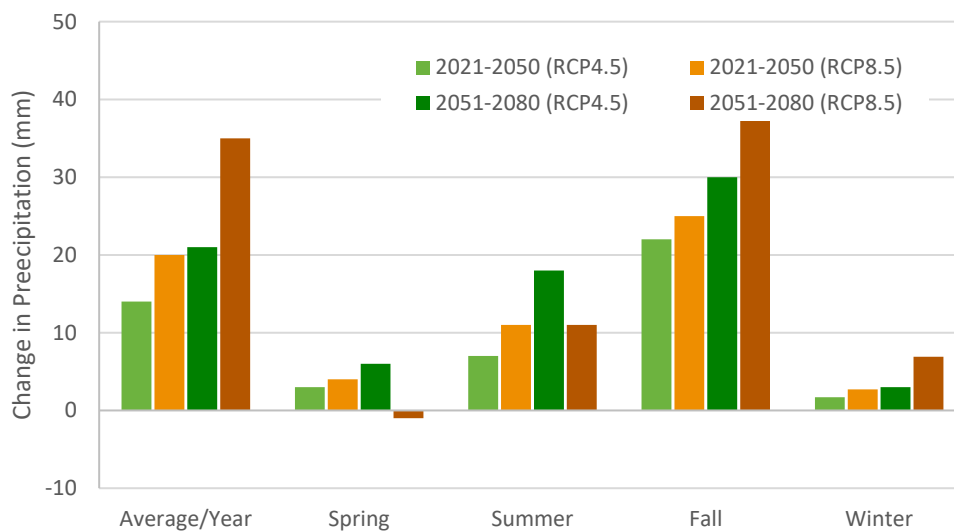


Figure 7 Projected Change in Total Precipitation from 1976-2005 Baseline

Precipitation changes will not be uniform throughout the year, with winter precipitation increasing by 9-10% in the near term and 13-18% by mid-century, and spring precipitation increasing by 6-10% in the near term to 10-18% by mid-century. Fall precipitation is projected to increase by 3-7% by mid-century while summer precipitation projections are more variable, with modest increases in the near term and a wider range of outcomes by mid-century, including the possibility of slight decreases under some scenarios. This variability reflects lower model confidence with seasonal precipitation projections.

In addition to changes in total precipitation, precipitation intensity indicators show modest but consistent increases. The average annual number of wet days exceeding 10 mm and 20 mm is projected to rise, and maximum single-day precipitation is also projected to increase by 8–9% in the near term and 14–16% by mid-century. Although the total number of dry days per year changes only slightly, these relatively stable annual totals do not preclude shifts in distribution. A future climate may have longer dry intervals with more intense rainfall events, particularly during the warm season.

3.5 Extreme Precipitation and Storms

The climate projections available from ClimateAtlas.ca include changes in total precipitation and heavy rainfall days, but they do not directly model specific storm types such as thunderstorms, winter ice storms, lake-effect snowstorms, or high-wind systems. As a result, projected changes in storm behaviour for this assessment are interpreted using ClimateAtlas.ca data in combination with broader regional and national studies.

For Collingwood, climate projections show increases in total annual precipitation, the number of heavy rainfall days, and maximum 1-day rainfall totals (**Figure 8**). These trends are consistent with national findings that extreme rainfall events are intensifying across Canada as the climate warms (Bush & Lemmen, 2019). Research indicates that heavy rainfall intensity increases with temperature (Cannon et

al., 2020), and while the exact magnitude of change at the local scale remains uncertain, the direction of change toward more intense rainfall in Collingwood is well supported.

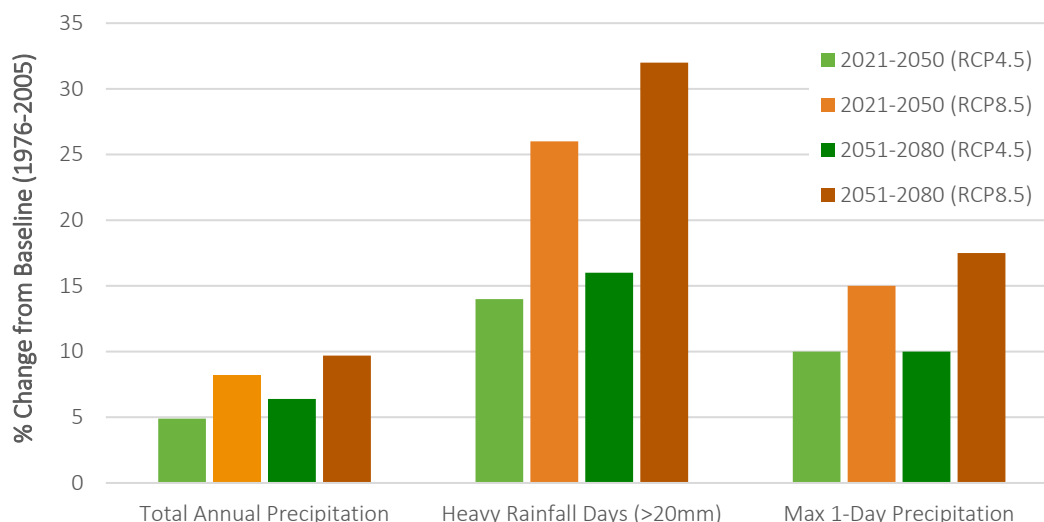


Figure 8 Projected Changes in Annual and Extreme Precipitation Indicators

Winter storm characteristics in Collingwood are also expected to evolve. Warmer winter temperatures combined with increasing winter precipitation suggest a greater likelihood of mixed precipitation events, including freezing rain and rain falling on snow or frozen ground. These compound conditions can increase the risk of localized flooding, ice accumulation on infrastructure, and stress on buildings and vegetation. Although overall snow cover duration is projected to decline in southern Ontario, periods that remain below freezing may still experience intense snowfall events (Bush & Lemmen, 2019). This suggests a shift toward more variable and disruptive winter storms, rather than a clear reduction in winter weather impacts with warmer temperatures.

Changes in extreme winds are less clearly defined by climate models than changes in temperature or precipitation, and national assessments indicate lower confidence in projections of future design wind speeds due to modelling limitations (Cannon et al., 2020). Current evidence does not indicate large increases in average wind speeds across southern Ontario; however, wind-related impacts may still increase. Warmer conditions and heavier rainfall can increase the effects of severe storms and Collingwood's exposure along Georgian Bay may further influence local wind behaviour. Even without significant increases in average wind speeds, heavier rainfall combined with strong gusts may increase the risk of wind-driven rain, tree failure, and localized power outages.

Overall, there is strong confidence that warming will continue and that heavy rainfall events will intensify. Confidence is lower regarding future changes in extreme wind speeds and certain compound winter storm conditions. Taken together, these projections suggest that Collingwood is likely to experience more frequent high-intensity rainfall events and increasingly variable winter storm patterns over time.

3.6 Drought Conditions and Wildfire

Climate projections for Collingwood do not indicate substantial changes in the number of consecutive dry days or overall annual precipitation deficits. While seasonal shifts and more intense rainfall events are projected, the available data do not suggest a strong trend toward prolonged drying conditions in the region. The *Ontario Provincial Climate Change Impact Assessment* (Climate Risk Institute, 2023) similarly indicates no significant change in projected moisture deficit for central or southwestern Ontario.

With precipitation and moisture deficit levels expected to either increase or remain similar to the baseline conditions, wildfire risk projections for Collingwood remain relatively low compared to northern and northwestern regions of Ontario. As a result, large-scale wildfire activity is not expected to become a primary local hazard for Collingwood based on available data and modelling.

However, wildfire activity elsewhere in Ontario and across Canada may still affect Collingwood through degraded air quality during major fire events. Smoke from distant fires has already resulted in air quality advisories in southern Ontario in recent years, so these indirect health and air quality effects remain a consideration in regional climate adaptation planning.

3.7 Great Lakes Influences

Collingwood's location along the southern shore of Georgian Bay makes it directly influenced by conditions in the Lake Michigan- Huron system, which are highly variable and respond to changes in precipitation, evaporation, runoff, and ice cover. Historical records show fluctuations of nearly two metres over the past century, including periods of record lows (1999–2014) followed by near-record highs in recent years (Lam & Dokoska, 2022).

Climate change will continue to influence these dynamics. Warmer air temperatures contribute to reduced ice cover and increased winter evaporation, while projected increases in precipitation may increase basin inflows. Model projections for Lake Michigan–Huron indicate continued variability throughout the century, with the potential for significantly higher upper-range water levels under the High Carbon emission scenario

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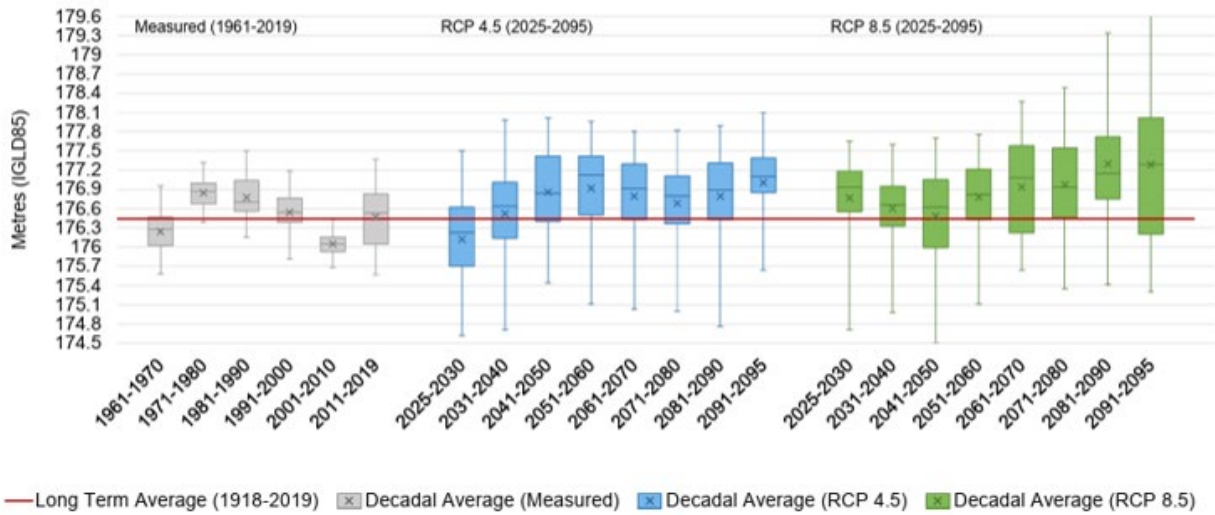


Figure 9); however, substantial uncertainty remains and both high and low water level conditions remain possible.

For Collingwood, the most significant risk arises from the compound impacts of elevated lake levels with storm events. High water levels combined with intense winds and wave action can increase the risk of shoreline erosion, coastal flooding, and damage to waterfront infrastructure. Even modest increases in average lake levels can increase storm surge impacts when extreme weather events occur.

These projections suggest that future risk along Georgian Bay is driven less by steady long-term change and more by continued variability and the potential for compound high-water and storm events. Adaptation planning should therefore consider fluctuating lake levels, shoreline exposure, and the intensification of precipitation and storm patterns described in previous sections.

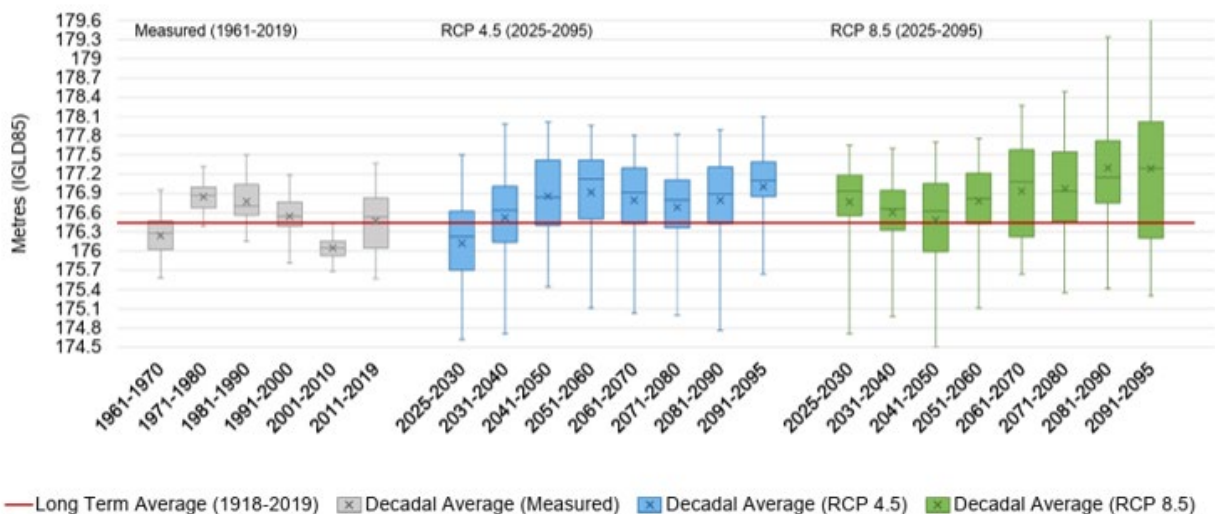


Figure 9 Historical and Projected Decadal Average Lake Levels for Lake Michigan-Huron under RCP4.5 and RCP8.5 (Lam & Dokoska, 2022)

4 Summary

The climate projections indicate that Collingwood's future climate will be warmer, characterized by shorter and milder winters, more frequent and prolonged heat events, increasing winter precipitation, and more intense rainfall. While total annual precipitation increases appear modest, seasonal shifts and heavier rainfall events suggest increased variability and higher potential for localized impacts.

Key projected changes include:

- An average annual temperature increase of approximately 2°C in the near term and over 4°C by mid-century under the high-emissions scenario.
- A 21–47 day expansion of the frost-free season.
- Significant reductions in very cold days and ice days.
- Substantial increases in hot days, heat waves, and tropical nights.
- Increased winter precipitation and a shift toward more mixed precipitation events.
- Increased intensity of rainfall events.
- Continued variability in Lake Michigan–Huron water levels, with compound high-water and storm risks along Georgian Bay.
- Increased storm events, including strong winds and intense precipitation.

While there is high confidence in continued warming and increasing heat extremes, projections related to precipitation intensity, storm characteristics, and wind extremes carry greater uncertainty; however, the direction of change toward increased variability and more frequent high-intensity events is supported by both local projections and national assessments.

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Attachments:

A – Climate Projections: Summary Table and Charts

B – Climate Variable Definitions

HM/ja

Attachment A - Climate Projections: Summary Table and Chart

Table A-1 Climate Projections: Collingwood, Ontario (Prairie Climate Centre, 2026)

Climate Variable	Baseline (1976-2005)	RCP4.5 (2021-2050)	RCP4.5 (2051-2080)	RCP8.5 (2021-2050)	RCP8.5 (2051-2080)
Mean Temperature (°C)	7.2	9.1	10.2	9.3	11.5
Mean Temperature – Spring (°C)	5.3	7.1	8.1	7.3	9.2
Mean Temperature - Summer (°C)	19	20.8	21.9	21.1	23.4
Mean Temperature – Fall (°C)	9.5	11.5	12.3	11.7	13.7
Mean Temperature – Winter (°C)	-5.4	-3.1	-1.8	-2.9	-0.3
Maximum Temperature (°C)	32.7	35	36	35.1	37.6
Minimum Temperature (°C)	-25.7	-21.8	-17.4	-19.9	-11.3
Ice Days ($\leq 0^{\circ}\text{C}$)	63.7	46.2	37.8	45.2	28.3
Mild Winter Days ($\leq -5^{\circ}\text{C}$)	84.5	65.4	54.9	63.6	42.8
Winter Days ($\leq -15^{\circ}\text{C}$)	22.5	12.5	7.7	11.3	3.9
Very Hot Days ($\geq 30^{\circ}\text{C}$)	9.7	23.2	33.3	25.2	48.6
Tropical Nights ($\geq 20^{\circ}\text{C}$)	4.4	11.8	18.8	14	32.7
Number of Heat Waves (count)	1.1	3.2	4.5	3.5	6
Average Length of Heat Waves (days)	2.5	4.4	5.2	4.7	6.7
Cooling Degree Days (count)	227.3	386.6	492.7	416.6	660.8
Heating Degree Days (count)	4180	3621	3352	3575	3018
Total Precipitation – Annual (mm)	906	950	980	964	994
Total Precipitation – Spring (mm)	197	211	218	217	232
Total Precipitation – Summer (mm)	215	218	221	219	214
Total Precipitation - Fall (mm)	251	258	269	262	262
Total Precipitation – Winter (mm)	242	264	272	267	287
Wet Days $\geq 10\text{mm}$ (count)	23	24.7	26	25.7	29.9
Wet Days $\geq 20\text{mm}$ (count)	5	5.7	6.3	5.8	6.6

Climate Variable	Baseline (1976-2005)	RCP4.5 (2021-2050)	RCP4.5 (2051-2080)	RCP8.5 (2021-2050)	RCP8.5 (2051-2080)
Max 1-Day Precipitation (mm)	40	44	46	44	47
Dry Days (count)	185.5	185.6	185.8	185	186.6
Frost-Free Season (days)	168	189	197	191	215
Frost Days	143.3	119.6	107.7	117.4	91.3
Date of Last Spring Frost	May 3	Apr 24	Apr 20	Apr 23	Apr 12
Date of First Fall Frost	Oct 21	Nov 1	Nov 7	Nov 3	Nov 17
Freeze-Thaw Cycles	65.2	59.9	56.7	58.9	51.7

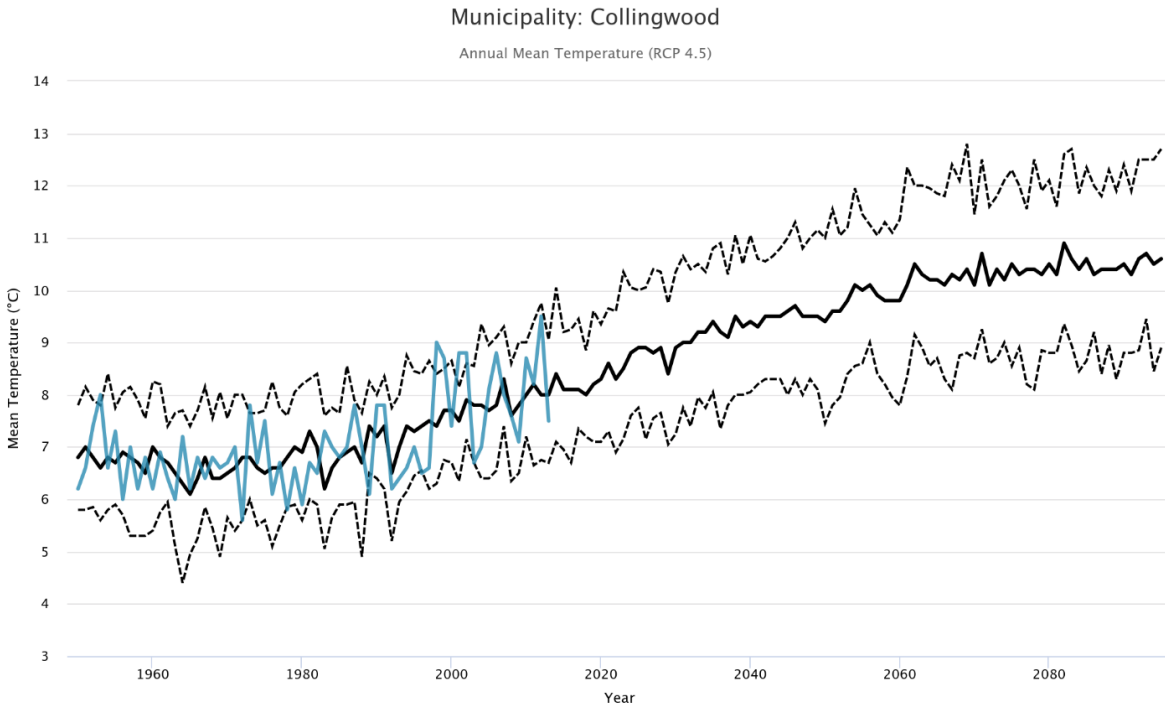


Figure A-1 Annual Mean Temperature (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

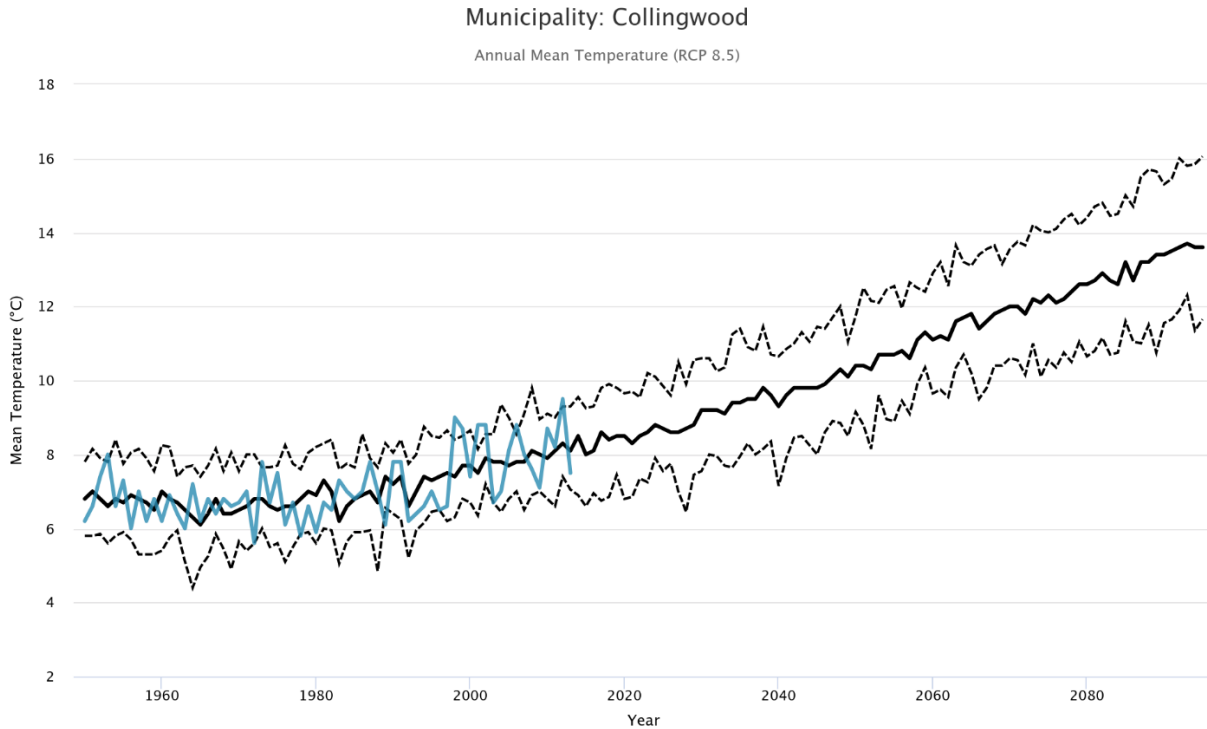


Figure A-2 Annual Mean Temperature (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

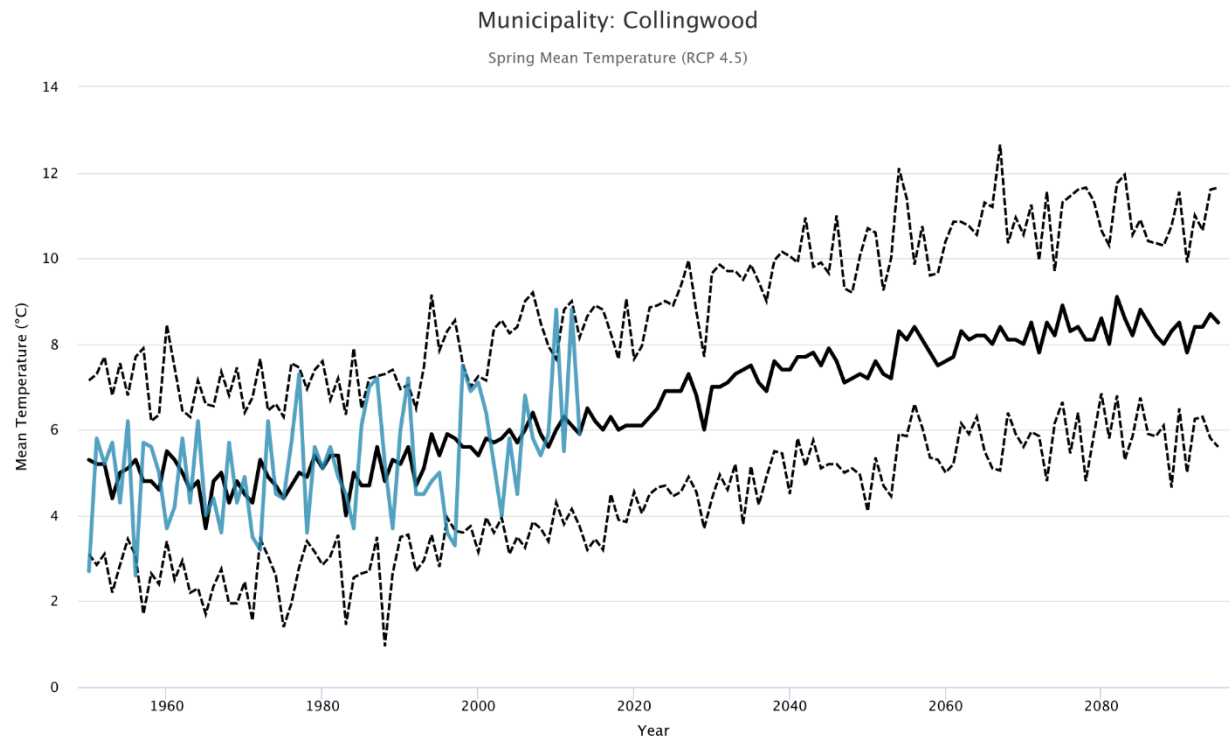


Figure A-3 Spring Mean Temperature (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

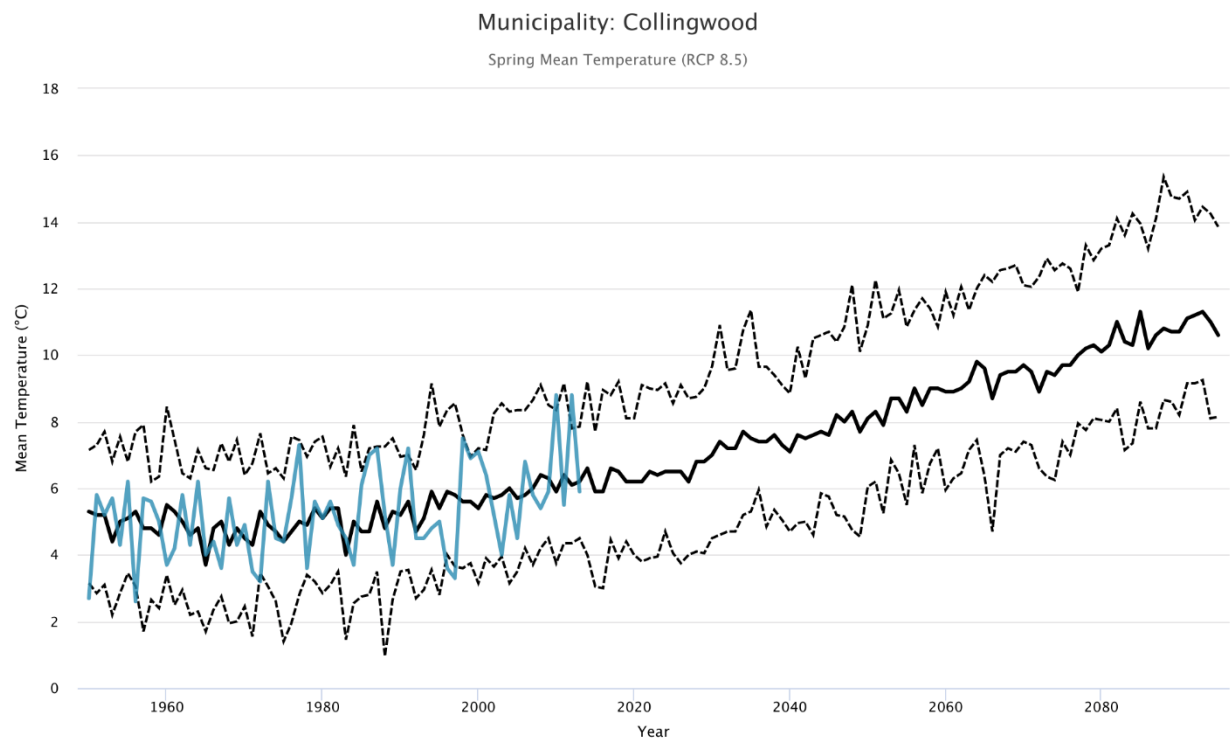


Figure A-4 Spring Mean Temperature (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

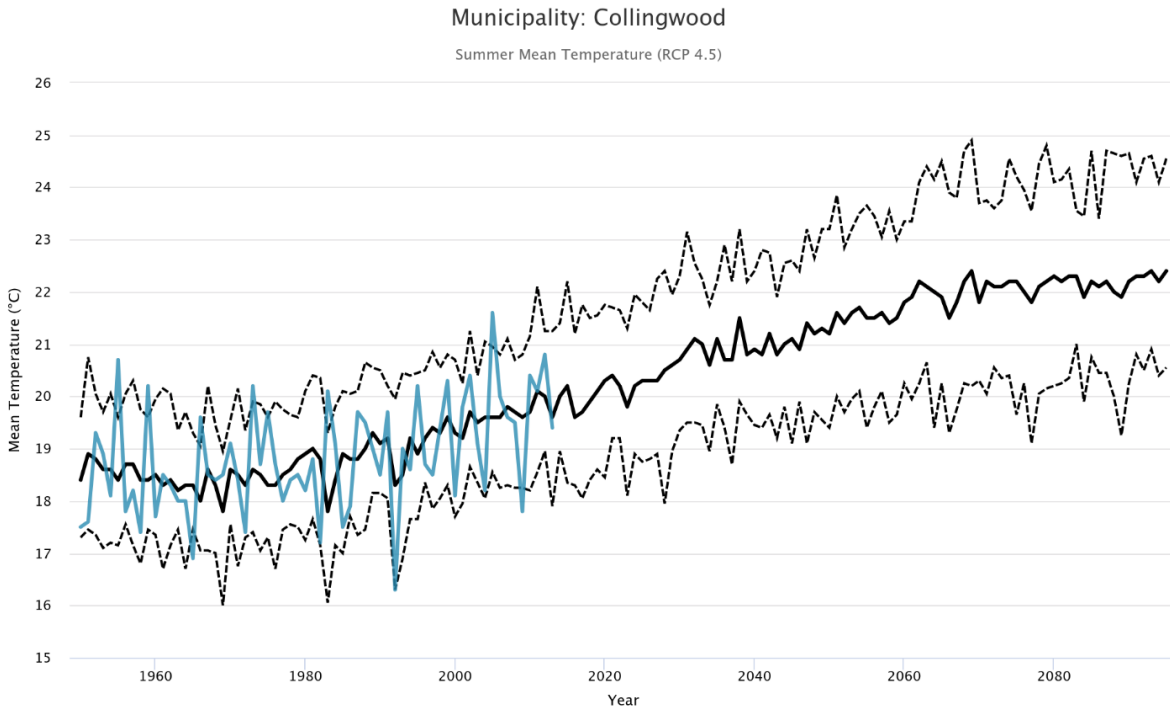


Figure A-5 Summer Mean Temperature (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

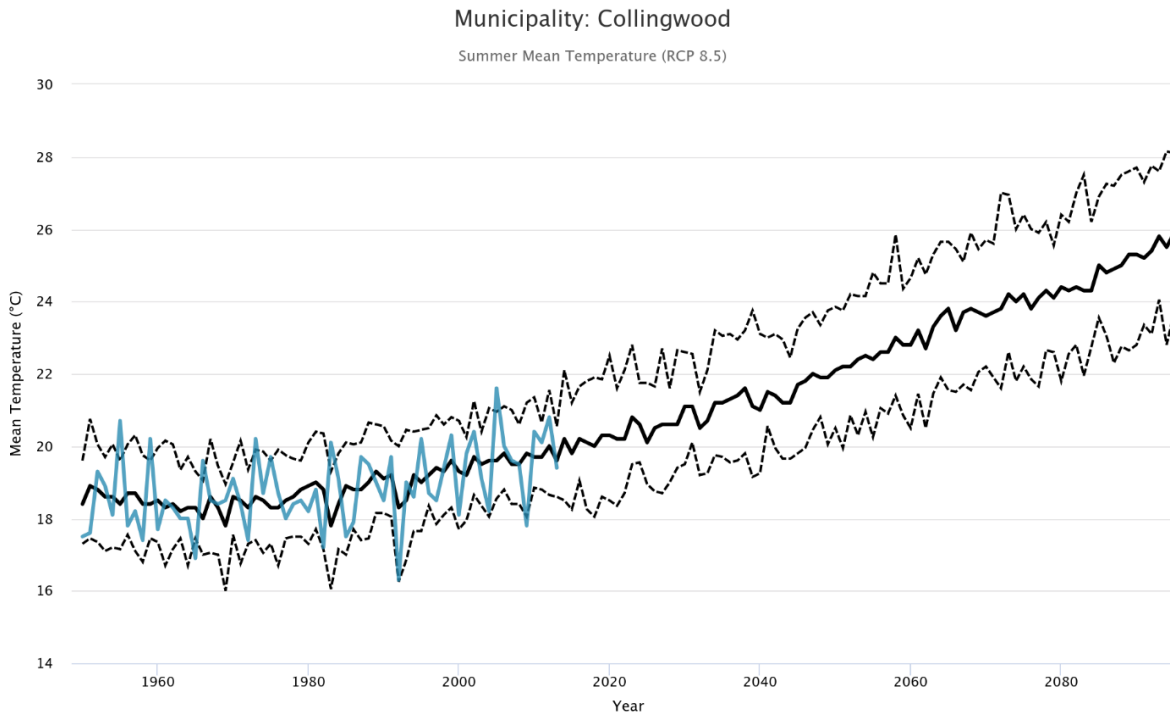


Figure A-6 Summer Mean Temperature (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

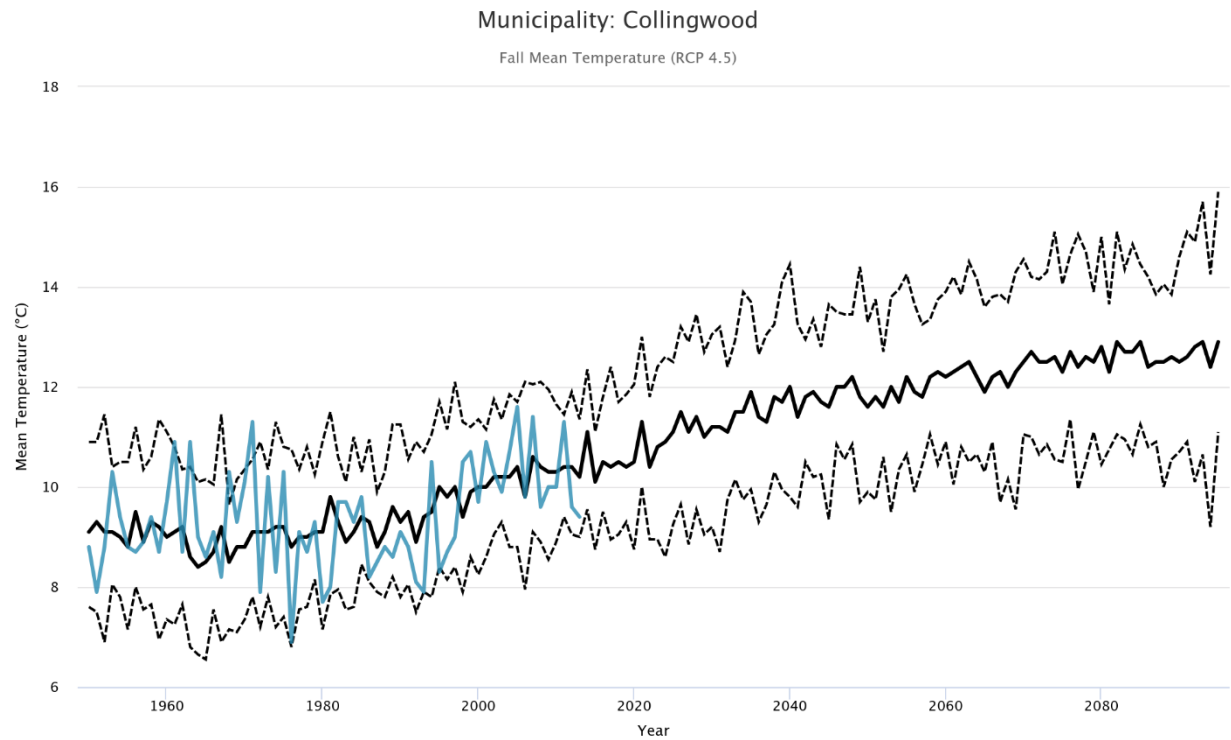


Figure A-7 Fall Mean Temperature (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

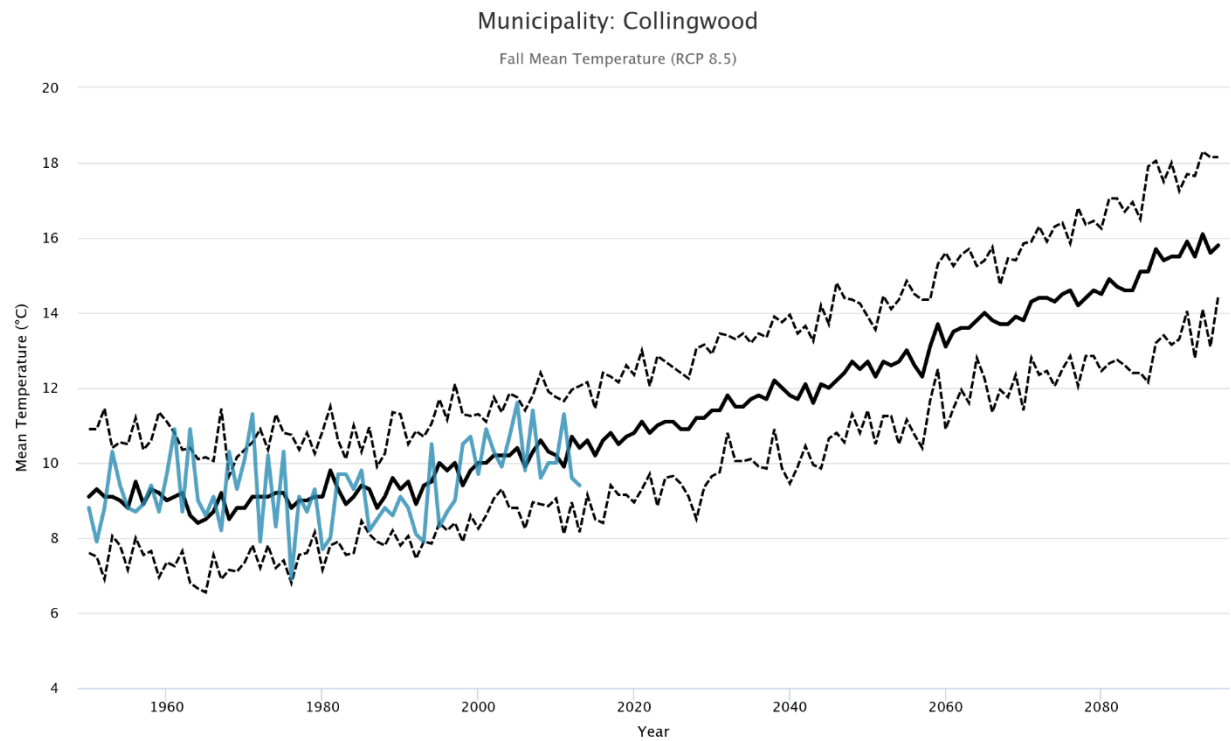


Figure A-8 Fall Mean Temperature (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

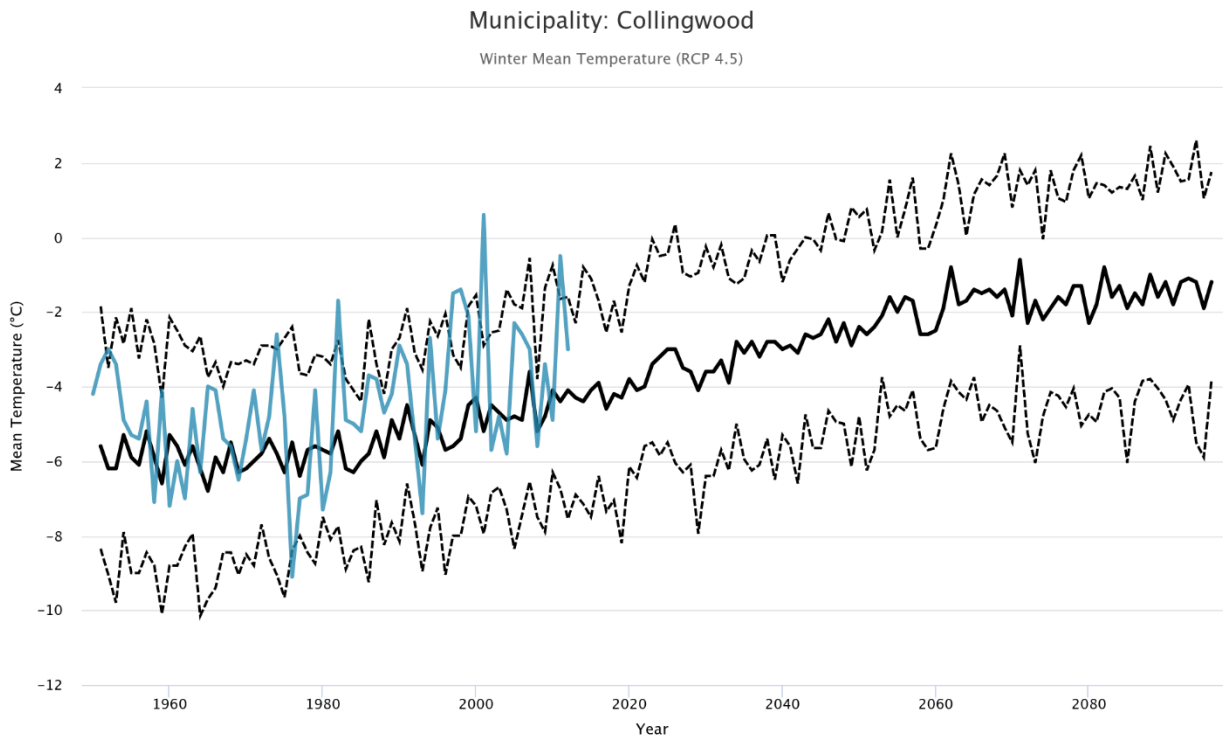


Figure A-9 Winter Mean Temperature (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

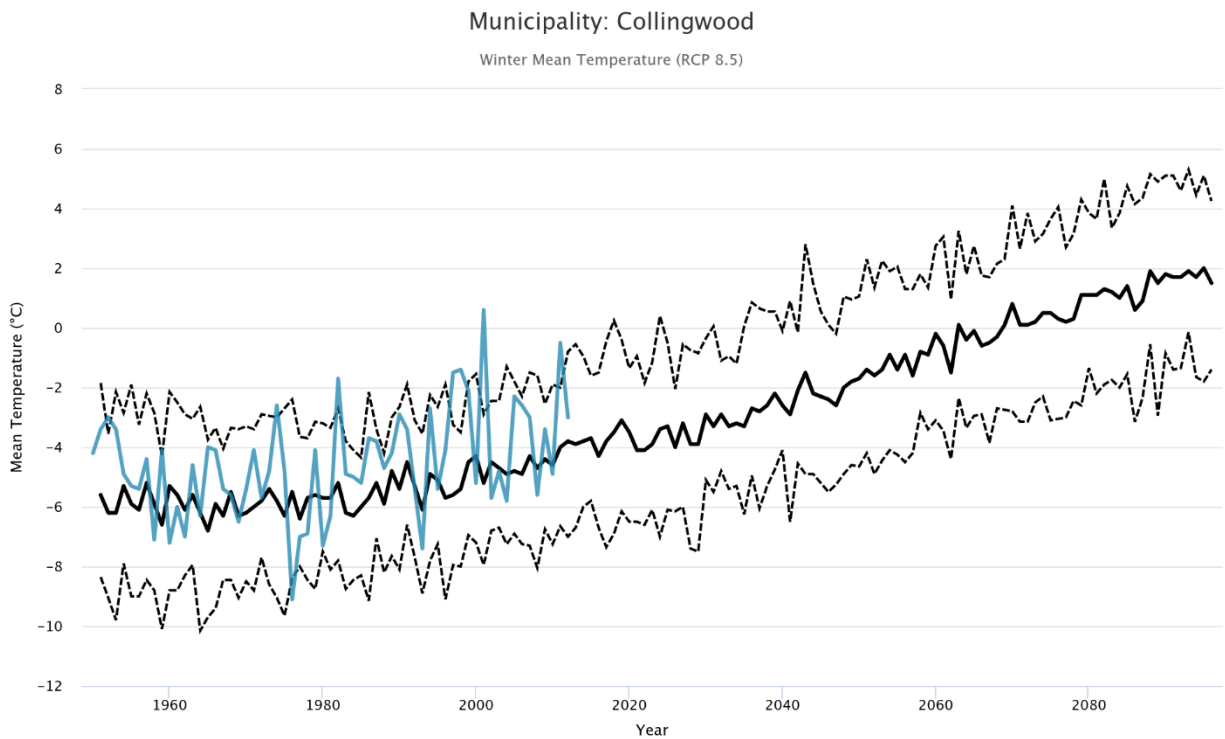


Figure A-10 Winter Mean Temperature (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

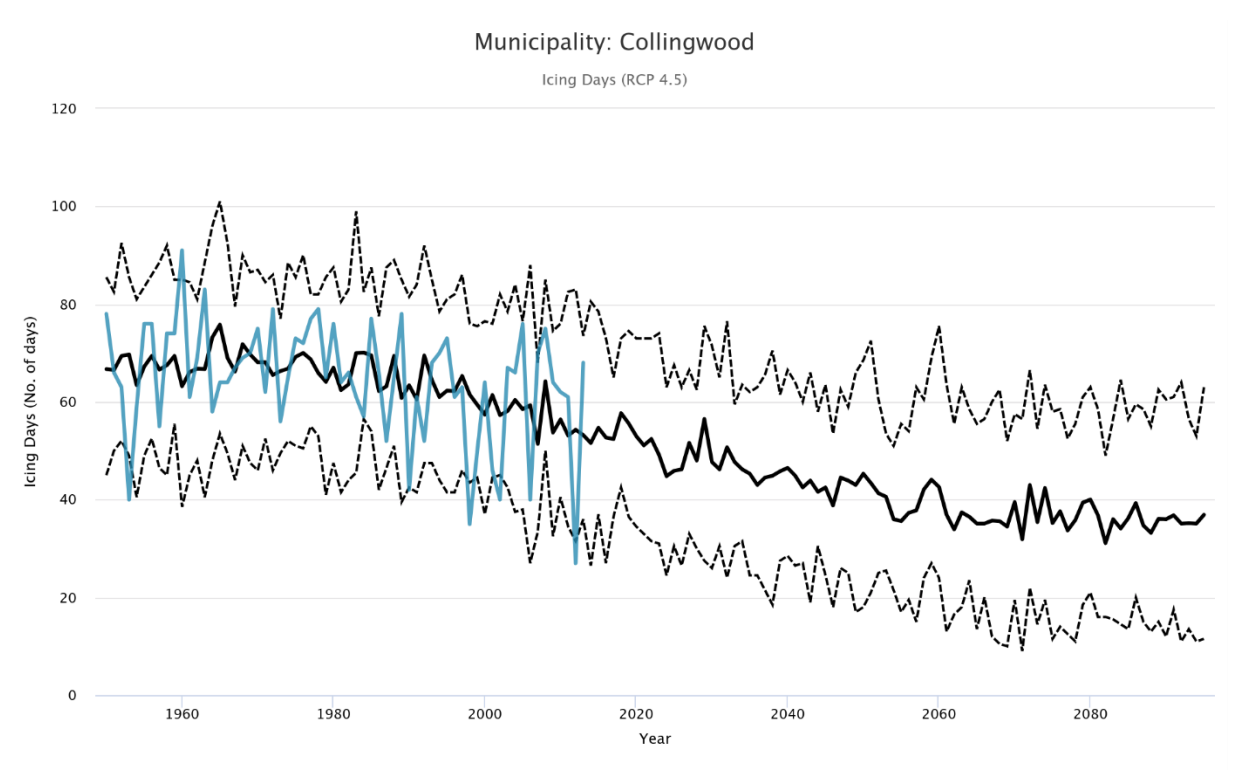


Figure A-11 Icing Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

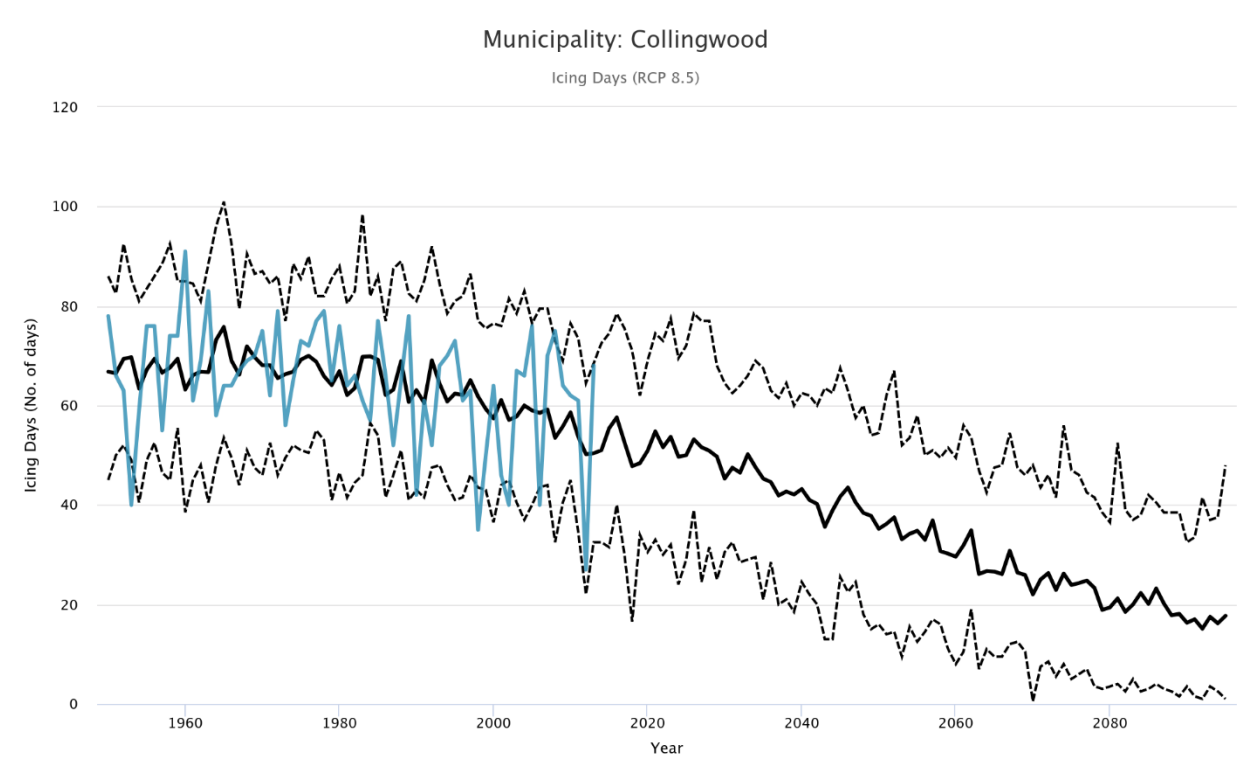


Figure A-12 Icing Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

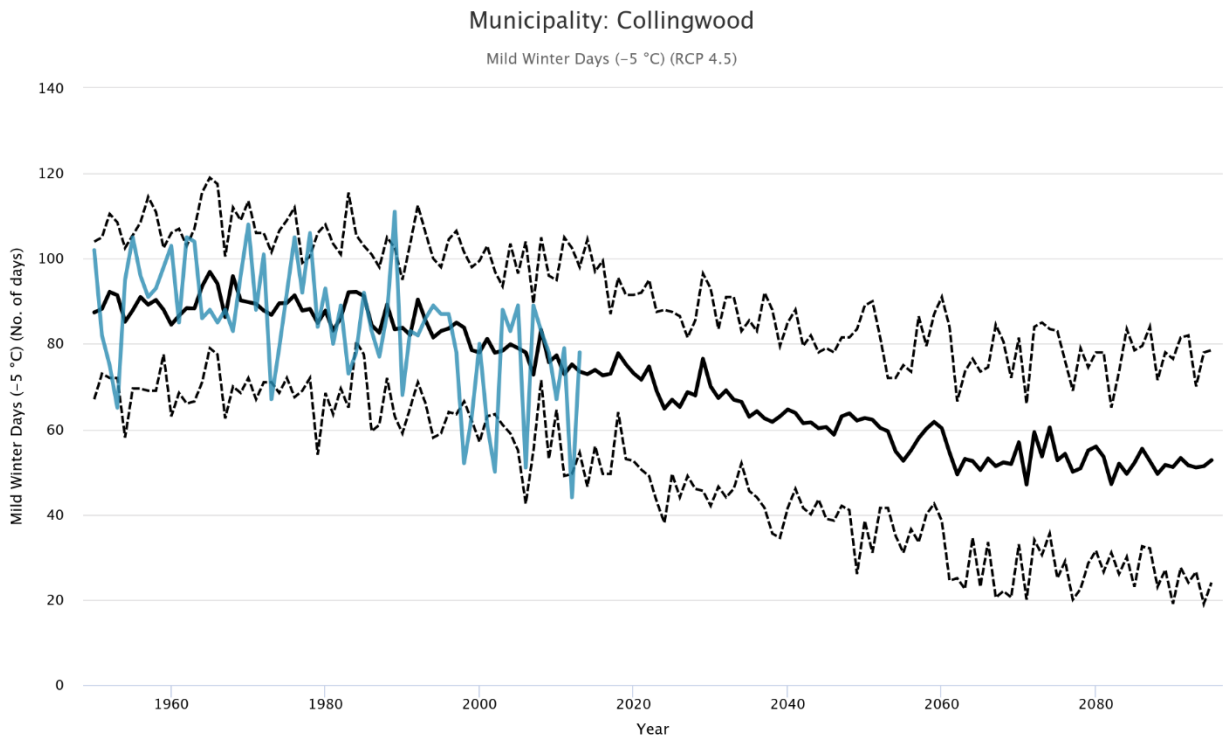


Figure A-13 Mild Winter Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

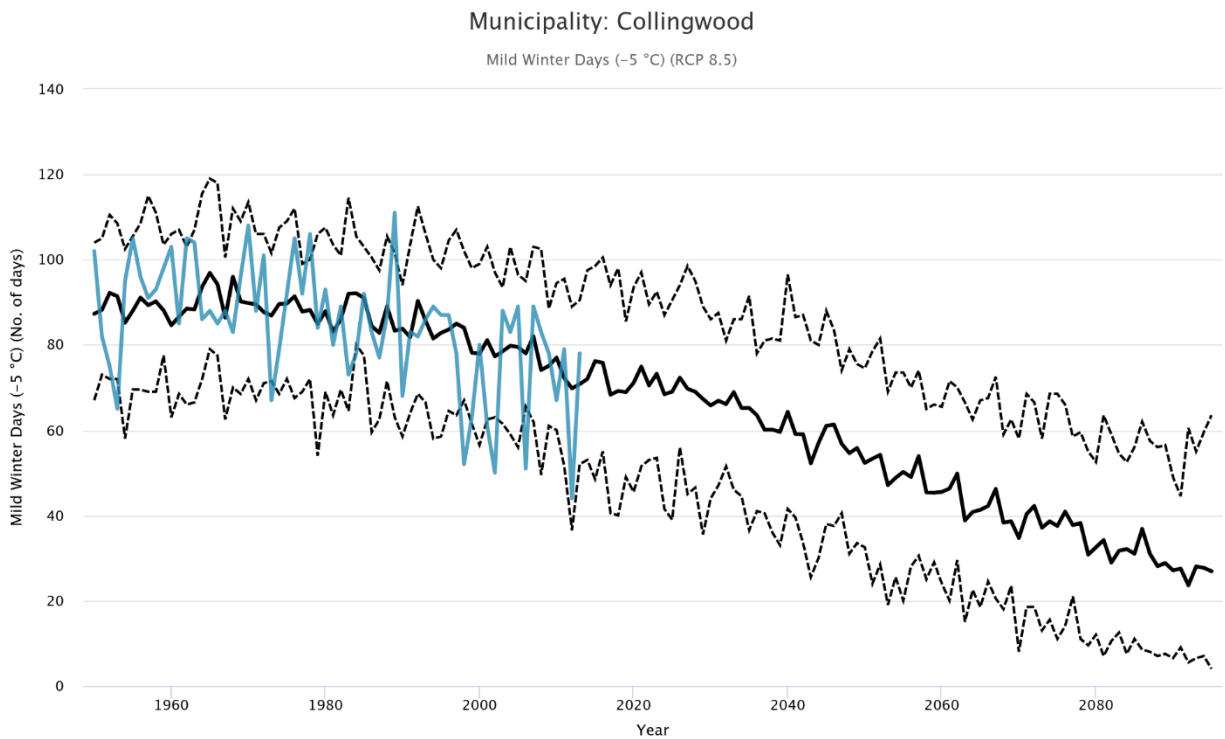


Figure A-14 Winter Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

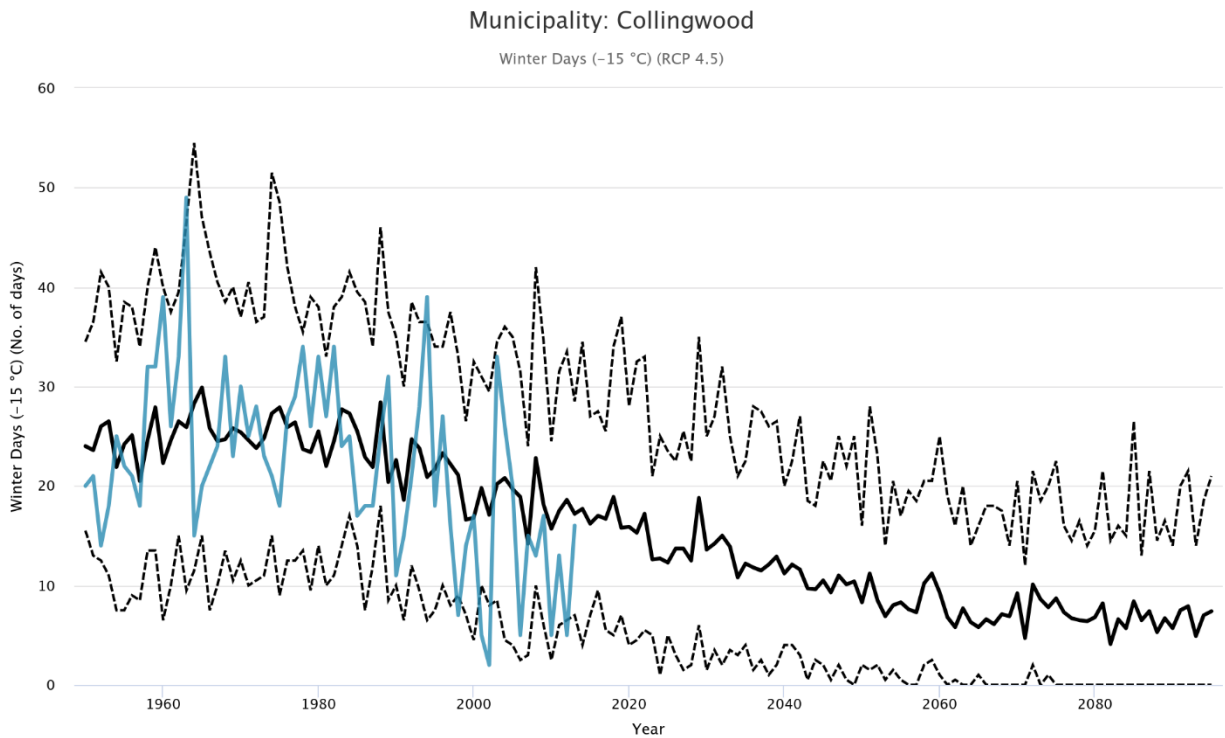


Figure A-15 Cold Winter Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

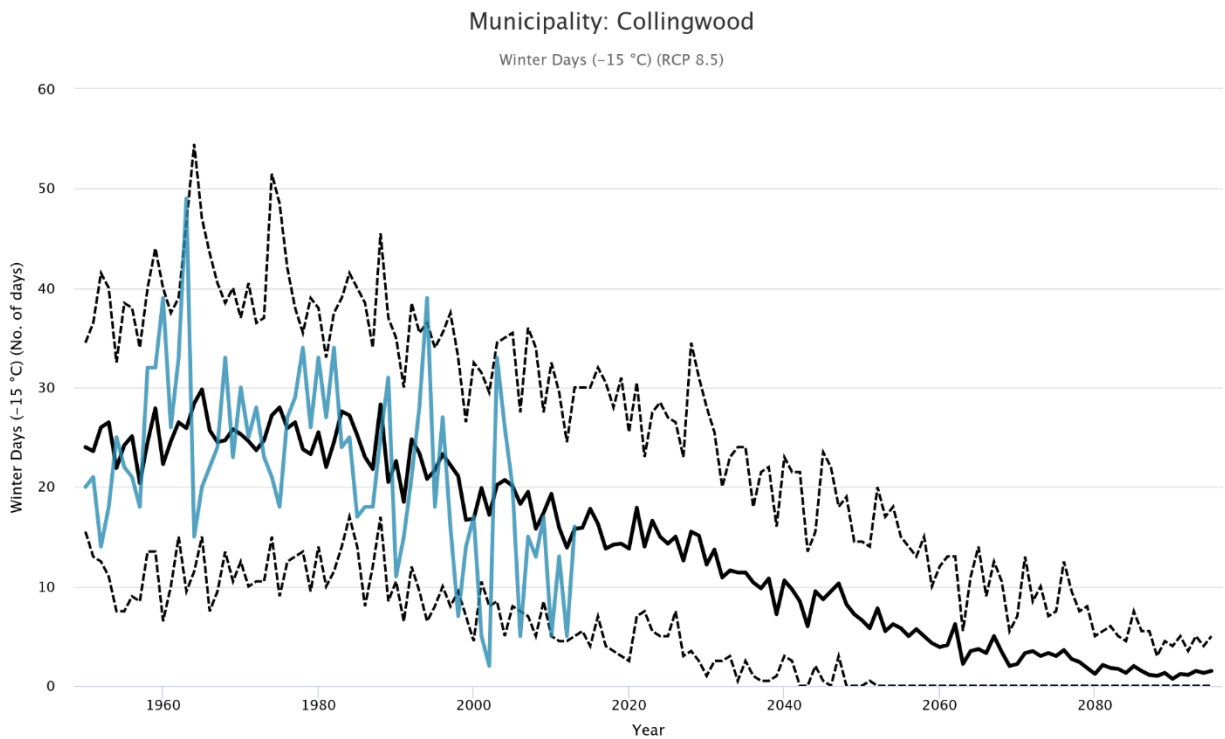


Figure A-16 Cold Winter Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

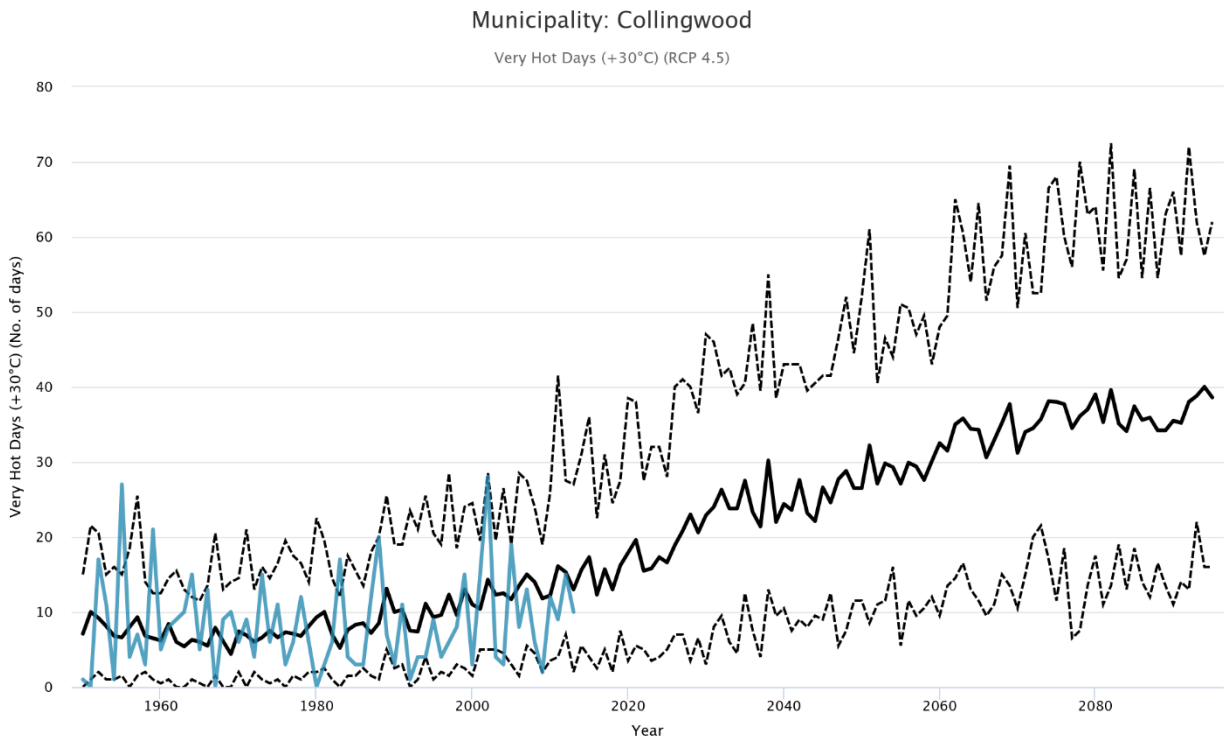


Figure A-17 Very Hot Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

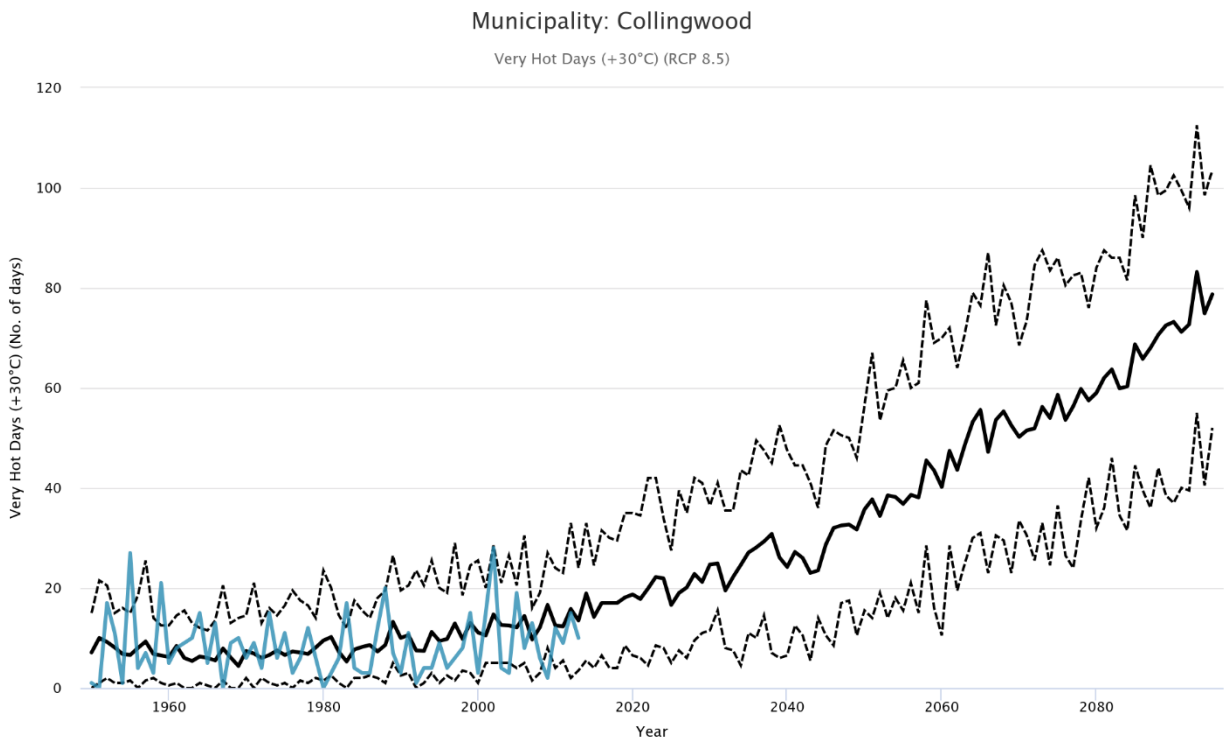


Figure A-18 Very Hot Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

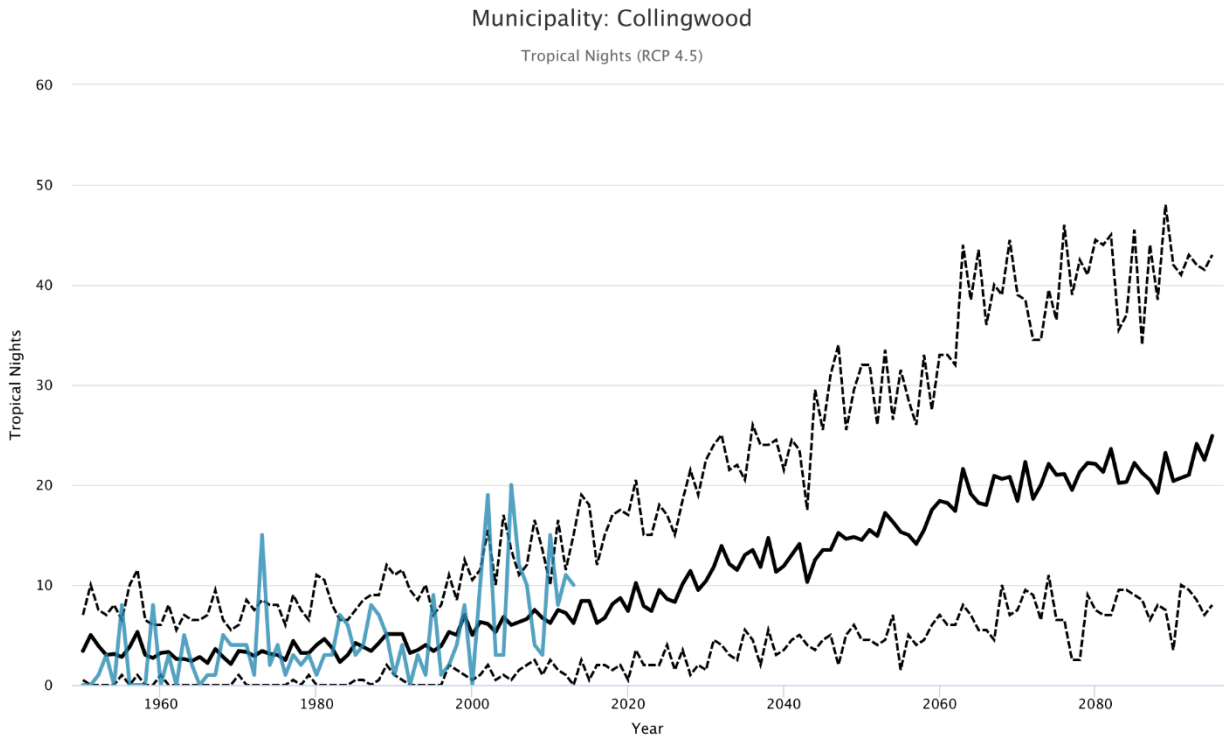


Figure A-19 Tropical Nights (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

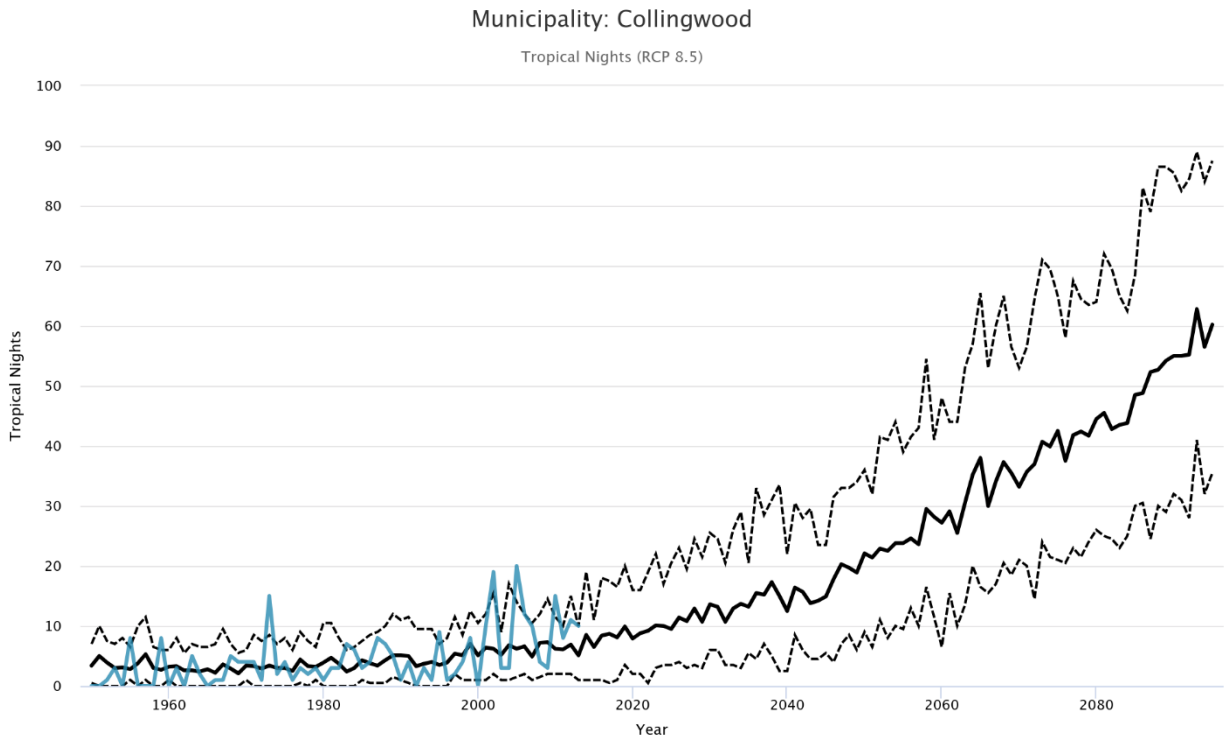


Figure A-20 Tropical Nights (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

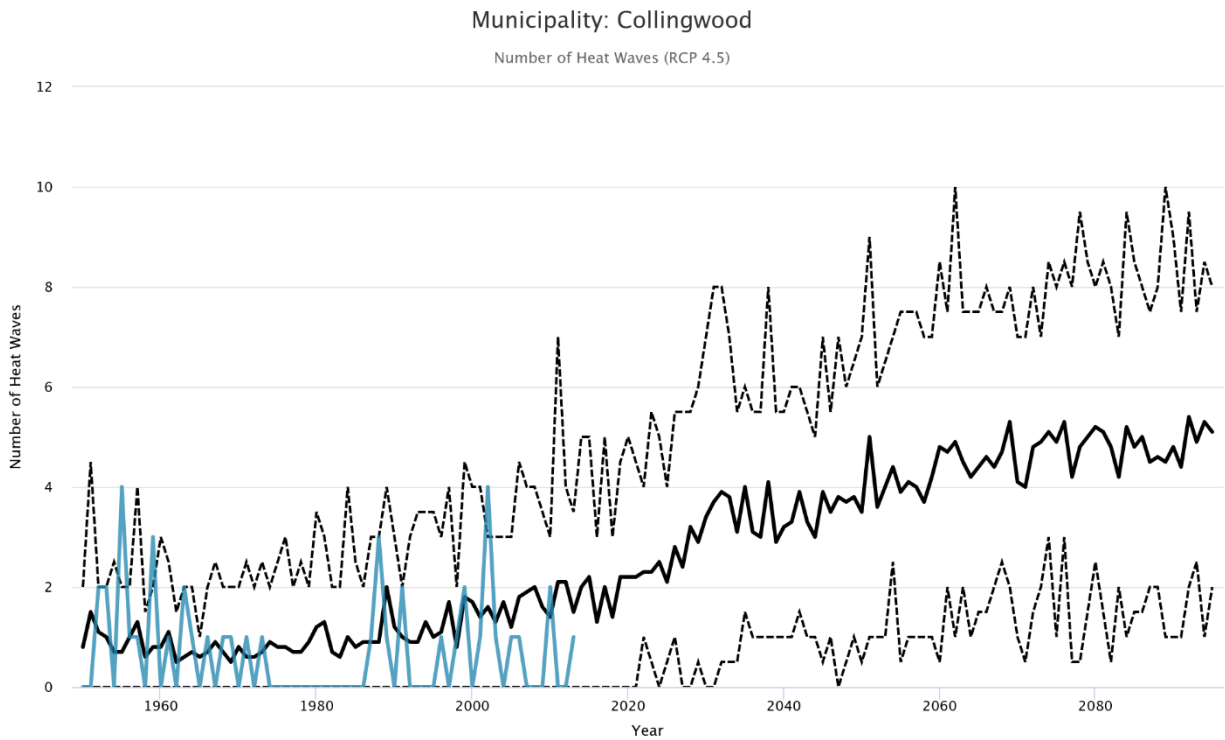


Figure A-21 Number of Heat Waves (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

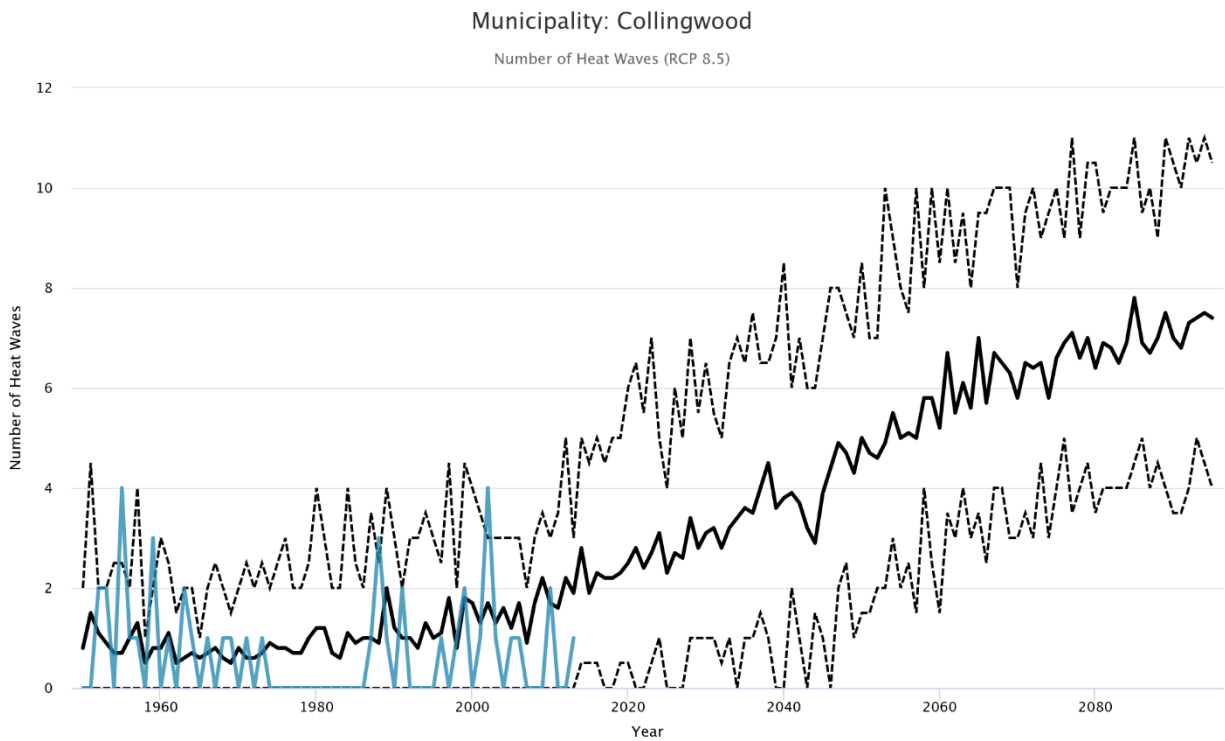


Figure A-22 Number of Heat Waves (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

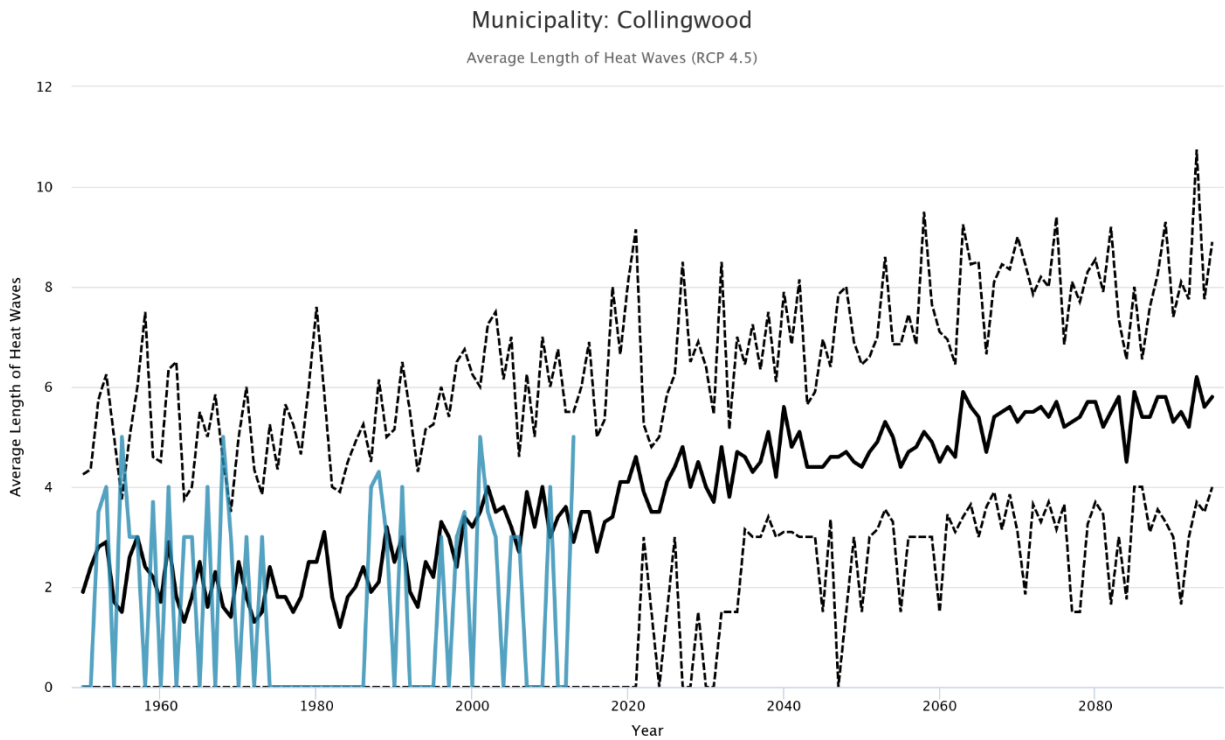


Figure A-23 Length of Heat Waves (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

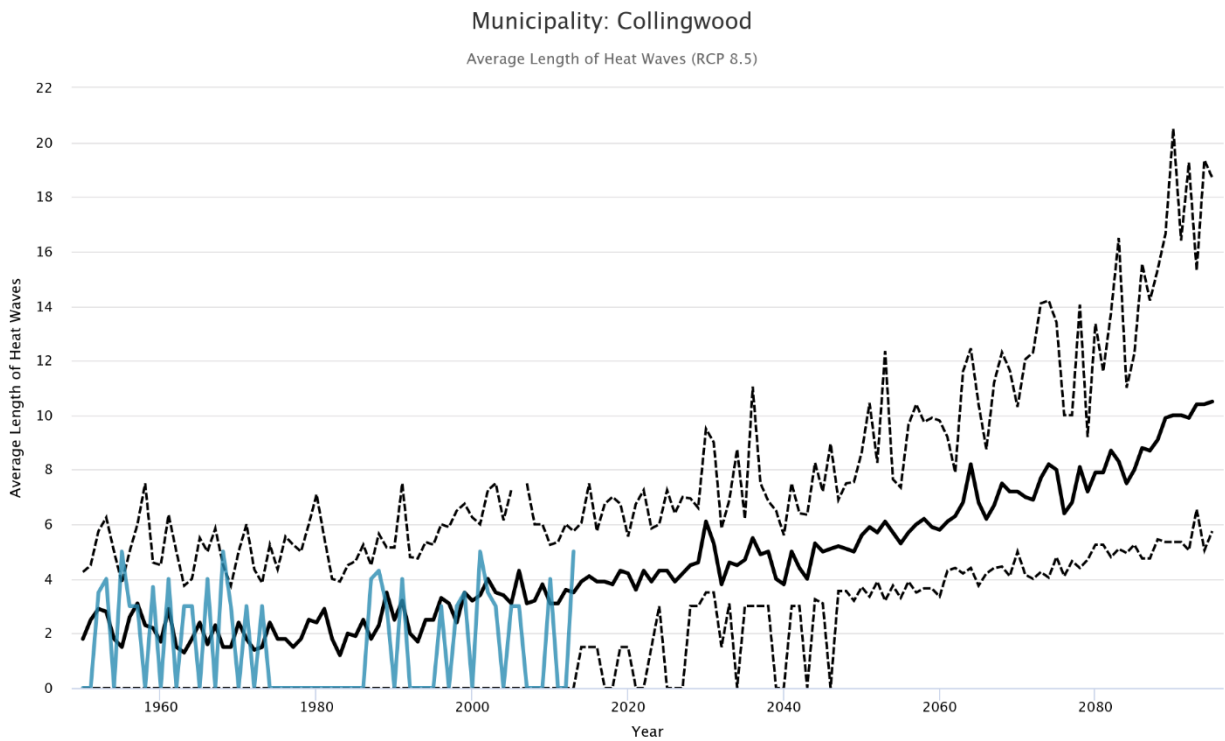


Figure A-24 Length of Heat Waves (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

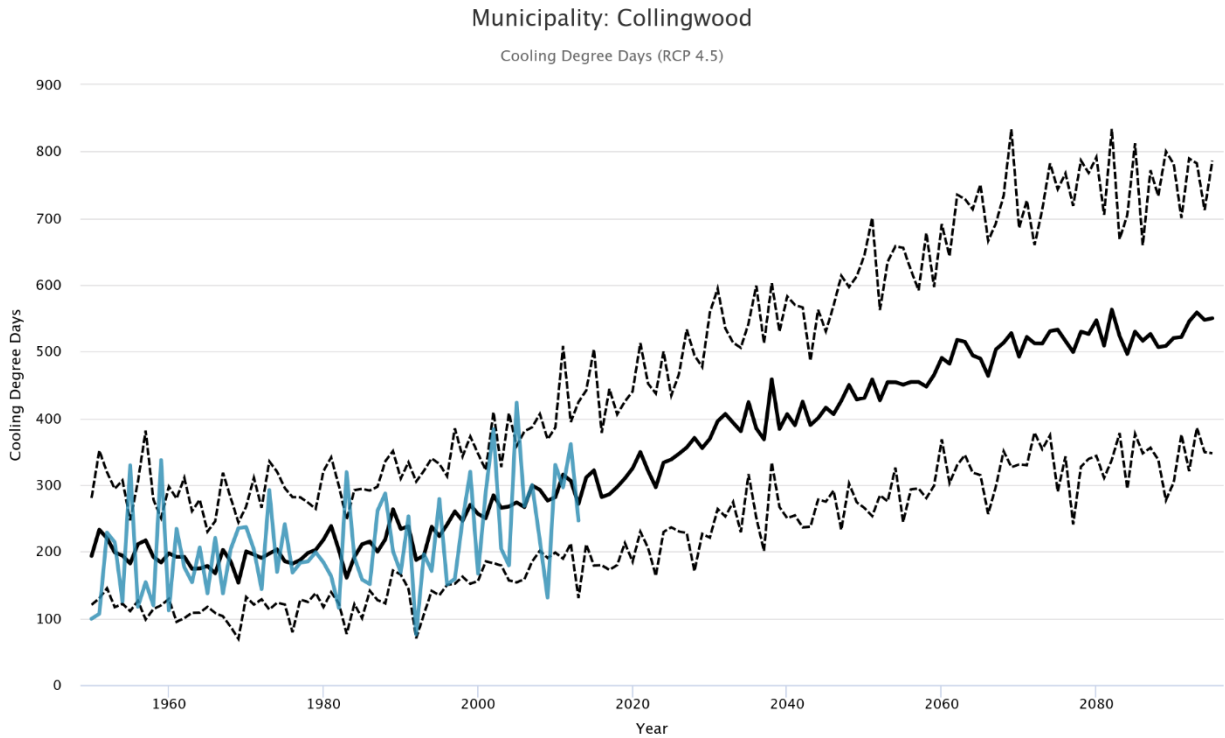


Figure A-25 Cooling Degree Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

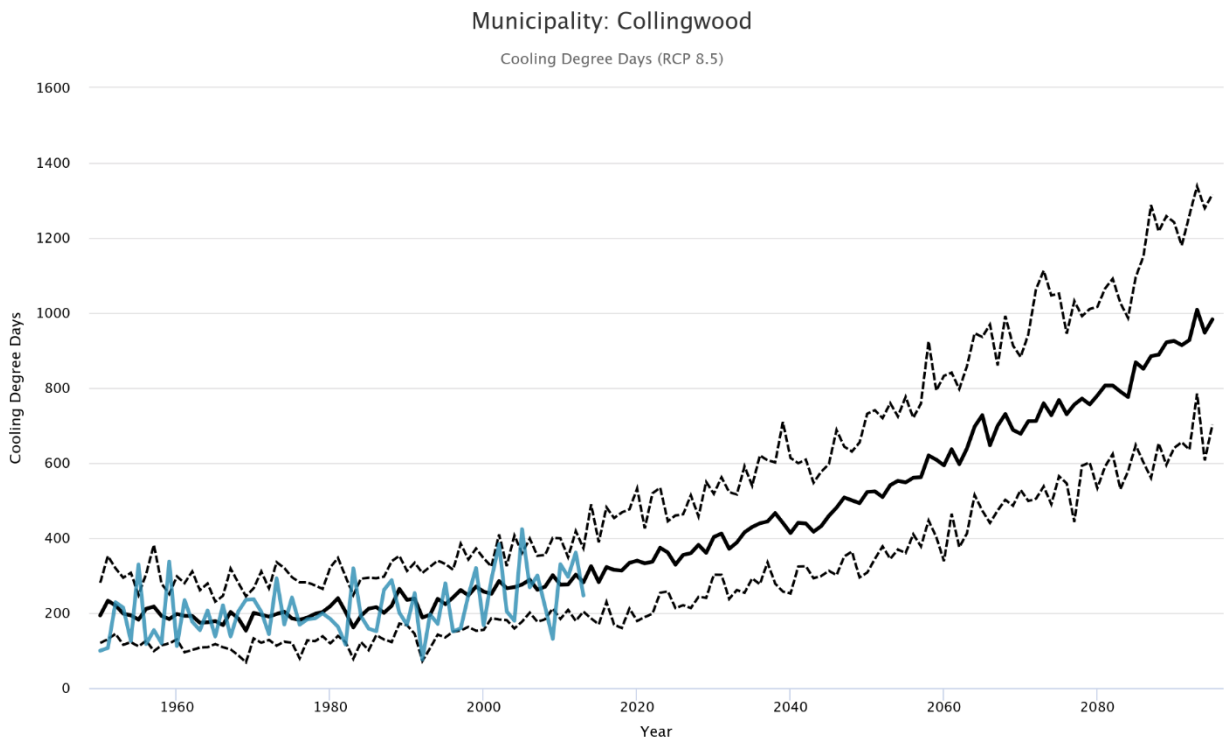


Figure A-26 Cooling Degree Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

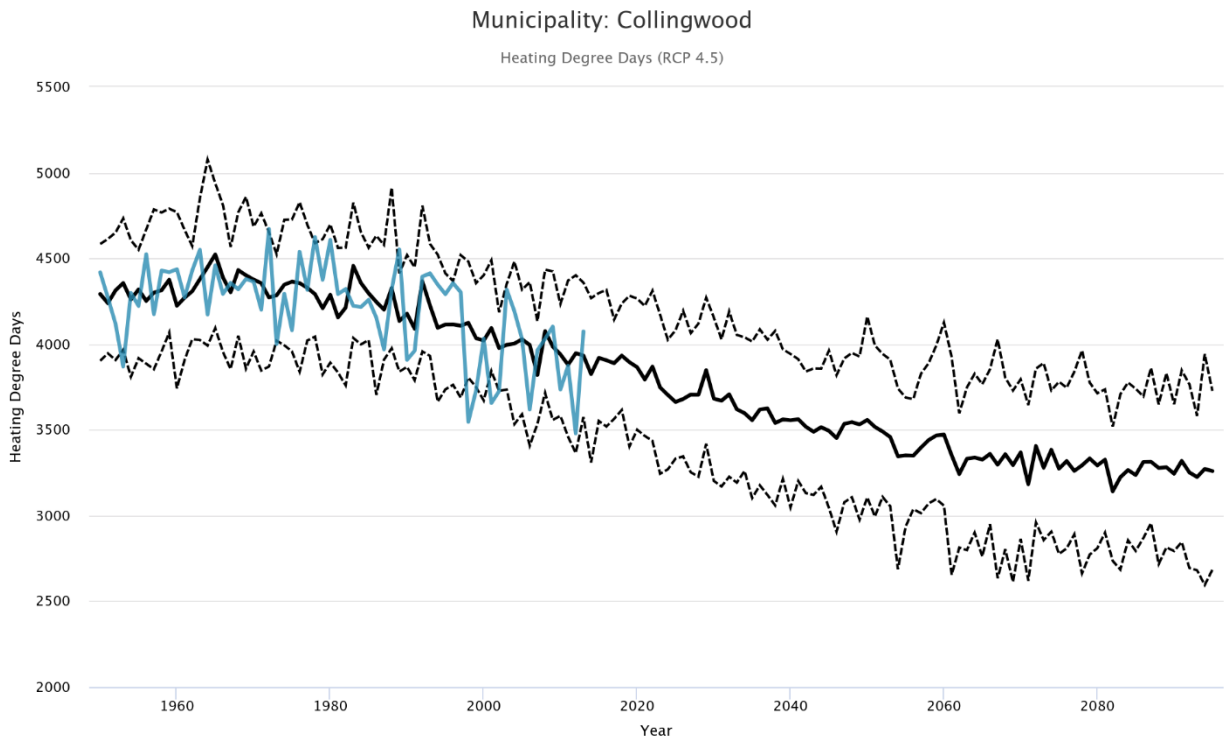


Figure A-27 Heating Degree Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

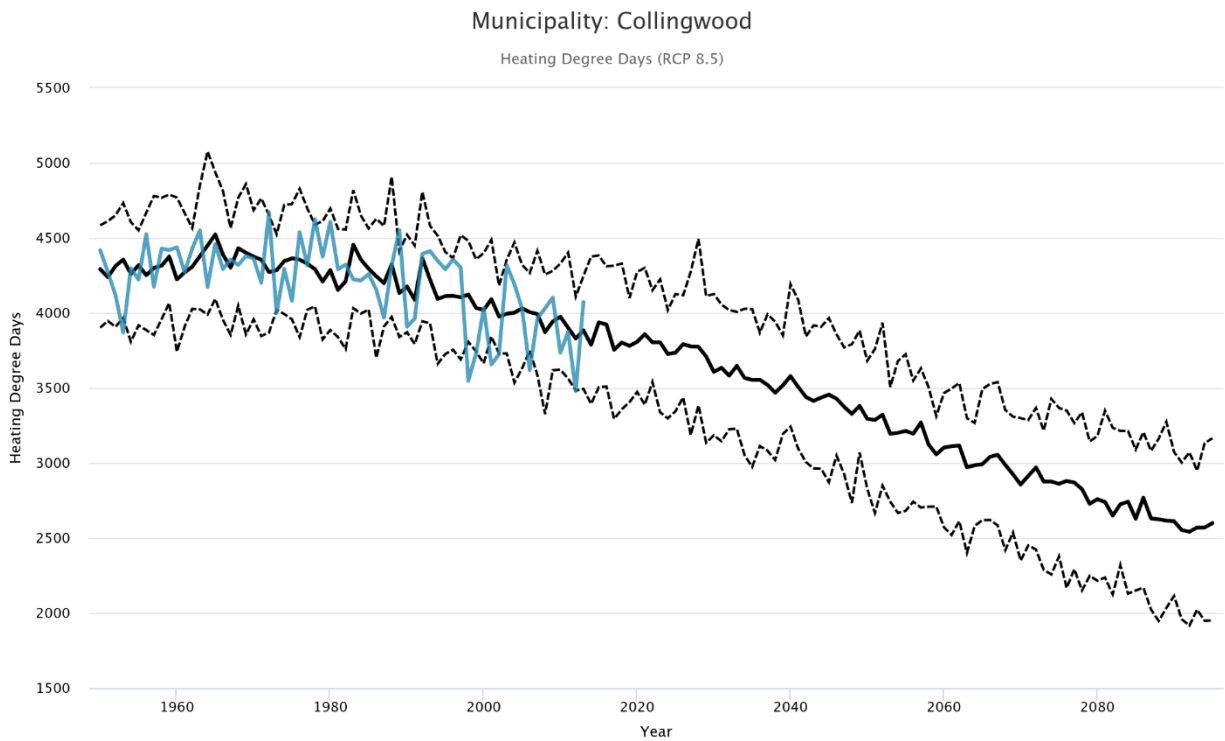


Figure A-28 Heating Degree Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

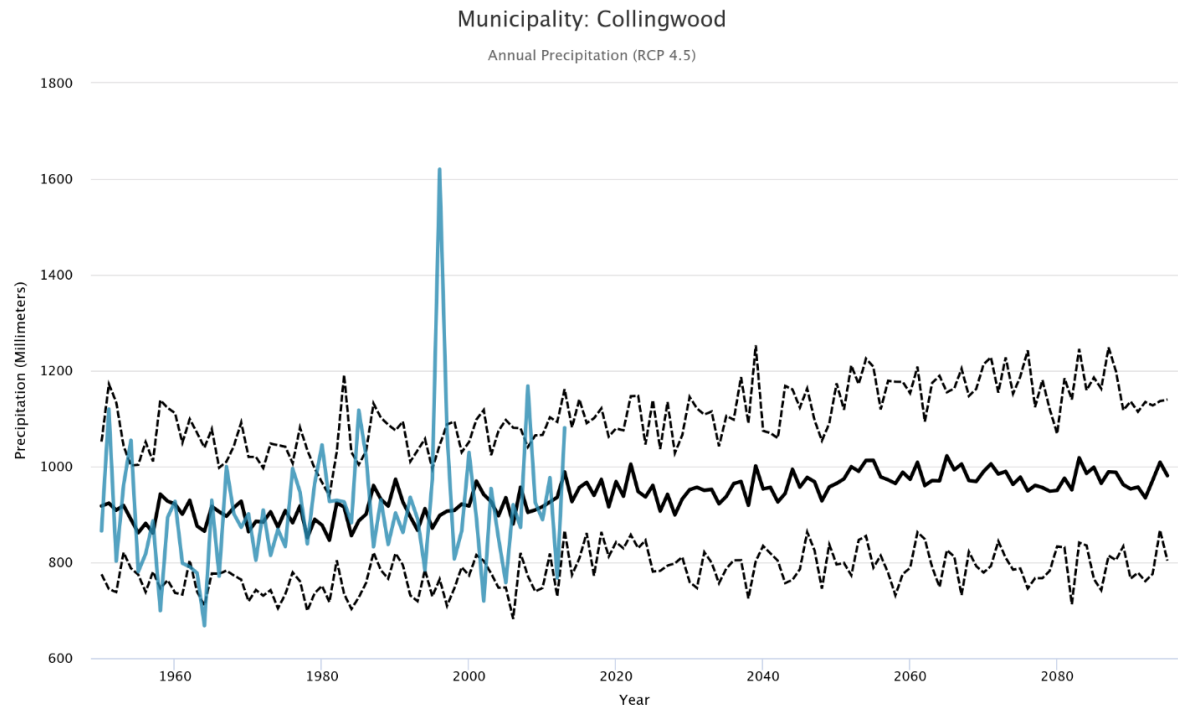


Figure A-29 Total Annual Precipitation (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

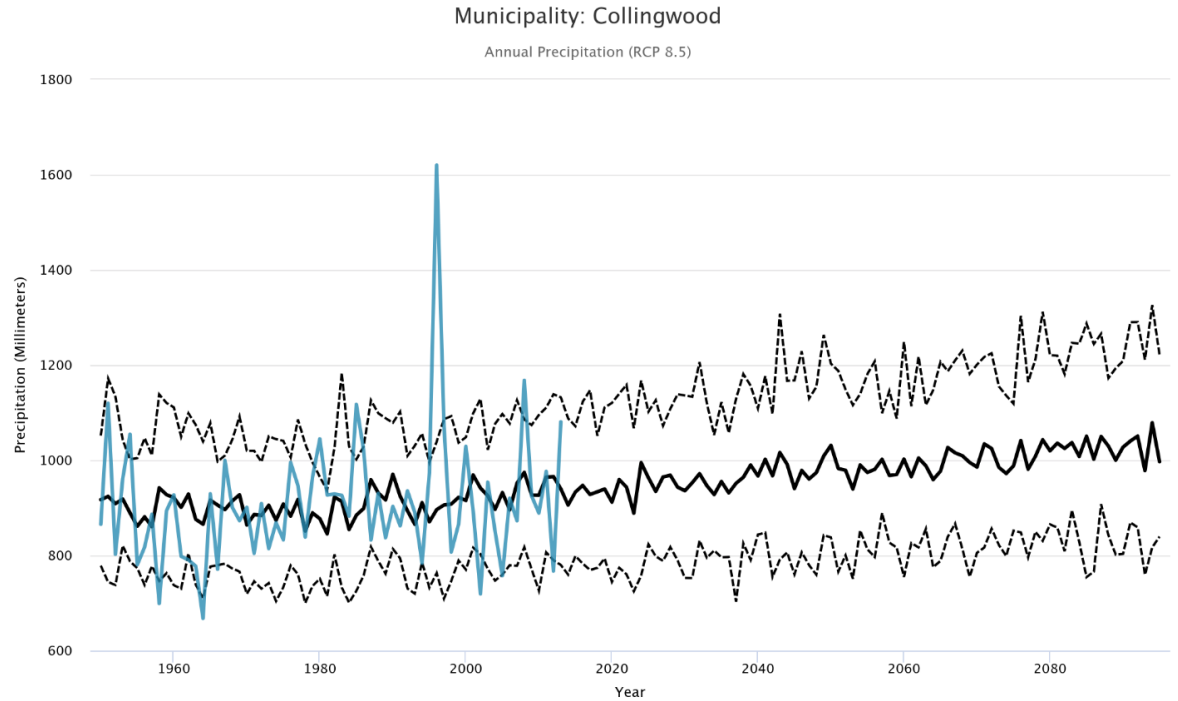


Figure A-30 Total Annual Precipitation (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

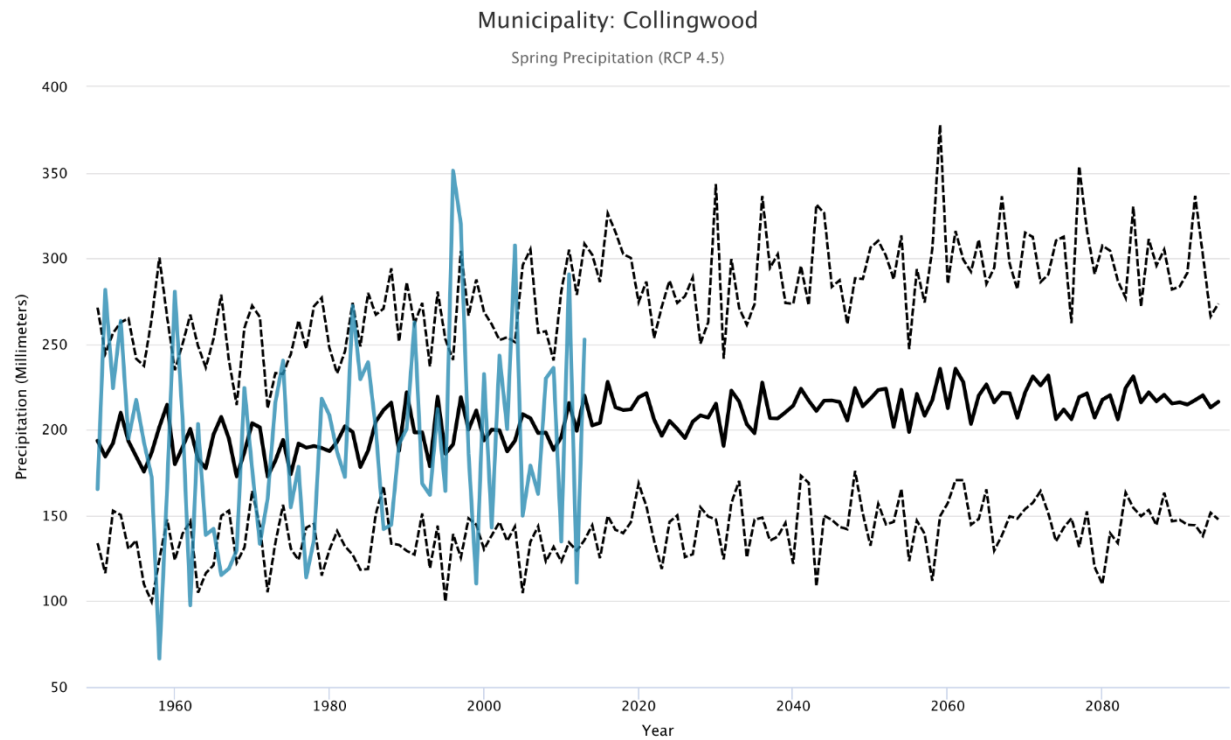


Figure A-31 Total Spring Precipitation (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

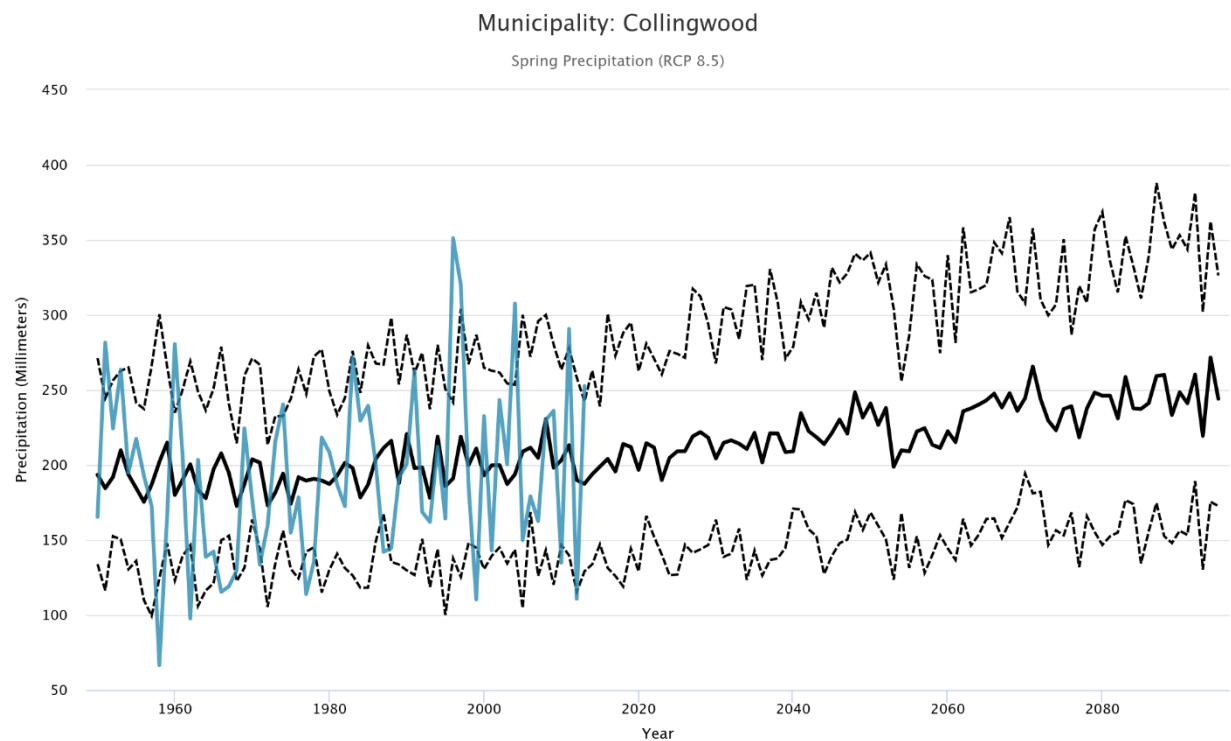


Figure A-32 Total Spring Precipitation (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

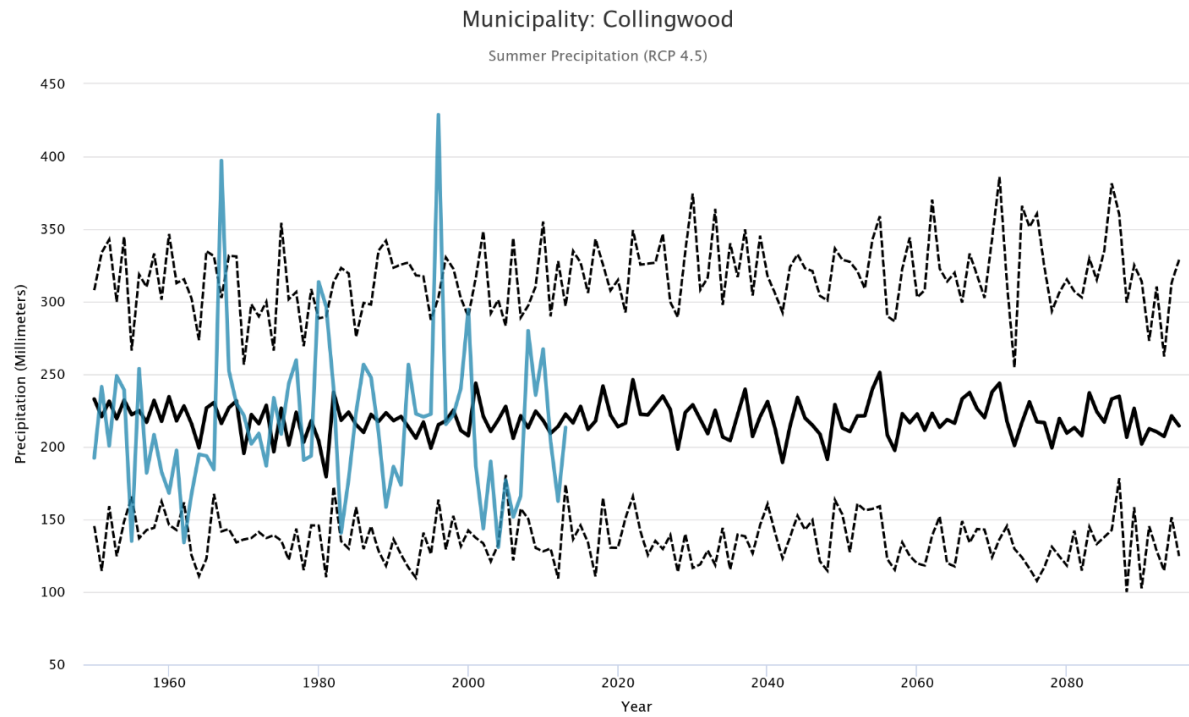


Figure A-33 Total Summer Precipitation (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

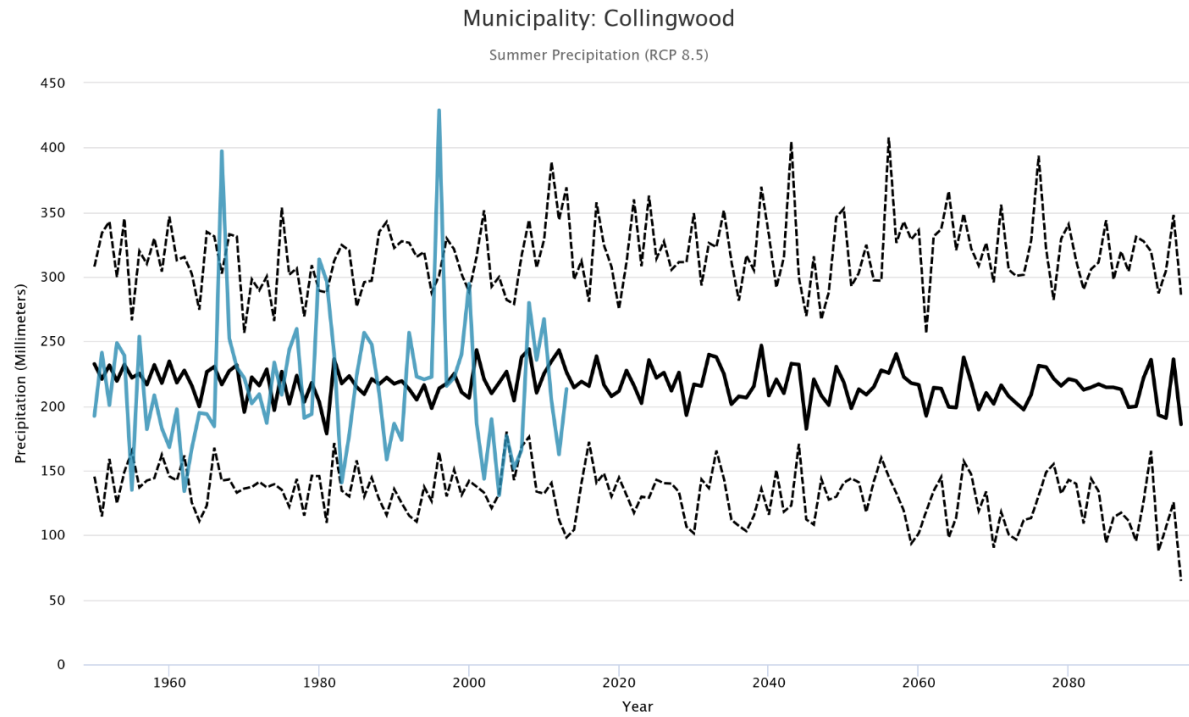


Figure A-34 Total Summer Precipitation (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

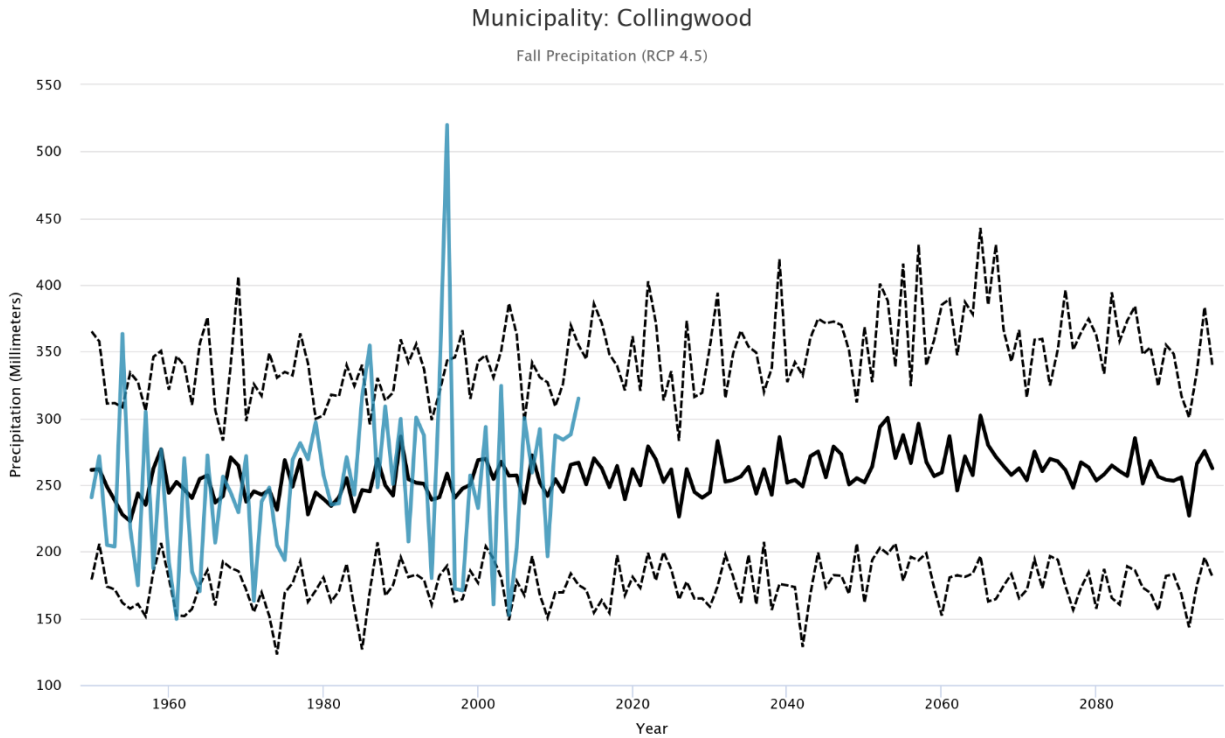


Figure A-35 Total Fall Precipitation (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

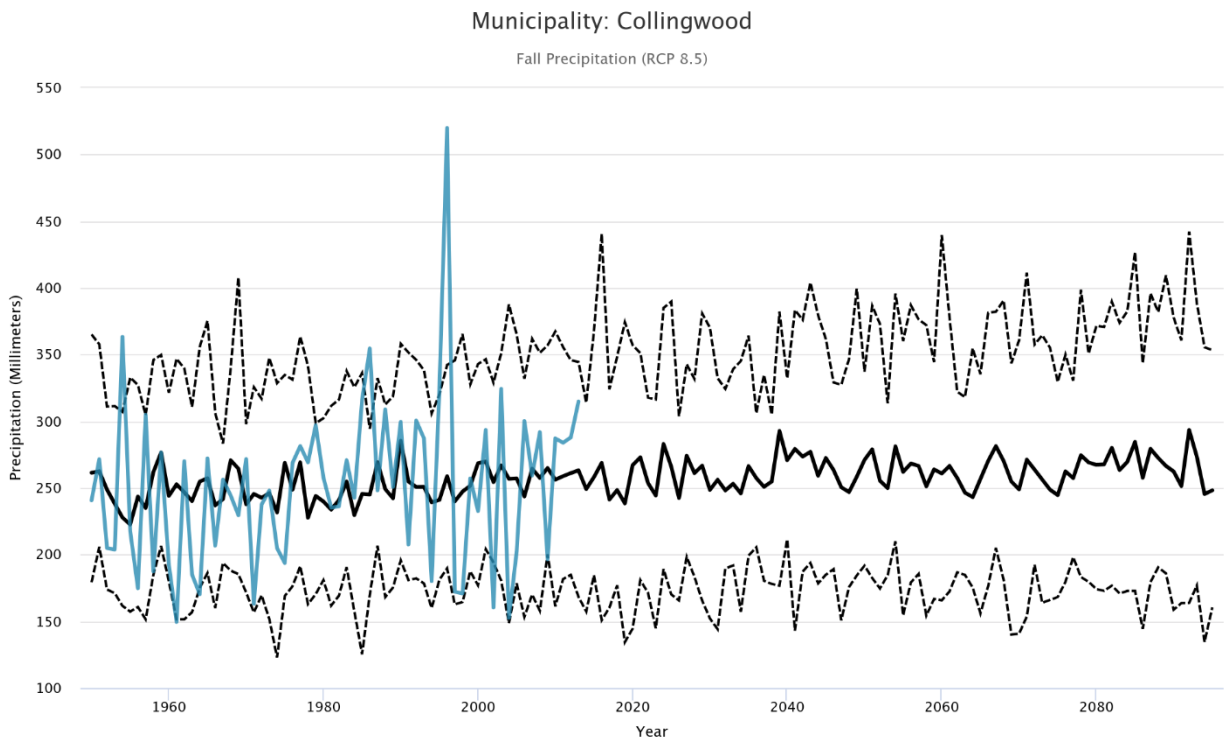


Figure A-36 Total Fall Precipitation (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

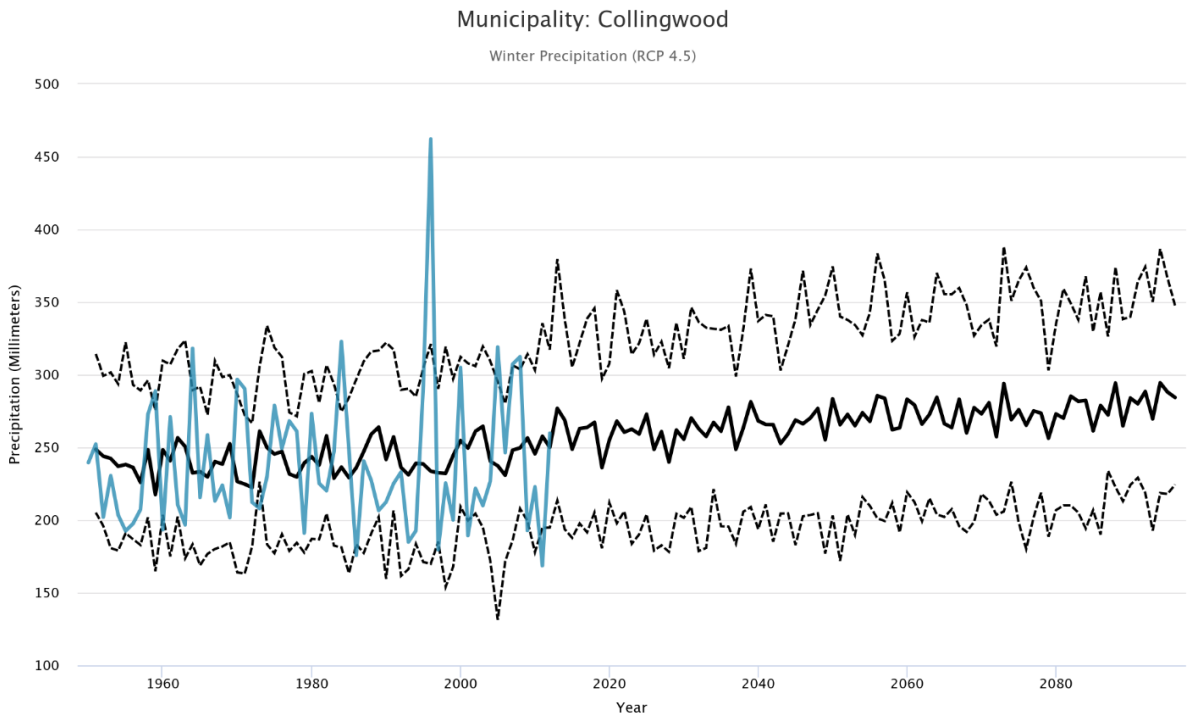


Figure A-37 Total Winter Precipitation (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

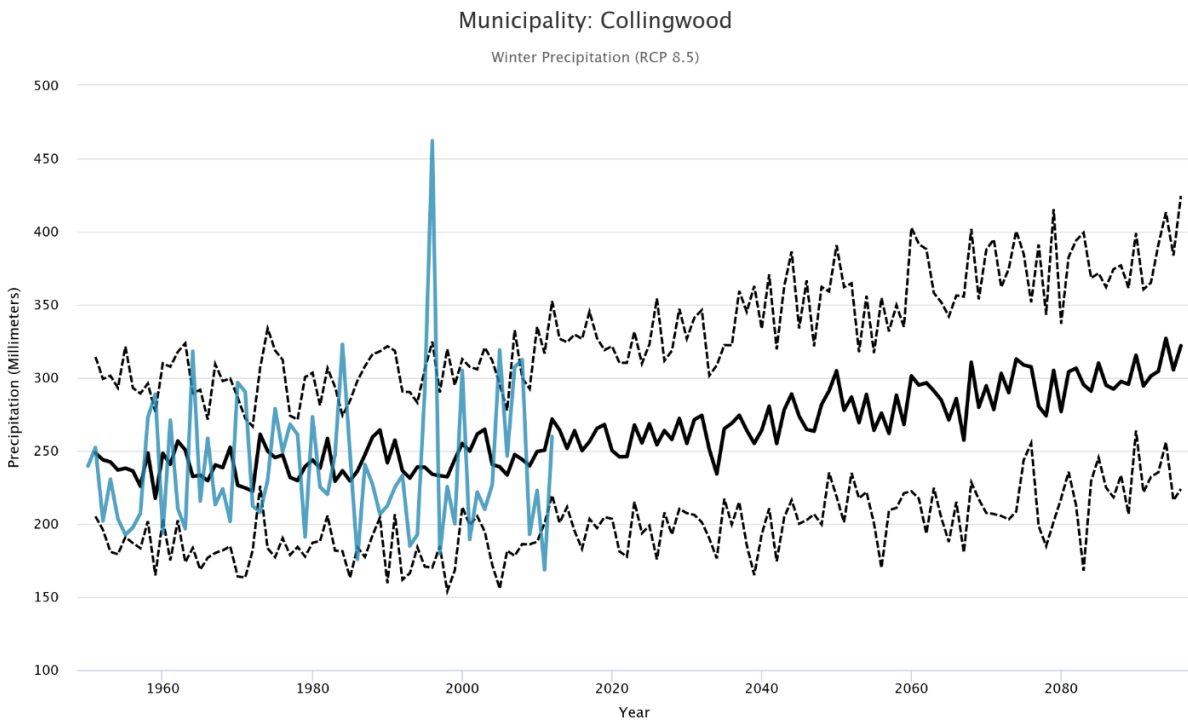


Figure A-38 Total Winter Precipitation (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

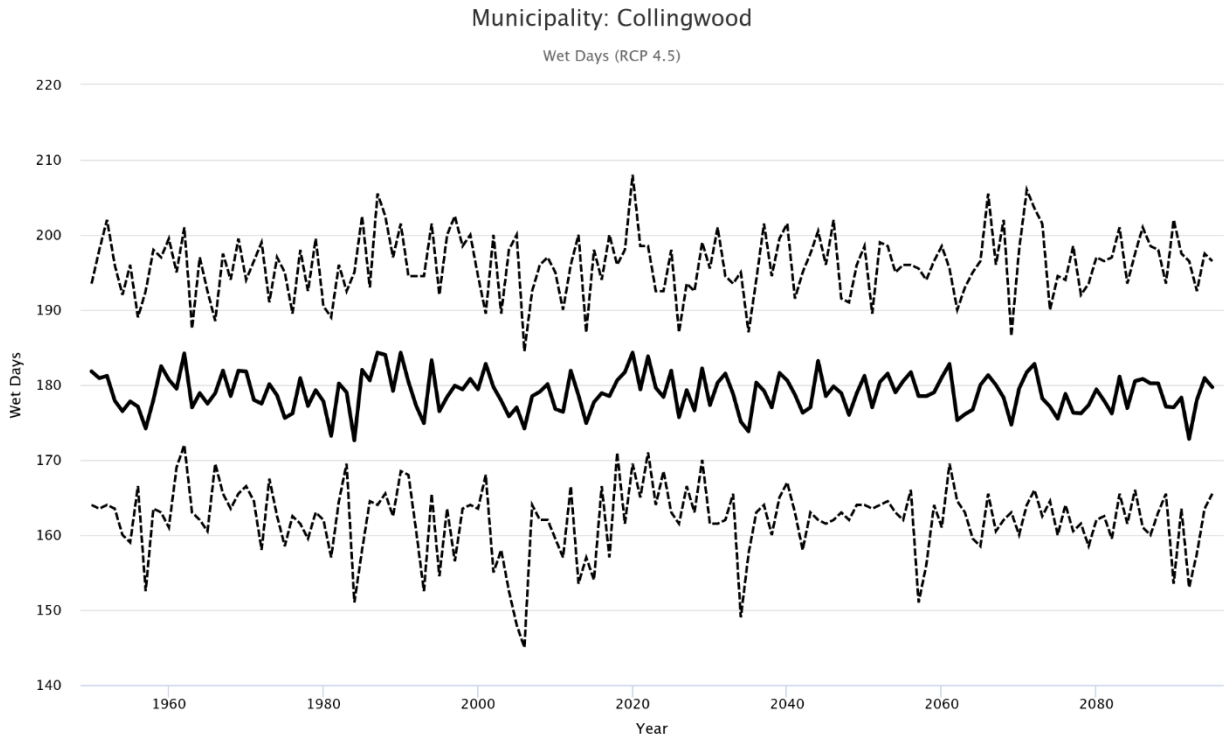


Figure A-39 Number of Wet Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

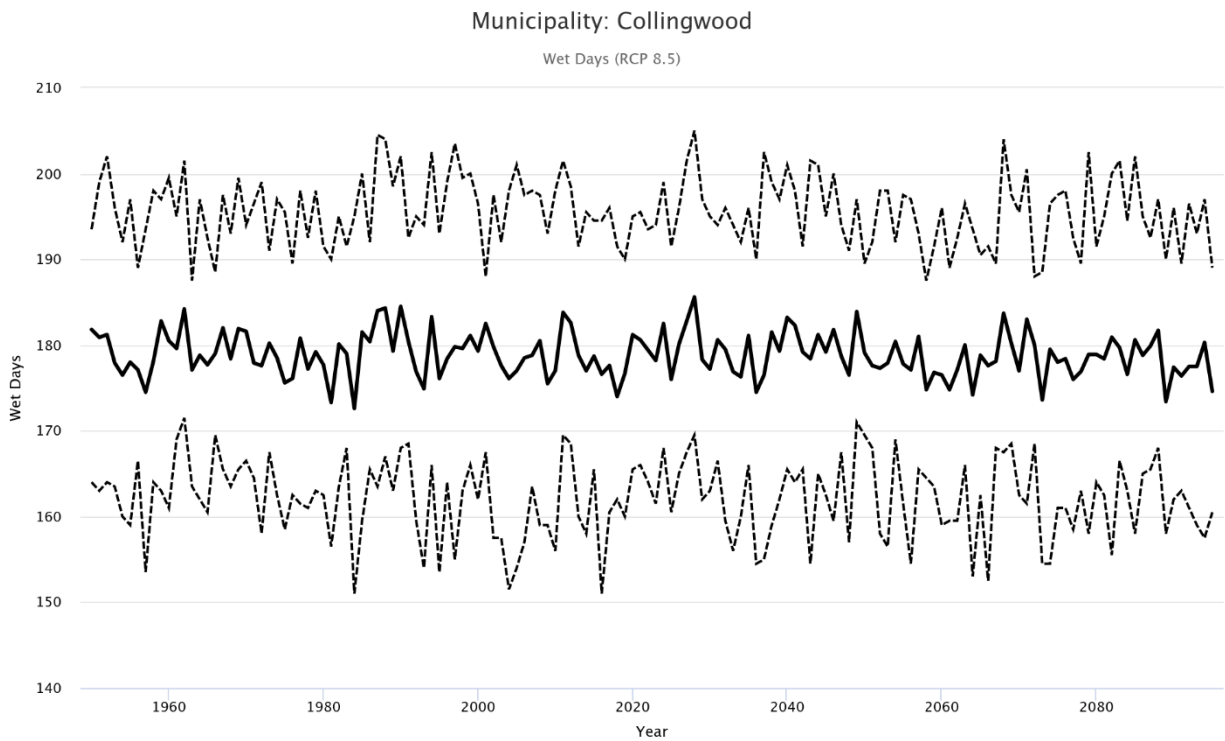


Figure A-40 Number of Wet Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

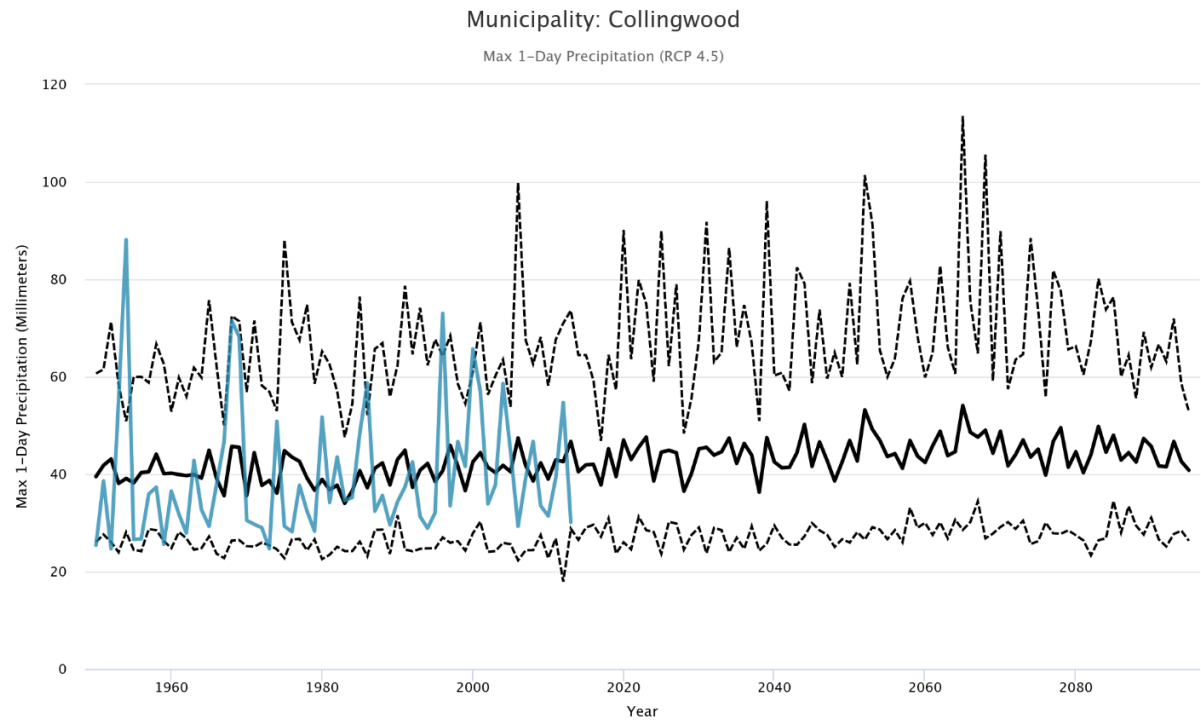


Figure A-41 Maximum 1-Day Precipitation (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

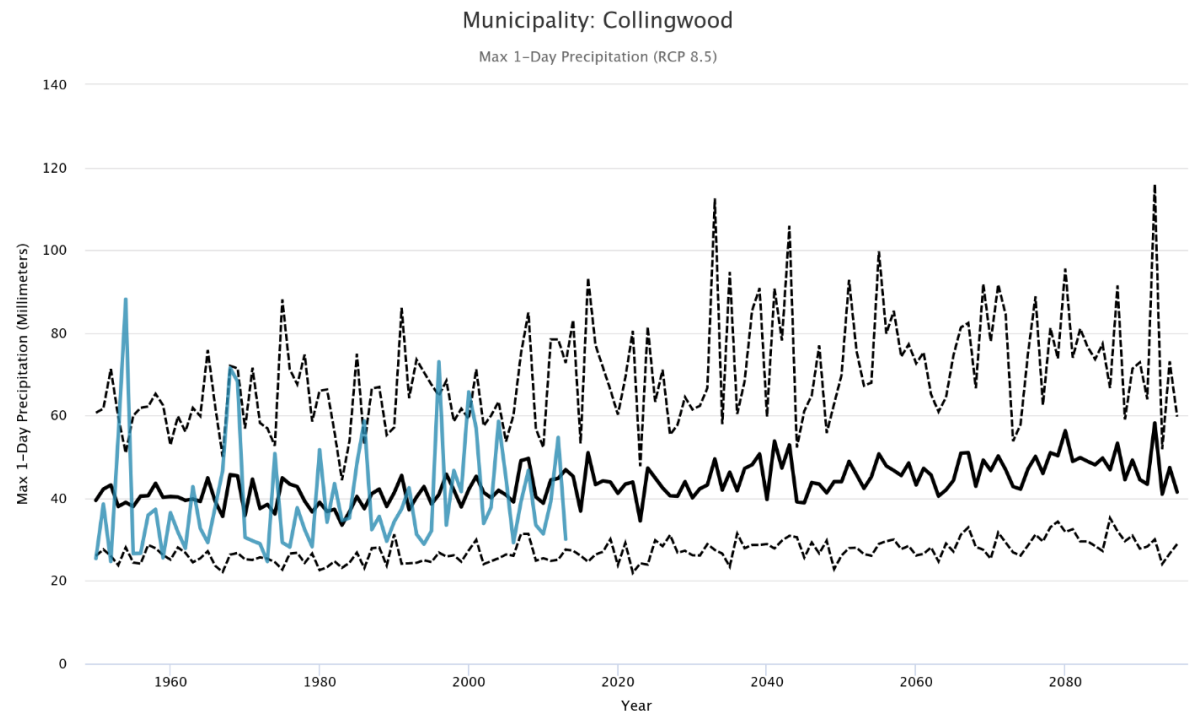


Figure A-42 Maximum 1-Day Precipitation (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

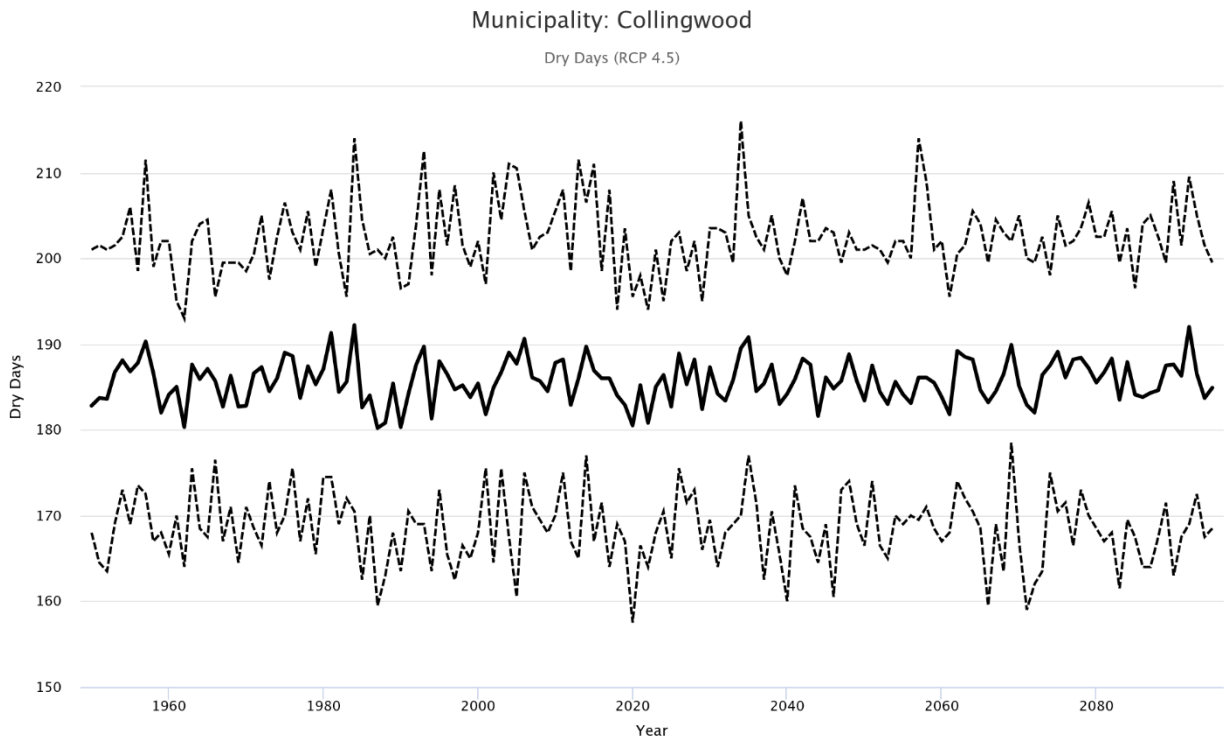


Figure A-43 Number of Dry Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

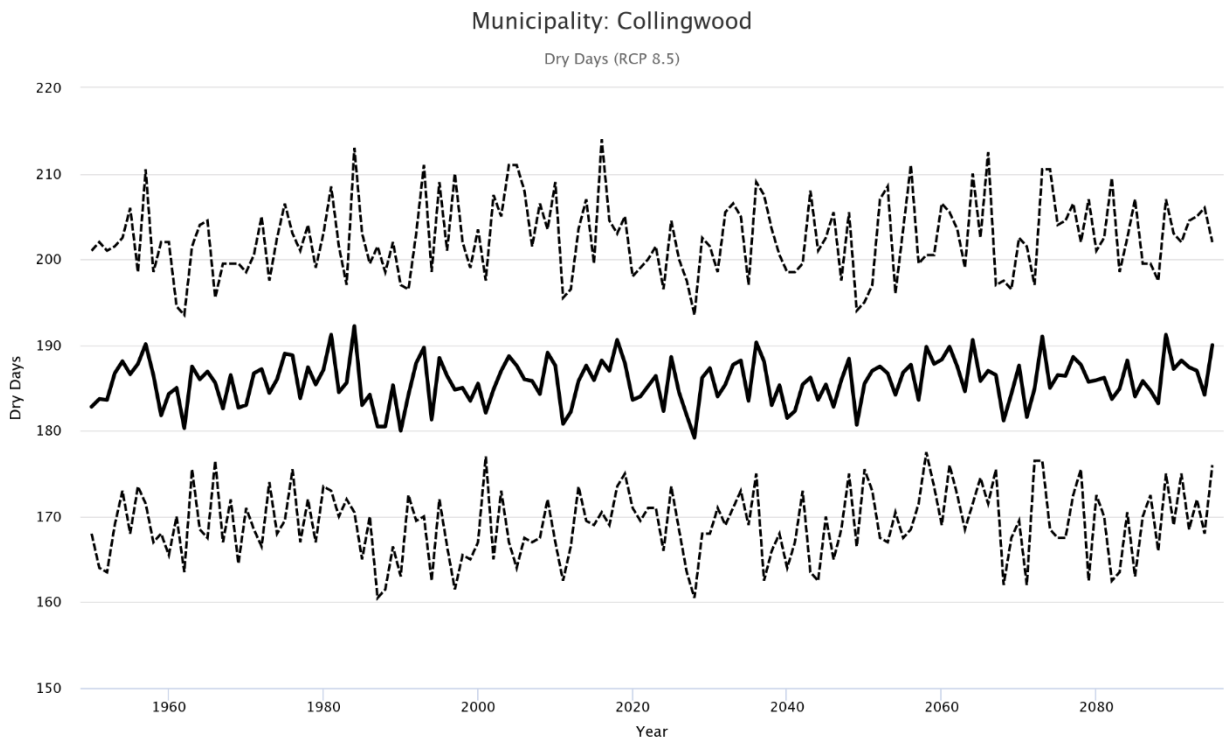


Figure A-44 Number of Dry Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

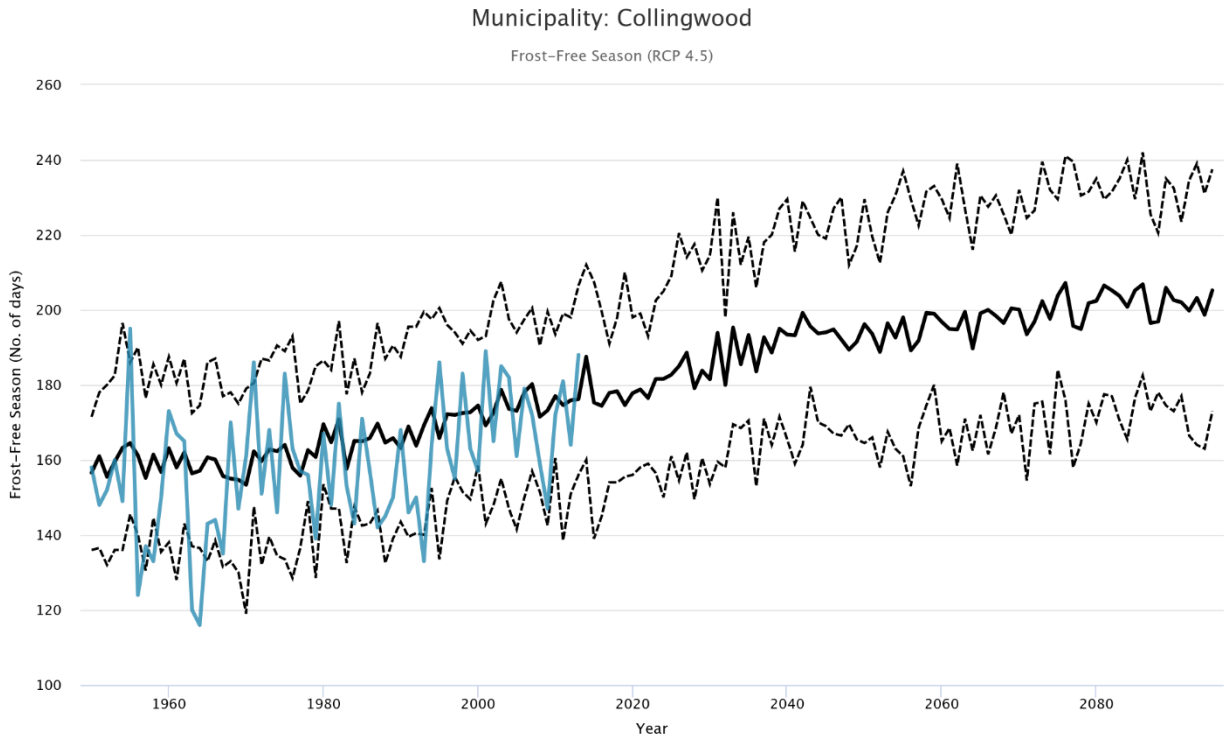


Figure A-45 Frost-Free Season (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

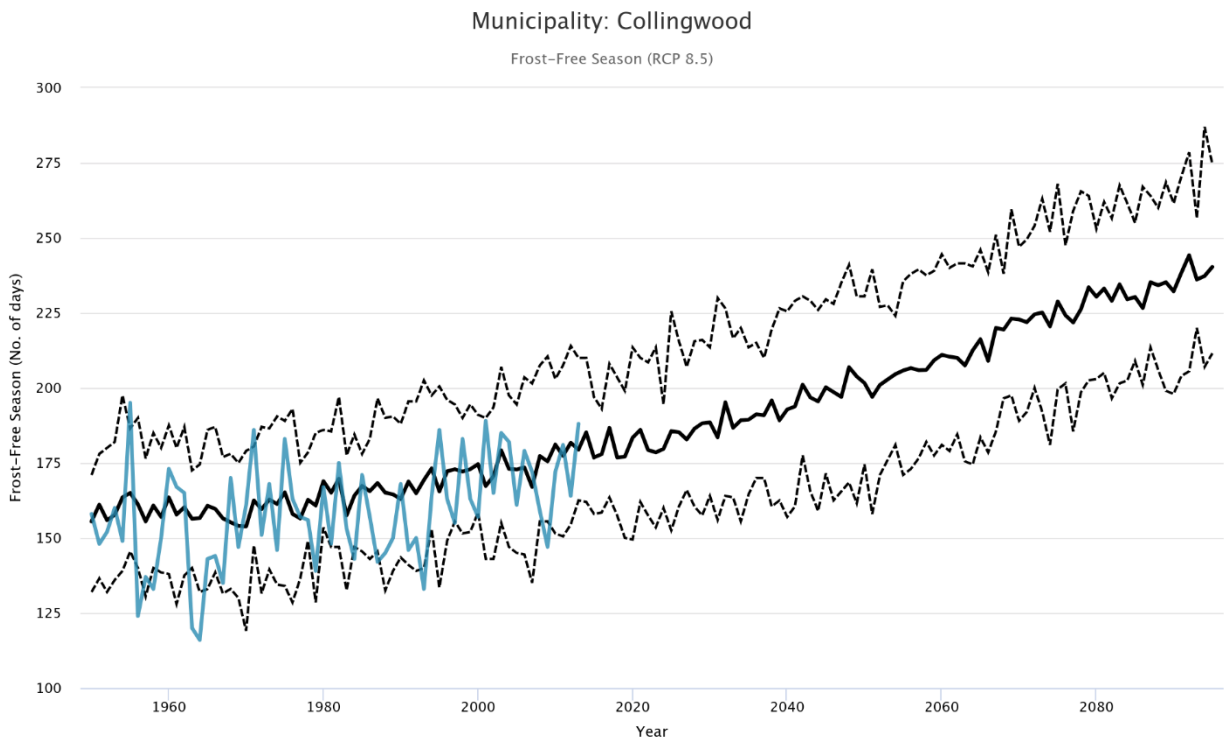


Figure A-46 Frost-Free Season (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

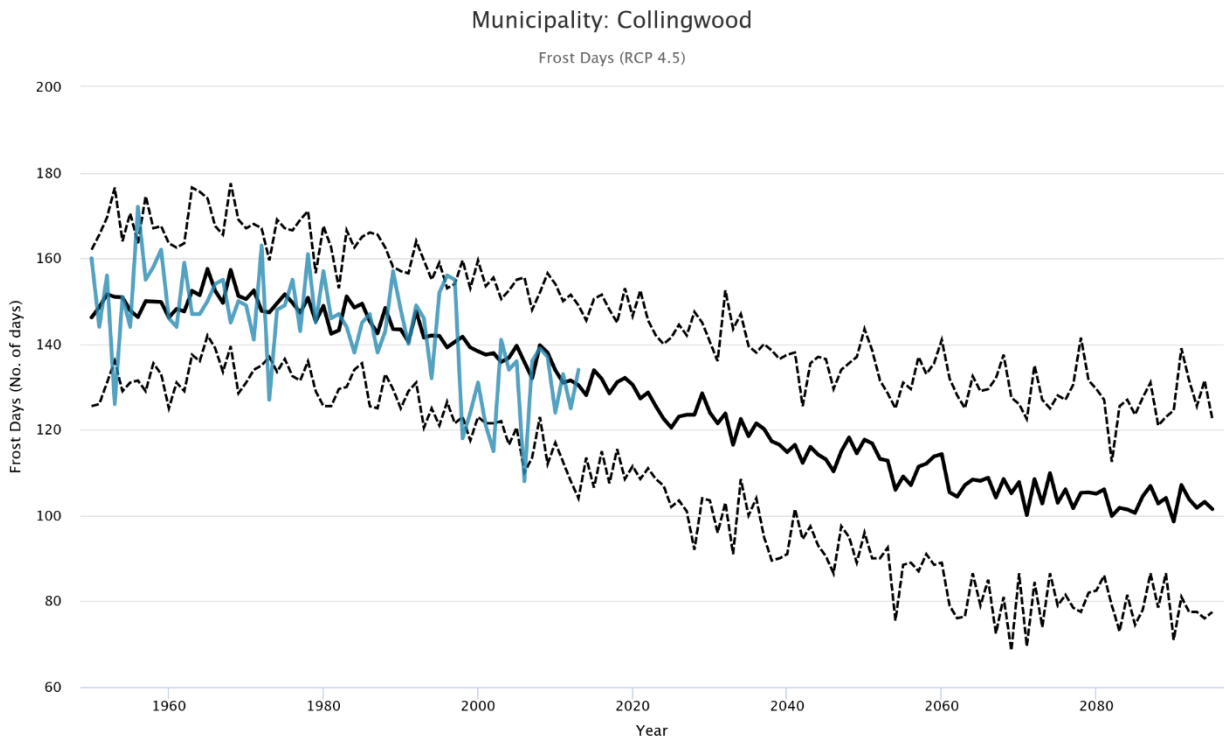


Figure A-47 Number of Frost Days (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

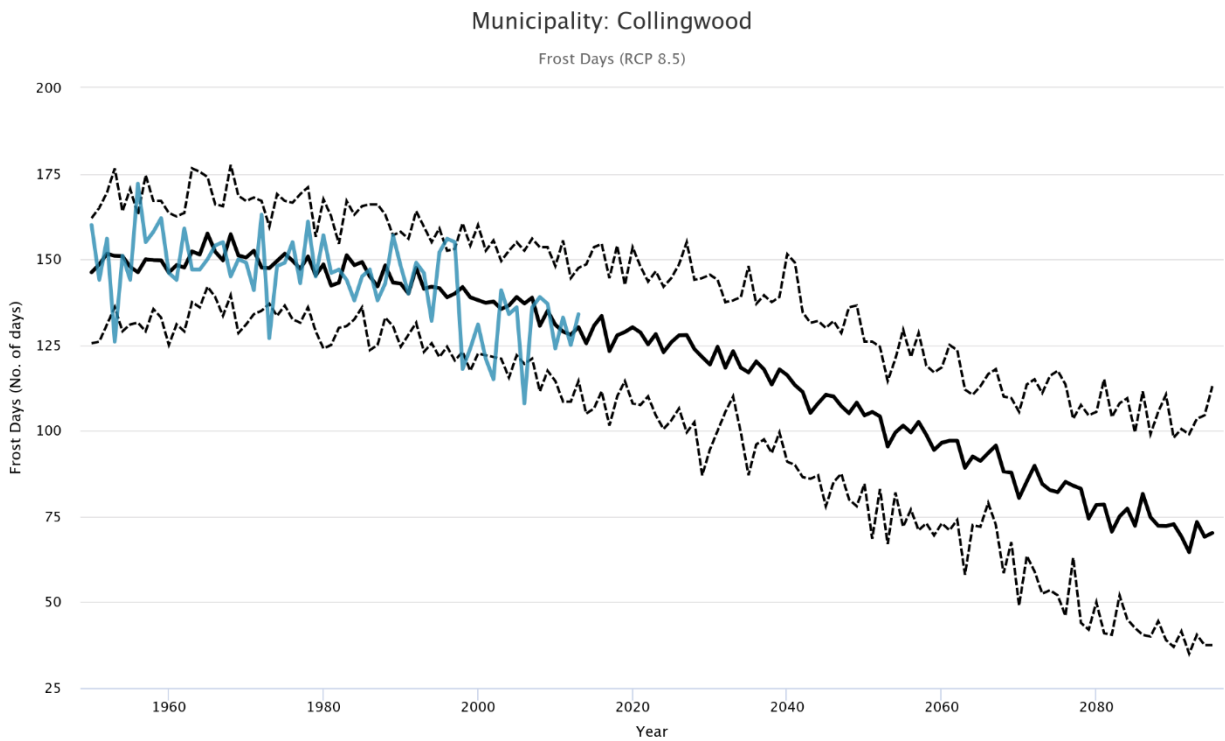


Figure A-48 Number of Frost Days (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

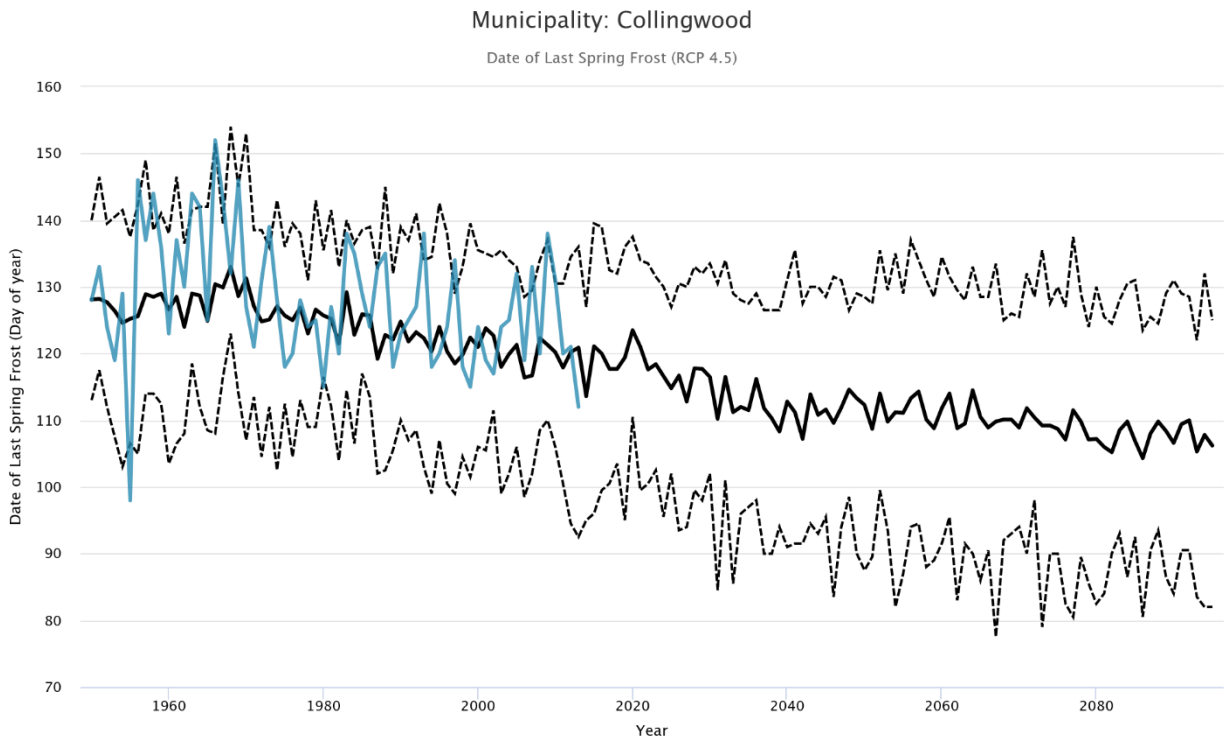


Figure A-49 Date of Last Spring Frost (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

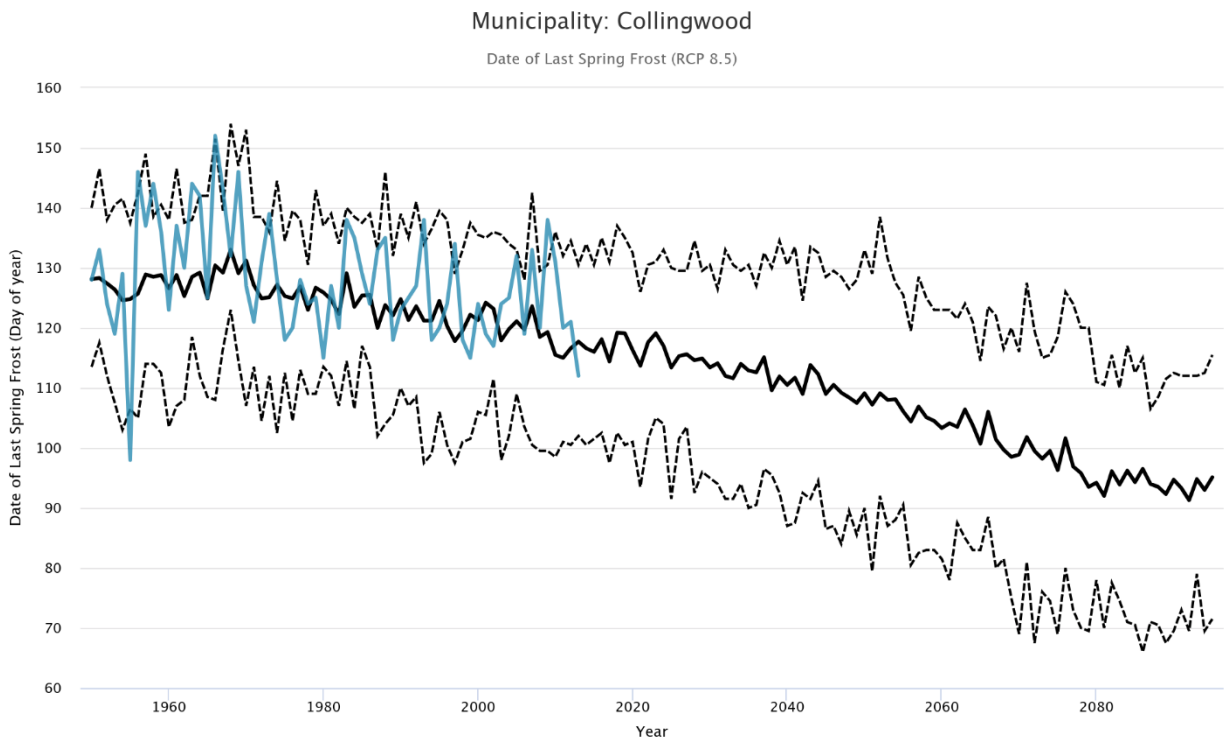


Figure A-50 Date of Last Spring Frost (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

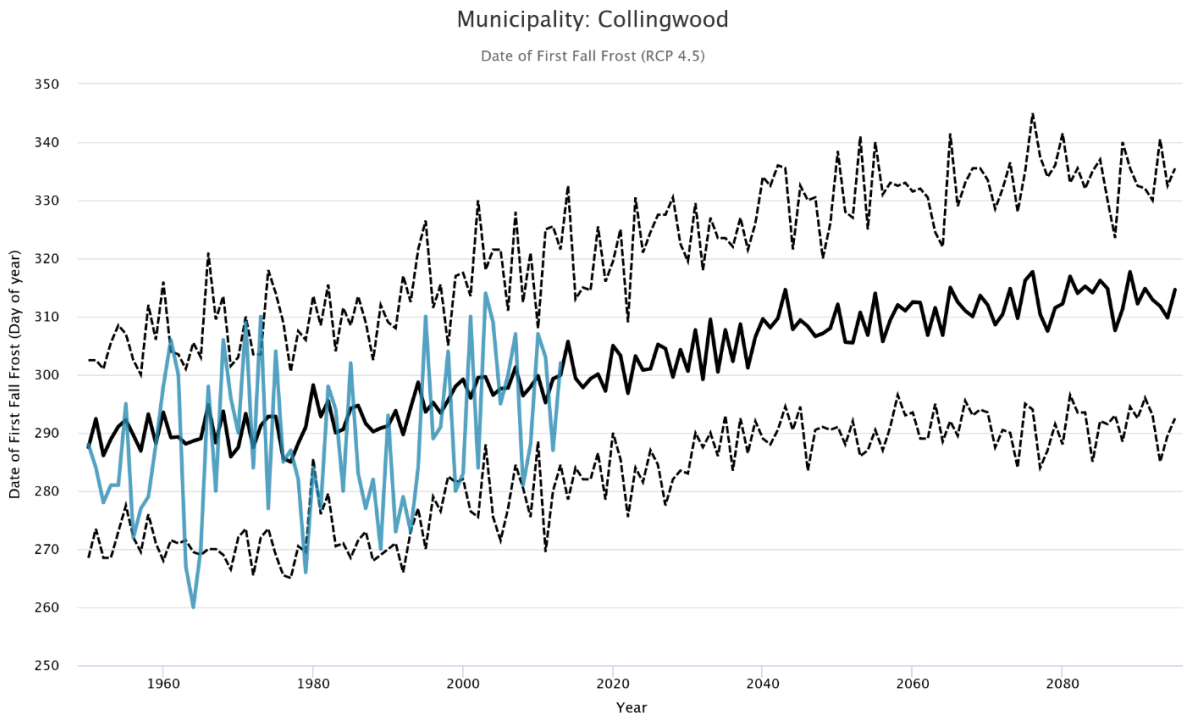


Figure A-51 Date of First Fall Frost (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

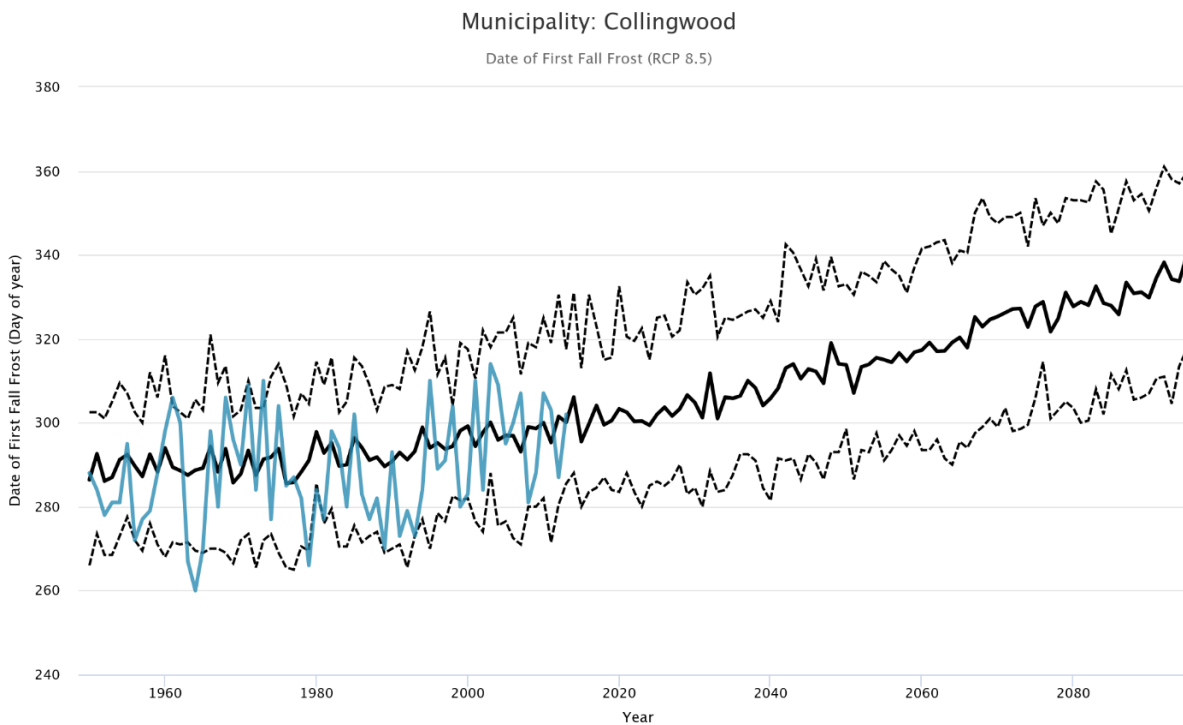


Figure A-52 Date of First Fall Frost (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

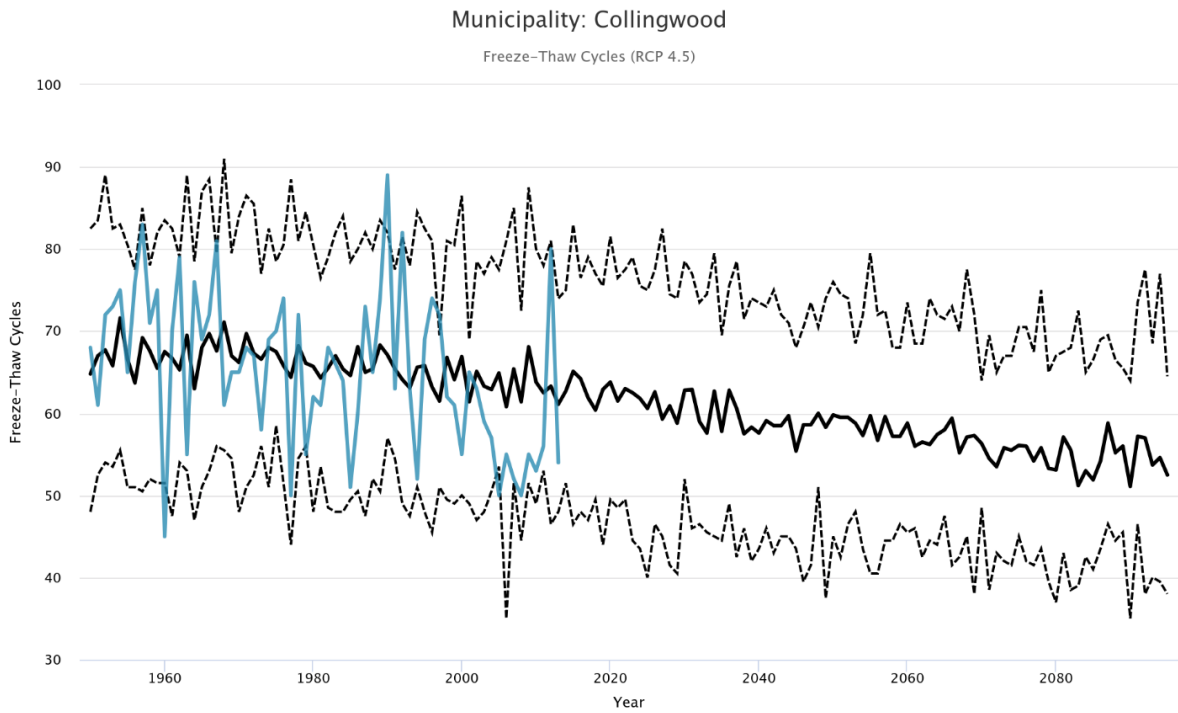


Figure A-53 Number of Freeze-Thaw Cycles (RCP4.5) – Historical and Projected (Prairie Climate Centre, 2026)

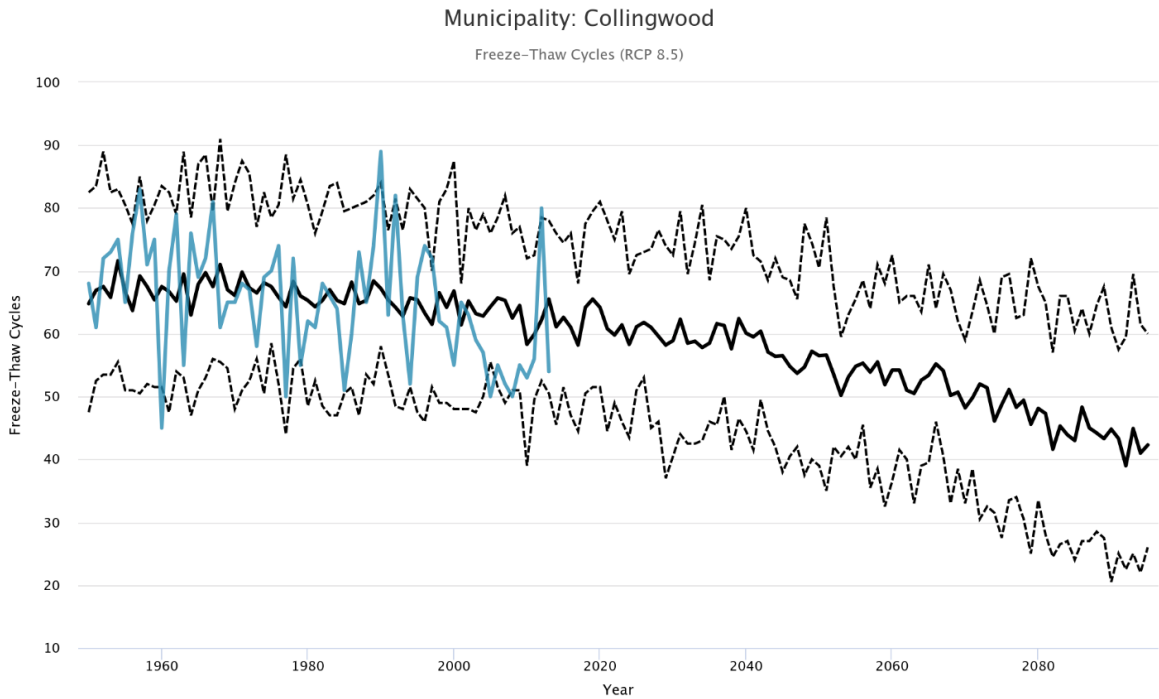


Figure A-54 Number of Freeze-Thaw Cycles (RCP8.5) – Historical and Projected (Prairie Climate Centre, 2026)

Attachment B - Climate Variable Definitions

Climate Variable Definitions (Prairie Climate Centre, 2026)

Average Length of Heat Waves

The average length of a heat wave (in days), where a heat wave is defined as three or more consecutive days with $t_{max} \geq 30\text{ }^{\circ}\text{C}$. Therefore, the minimum average length of heat waves will always be greater than or equal to three.

Coldest Minimum Temperature

The minimum temperature of the year.

Cooling Degree Days

Annual sum of the number of degrees Celsius that each day's mean temperature is above $18\text{ }^{\circ}\text{C}$.

Date of First Fall Frost

The first date in the fall (or late summer) on which the daily minimum temperature is equal to or less than $0\text{ }^{\circ}\text{C}$ ($T_{min} \leq 0\text{ }^{\circ}\text{C}$).

Because this variable is largely used to assess the end of the growing season in southern Canada, the earliest possible date for a fall frost was set as July 15; that is, the date of the first fall frost in any given year is determined by an assessment of minimum temperatures, one day at a time, forwards from July 15.

Date of Last Spring Frost

The spring date after which there are no daily minimum temperatures during the growing season less than or equal to $0\text{ }^{\circ}\text{C}$ ($T_{min} > 0\text{ }^{\circ}\text{C}$). Because this variable is largely used to assess the beginning of the growing season in southern Canada, the latest possible date for a spring frost was set as July 15; that is, the date of the last spring frost in any given year is determined by an assessment of minimum temperatures, one day at a time, backwards from July 15.

Dry Days

A Dry Day is a day with less than 0.2 mm of precipitation. A threshold value of 0.2 mm is used to be consistent with the Meteorological Service of Canada.

Freeze-Thaw Cycles

A freeze-thaw cycle occurs when the daily maximum temperature (T_{max}) is higher than $0\text{ }^{\circ}\text{C}$ and the daily minimum temperature (T_{min}) is less than or equal to $-1\text{ }^{\circ}\text{C}$. The minimum temperature of $-1\text{ }^{\circ}\text{C}$ (rather than $0\text{ }^{\circ}\text{C}$) is used as the threshold for freezing to raise the likelihood that water actually froze at the surface.

Frost Days

A day on which the daily minimum temperature (T_{min}) is below 0 °C.

Frost-Free Season

The number of days between the date of the last spring frost and the date of the first fall frost, equivalent to the number of consecutive days during the 'summer' without any daily minimum temperatures equal to or below 0 °C.

Heating Degree Days

Annual sum of the number of degrees Celsius that each day's mean temperature is below 18 °C.

Heavy Precipitation Days (10 mm)

Heavy Precipitation Days are defined in two ways: either as a day on which at least a total of 10 mm of rain and/or liquid-equivalent frozen precipitation is deposited at the surface, or a day with 20 mm.

Heavy Precipitation Days (20 mm)

Heavy Precipitation Days are defined in two ways: either as a day on which at least a total of 10 mm of rain and/or liquid-equivalent frozen precipitation is deposited at the surface, or a day with 20 mm.

Icing Days

An Icing Day is a day on which the daily maximum temperature (T_{max}) is less than or equal to 0 °C.

Max 1-Day Precipitation

The maximum precipitation that falls in single calendar day.

Maximum Temperature

The daily maximum temperature (T_{max}).

Mean Temperature

The average of the daily maximum temperature (T_{max}) and the daily minimum temperature (T_{min}).

Mild Winter Days (-5 °C)

A Mild Winter Day is a day with a minimum temperature (T_{min}) less than or equal to -5 °C.

Minimum Temperature

The minimum(daily) minimum temperature (T_{min}).

Number of Heat Waves

The number of heat waves per year, where a heat wave is defined as three or more consecutive days with $t_{max} \geq 30$ °C.

Precipitation

The depth of liquid and/or frozen water deposited on the surface, with frozen precipitation converted to its liquid water equivalent.

Tropical Nights

A Tropical Night occurs when the daily minimum temperature ($T_{\min}$) is greater than or equal to 20 °C.

Very Hot Days (+30°C)

A Very Hot Day is a day with a maximum temperature ($T_{\max}$) greater than or equal to 30 °C.

Warmest Maximum Temperature

The maximum maximum (daily) temperature of the year.

Wet Days

A Wet Day is a day with at least 0.2 mm of precipitation. A threshold value of 0.2 mm is used to be consistent with the Meteorological Service of Canada.

Winter Days (-15 °C)

A Winter Day is a day with a minimum temperature ($T_{\min}$) less than or equal to -15 °C.

Appendix B – Climate Impact Statements

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic
1	Increased precipitation intensity may flood roads, resulting in disrupted transportation networks and reduced reliability of goods, services, and emergency response.	X	O		O
2	Increased winter precipitation may increase winter maintenance requirements for transportation network and municipal facilities, resulting in reduced reliability of winter operations and service delivery.	X	O		O
3	More spring precipitation may saturate soils and reduce ground stability, resulting in impaired performance of roads, trails, and structures and delays to construction and maintenance activities.	X	O		O
4	More precipitation may raise lake and receiving water levels, resulting in operational challenges for wastewater treatment facilities and stormwater systems.	X	O	O	O
5	More precipitation may increase lake levels, resulting in increased exposure of shoreline infrastructure, docks, trails, and waterfront facilities to wave action and flooding.	X	O	O	O
6	Earlier spring onset and later fall onset may extend construction season, resulting in increased flexibility for project scheduling and higher annual infrastructure delivery capacity.	X	O	O	O
7	Increasing humidity may accelerate the deterioration of moisture-sensitive goods and materials, resulting in loss or damage to stored agricultural products and cultural artifacts.	O	O		X
8	Increasing humidity may extend concrete curing and drying times, resulting in reduced construction productivity and higher risk of material defects.	X			O
9	Hotter summers, with more days with maximum temperatures greater than 30°C may accelerate deterioration of pavement and building materials, resulting in reduced service life of infrastructure and buildings.	X	O		O
10	Hotter summers, with more days with maximum temperatures greater than 30°C may increase peak demand for potable water, resulting in competition among residential, irrigation, commercial, and recreational users.	X	O		O
11	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase indoor overheating, resulting in reduced housing habitability and comfort for residents without adequate cooling.	O	X		O
12	Hotter summers with more frequent heat waves and tropical nights (>20°C) may reduce the effectiveness of passive cooling, resulting in increased reliance on mechanical cooling and increasing electricity demand.	X	O		O

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic
13	Hotter, more humid summers may reduce productivity and reliability of indoor industrial processes, resulting in operational inefficiencies and higher operating costs.	X	O		O
14	Hotter, more humid summers may accelerate corrosion and reduce reliability of electrical and mechanical components, resulting in increased maintenance demands and service disruptions.	X	O		O
15	Hotter, drier summers may increase the frequency and severity of wildfires, resulting in direct damage to natural environments, buildings, and critical infrastructure.	X	O	X	O
16	Warmer winters may lower lake levels due to reduced ice coverage that may increase evaporation rates, resulting in operational challenges for drinking water treatment systems.	X	O		O
17	Warmer winters may decrease the number of freeze-thaw events, resulting in reduced physical stress and deterioration of built infrastructure.	X	O		O
18	Warmer winters may increase the number of freeze-thaw events, resulting in accelerated deterioration of roads, concrete structures, and other built infrastructure.	X	O		O
19	Warmer winters may reduce peak heating demands, resulting in inefficiencies associated with oversized heating systems.	X	O		O
20	Warmer, wetter winters may increase occurrence of mixed precipitation events such as freezing rain, resulting in hazardous travel conditions and service disruptions.	X	O	O	O
21	Warmer, wetter winters may increase winter meltwater volumes, resulting in overloading of stormwater and sanitary systems.	X	O	O	O
22	Warmer, wetter winters may increase snow and ice loading on roofs, canopies, and infrastructure, resulting in higher risk of structural damage and service disruptions.	X	X		O
23	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage power and communication infrastructure through ice and wind loading, resulting in more frequent outages and extended restoration times.	X	O		O
24	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may disrupt road, sidewalk, and transit operations, resulting in reduced mobility and increased safety risks.	X	O		O
25	Increasing frequency of extreme weather events may reduce recovery time between events, resulting in cumulative stress on infrastructure, services, and communities.	O	X		O
26	Increased precipitation intensity may flood homes, resulting in displacement of residents, damage to residential property, and increased insurance and uninsured financial losses.	O	X		O
27	Increased precipitation intensity may increase demand on emergency services, resulting in reduced response capacity during concurrent or cascading emergency events.	O	X		O



ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic
28	Increased precipitation intensity may increase inflow into sanitary system, resulting in sewer backups that affect homes and businesses.	O	X	O	O
29	More winter precipitation may increase the physical demands of snow and ice removal activities, resulting in elevated risk of injury and acute health events, particularly among older adults and people with underlying health conditions.	O	X		O
30	More precipitation may increase lake levels, resulting in reduced access to beaches, waterfront trails, and culturally and recreationally important shoreline areas.	O	O	X	O
31	Decreasing number of extreme cold days may reduce cold-related health risks, resulting in fewer cold-related injuries and reduced demand for emergency and warming services.	O	X		O
32	Increasing humidity may increase the risk of mould growth in buildings, resulting in degraded indoor air quality and increased respiratory health risks, particularly for vulnerable populations.	O	X		O
33	Hotter summers, with more days with maximum temperatures greater than 30°C may reduce the feasibility and comfort of outdoor community events, resulting in reduced participation and increased risk to participant health and safety.	O	X		O
34	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase periods of poor air quality, resulting in elevated respiratory health risks and reduced outdoor activity.	O	X	O	O
35	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase cumulative heat stress and reduce overnight recovery, resulting in elevated health risks, particularly for vulnerable populations.	O	X		O
36	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase the consequences of power outages during heat events, resulting in rapid indoor overheating and elevated health and safety risks.	O	X		O
37	Hotter summers and more frequent heat waves may increase heat-related illness and injury among outdoor workers and vulnerable populations, resulting in reduced safe work and activity periods, productivity losses, and increased pressure on health, emergency, and community services.	O	X	O	O
39	Hotter, more humid summers may increase competition for shaded and cooled public spaces, resulting in crowding, access constraints, and equity concerns.	O	X	O	O
40	Hotter, drier summers may increase exposure to wildfire smoke and air pollution, resulting in degraded air quality and reduced safe access to outdoor environments.	O	X	O	O
41	Warmer, wetter winters may increase rain-on-snow events, resulting in flooding of homes and properties.	O	X		O

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic
42	Warmer winters may reduce reliability of winter-dependent community events, resulting in increased cancellations and reduced participation in winter programming.		X	O	O
43	Warmer winters may increase exposure to infectious diseases, resulting in increased health risks.		X		O
44	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage buildings and vehicles, resulting in reduction in areas where insurance coverage is available, increasing insurance coverage costs becoming unaffordable, increasing uninsured costs to repair or replace damaged property.		X		O
45	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may increase demand on emergency and municipal services, resulting in reduced response capacity during concurrent or prolonged emergencies.	O	X		O
46	Increasing frequency and severity of climate-related events may contribute to cumulative stress and mental health impacts for residents and responders over time, resulting in increased demand for mental health and social support services and reduced individual and workforce resilience.		X		O
47	Increased precipitation intensity may increase inflow into wastewater treatment systems, resulting in treatment bypass events that degrade water quality in receiving waters.	X	O	O	O
48	More precipitation may increase lake levels, resulting in prolonged inundation of coastal wetlands and nearshore habitats and associated changes to vegetation communities, wildlife use, and ecological function.	O	O	X	O
49	Hotter summers, with more days with maximum temperatures greater than 30°C may deteriorate lake water quality with warmer water and increased algal growth, resulting in degraded lake water quality.	O	O	X	O
50	Hotter, drier summers may increase stress on vegetation, resulting in reduced plant health and loss of ecosystem services.	O	O	X	O
51	Hotter, drier summers may reduce streamflows and baseflows, resulting in stress to aquatic ecosystems and constraints on water availability.	O	O	X	O
52	Warmer winters may increase the number of freeze-thaw events, resulting in increased reliance on road salt and de-icing practices.	O	O	X	O
53	Warmer, wetter winters may increase occurrence of mixed precipitation events such as freezing rain, resulting in increased ice accretion, runoff, and physical stress on vegetation, soils, and aquatic systems.	O	O	X	O

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic
54	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage trees and vegetation, resulting in cascading disruptions to parks, power supply, transportation routes, and other public services.	O	O	X	O
55	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may accelerate erosion of shoreline and watercourses, resulting in loss of land stability and reduced availability of natural and developed shoreline areas.	O	O	X	O
56	Changes in precipitation patterns may increase runoff, resulting in reduced groundwater recharge and degraded groundwater quality.	O	O	X	O
57	Increased precipitation intensity may increase runoff, resulting in surface contaminants transported to water bodies (streams, rivers, lakes) deteriorating aquatic habitats and drinking water sources, impacting recreational water use and culturally and spiritually significant activities.		O	X	O
58	More fall precipitation may alter the timing and magnitude of streamflows, resulting in disrupted aquatic habitat conditions during critical fish spawning and early life stages.		O	X	O
59	Decreasing number of extreme cold days may increase the survival of invasive species, resulting in increased pressure on native flora and fauna.		O	X	O
60	Earlier spring onset and later fall onset may extend the growing season, resulting in prolonged biological activity and vegetation growth.		O	X	O
61	Earlier spring onset and later fall onset may increase pest and invasive species pressures, resulting in greater stress on native ecosystems and agricultural systems.		O	X	O
62	Hotter, more humid summers may increase the survival and spreading of invasive species, resulting in increased pressure on native ecosystems and biodiversity.		O	X	O
63	Warmer winters may lower lake levels due to reduced ice coverage and increased evaporation, resulting in impacts to aquatic habitats and shoreline conditions.		O	X	O
64	Warmer winters may alter animal migration and hibernation patterns, resulting in changes to species distribution and seasonal ecosystem dynamics.		O	X	O
65	Decreasing number of extreme cold days may reduce the reliability of winter tourism and cold-dependent economic activities, resulting in reduced seasonal economic activity and employment.	O	O	O	X
66	Earlier spring onset and later fall onset may increase tourism in shoulder seasons, resulting in increased use of public spaces and visitor-serving amenities.	O	O	O	X
67	Hotter summers, with more days with maximum temperatures greater than 30°C may increase warm-weather tourism, resulting in increased use of recreational areas and visitor-serving infrastructure.	O	O	O	X

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic
68	Increased precipitation intensity may damage crops, resulting in reduced agricultural productivity and increased risk to local food systems.		O	O	X

Notes:

X – Primary System; **O** – Secondary System

Climate impact statement ID 38 was removed during post-workshop refinement because it duplicated another impact statement. The original identification numbers have been retained to preserve consistency with the vulnerability assessment results and risk register.

Appendix C – Vulnerability Assessment Results

Table C-1 Vulnerability Assessment Results

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic	Sensitivity	Adaptive Capacity	Vulnerability Rating
4	More precipitation may raise lake and receiving water levels, resulting in operational challenges for wastewater treatment facilities and stormwater systems.	X	O	O	O	High	Medium	High
5	More precipitation may increase lake levels, resulting in increased exposure of shoreline infrastructure, docks, trails, and waterfront facilities to wave action and flooding.	X	O	O	O	High	Medium	High
7	Increasing humidity may accelerate the deterioration of moisture-sensitive goods and materials, resulting in loss or damage to stored agricultural products and cultural artifacts.	O	O		X	Medium	Low	High
15	Hotter, drier summers may increase the frequency and severity of wildfires, resulting in direct damage to natural environments, buildings, and critical infrastructure.	X	O	X	O	High	Low	High
16	Warmer winters may lower lake levels due to reduced ice coverage that may increase evaporation rates, resulting in operational challenges for drinking water treatment systems.	X	O		O	High	Low	High
18	Warmer winters may increase the number of freeze-thaw events, resulting in accelerated deterioration of roads, concrete structures, and other built infrastructure.	X	O		O	Medium	Low	High
20	Warmer, wetter winters may increase occurrence of mixed precipitation events such as freezing rain, resulting in hazardous travel conditions and service disruptions.	X	O	O	O	Medium	Low	High
23	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage power and communication infrastructure through ice and wind loading, resulting in more frequent outages and extended restoration times.	X	O		O	High	Low	High
26	Increased precipitation intensity may flood homes, resulting in displacement of residents, damage to residential property, and increased insurance and uninsured financial losses.	O	X		O	High	Medium	High
27	Increased precipitation intensity may increase demand on emergency services, resulting in reduced response capacity during concurrent or cascading emergency events.	O	X		O	High	Medium	High
28	Increased precipitation intensity may increase inflow into sanitary system, resulting in sewer backups that affect homes and businesses.	O	X	O	O	High	Low	High
30	More precipitation may increase lake levels, resulting in reduced access to beaches, waterfront trails, and culturally and recreationally important shoreline areas.	O	O	X	O	Medium	Low	High
33	Hotter summers, with more days with maximum temperatures greater than 30°C may reduce the feasibility and comfort of outdoor community events, resulting in reduced participation and increased risk to participant health and safety.	O	X		O	High	Medium	High
41	Warmer, wetter winters may increase rain-on-snow events, resulting in flooding of homes and properties.	O	X		O	Medium	Low	High
42	Warmer winters may reduce reliability of winter-dependent community events, resulting in increased cancellations and reduced participation in winter programming.		X	O	O	High	Low	High
43	Warmer winters may increase exposure to infectious diseases, resulting in increased health risks.		X		O	Medium	Low	High
44	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage buildings and vehicles, resulting in reduction in areas where insurance coverage is available, increasing insurance coverage costs becoming unaffordable, increasing uninsured costs to repair or replace damaged property.		X		O	High	Medium	High
45	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may increase demand on emergency and municipal services, resulting in reduced response capacity during concurrent or prolonged emergencies.	O	X		O	High	Medium	High
46	Increasing frequency and severity of climate-related events may contribute to cumulative stress and mental health impacts for residents and responders over time, resulting in increased demand for mental health and social support services and reduced individual and workforce resilience.		X		O	Medium	Low	High
47	Increased precipitation intensity may increase inflow into wastewater treatment systems, resulting in treatment bypass events that degrade water quality in receiving waters.	X	O	O	O	Medium	Low	High

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic	Sensitivity	Adaptive Capacity	Vulnerability Rating
50	Hotter, drier summers may increase stress on vegetation, resulting in reduced plant health and loss of ecosystem services.	O	O	X	O	High	Low	High
54	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage trees and vegetation, resulting in cascading disruptions to parks, power supply, transportation routes, and other public services.	O	O	X	O	High	Low	High
55	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may accelerate erosion of shoreline and watercourses, resulting in loss of land stability and reduced availability of natural and developed shoreline areas.	O	O	X	O	Medium	Low	High
62	Hotter, more humid summers may increase the survival and spreading of invasive species, resulting in increased pressure on native ecosystems and biodiversity.		O	X	O	High	Medium	High
65	Decreasing number of extreme cold days may reduce the reliability of winter tourism and cold-dependent economic activities, resulting in reduced seasonal economic activity and employment.	O	O	O	X	High	Low	High
1	Increased precipitation intensity may flood roads, resulting in disrupted transportation networks and reduced reliability of goods, services, and emergency response.	X	O		O	Medium	Medium	Medium
2	Increased winter precipitation may increase winter maintenance requirements for transportation network and municipal facilities, resulting in reduced reliability of winter operations and service delivery.	X	O		O	Medium	Medium	Medium
9	Hotter summers, with more days with maximum temperatures greater than 30°C may accelerate deterioration of pavement and building materials, resulting in reduced service life of infrastructure and buildings.	X	O		O	Medium	Medium	Medium
11	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase indoor overheating, resulting in reduced housing habitability and comfort for residents without adequate cooling.	O	X		O	Medium	Medium	Medium
12	Hotter summers with more frequent heat waves and tropical nights (>20°C) may reduce the effectiveness of passive cooling, resulting in increased reliance on mechanical cooling and increasing electricity demand.	X	O		O	Medium	Medium	Medium
14	Hotter, more humid summers may accelerate corrosion and reduce reliability of electrical and mechanical components, resulting in increased maintenance demands and service disruptions.	X	O		O	Medium	Medium	Medium
21	Warmer, wetter winters may increase winter meltwater volumes, resulting in overloading of stormwater and sanitary systems.	X	O	O	O	Medium	Medium	Medium
22	Warmer, wetter winters may increase snow and ice loading on roofs, canopies, and infrastructure, resulting in higher risk of structural damage and service disruptions.	X	X		O	Medium	Medium	Medium
25	Increasing frequency of extreme weather events may reduce recovery time between events, resulting in cumulative stress on infrastructure, services, and communities.	O	X		O	Medium	Medium	Medium
34	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase periods of poor air quality, resulting in elevated respiratory health risks and reduced outdoor activity.	O	X	O	O	Medium	Medium	Medium
36	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase the consequences of power outages during heat events, resulting in rapid indoor overheating and elevated health and safety risks.	O	X		O	Medium	Medium	Medium
37	Hotter summers and more frequent heat waves may increase heat-related illness and injury among outdoor workers and vulnerable populations, resulting in reduced safe work and activity periods, productivity losses, and increased pressure on health, emergency, and community services.	O	X	O	O	Medium	Medium	Medium
39	Hotter, more humid summers may increase competition for shaded and cooled public spaces, resulting in crowding, access constraints, and equity concerns.	O	X	O	O	Medium	Medium	Medium
40	Hotter, drier summers may increase exposure to wildfire smoke and air pollution, resulting in degraded air quality and reduced safe access to outdoor environments.	O	X	O	O	Medium	Medium	Medium
49	Hotter summers, with more days with maximum temperatures greater than 30°C may deteriorate lake water quality with warmer water and increased algal growth, resulting in degraded lake water quality.	O	O	X	O	Medium	Medium	Medium

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic	Sensitivity	Adaptive Capacity	Vulnerability Rating
52	Warmer winters may increase the number of freeze-thaw events, resulting in increased reliance on road salt and de-icing practices.	O	O	X	O	Medium	Medium	Medium
53	Warmer, wetter winters may increase occurrence of mixed precipitation events such as freezing rain, resulting in increased ice accretion, runoff, and physical stress on vegetation, soils, and aquatic systems.	O	O	X	O	Medium	Medium	Medium
56	Changes in precipitation patterns may increase runoff, resulting in reduced groundwater recharge and degraded groundwater quality.	O	O	X	O	Medium	Medium	Medium
57	Increased precipitation intensity may increase runoff, resulting in surface contaminants transported to water bodies (streams, rivers, lakes) deteriorating aquatic habitats and drinking water sources, impacting recreational water use and culturally and spiritually significant activities.		O	X	O	Medium	Medium	Medium
58	More fall precipitation may alter the timing and magnitude of streamflows, resulting in disrupted aquatic habitat conditions during critical fish spawning and early life stages.		O	X	O	Medium	Medium	Medium
59	Decreasing number of extreme cold days may increase the survival of invasive species, resulting in increased pressure on native flora and fauna.		O	X	O	Medium	Medium	Medium
61	Earlier spring onset and later fall onset may increase pest and invasive species pressures, resulting in greater stress on native ecosystems and agricultural systems.		O	X	O	Medium	Medium	Medium
66	Earlier spring onset and later fall onset may increase tourism in shoulder seasons, resulting in increased use of public spaces and visitor-serving amenities.	O	O	O	X	Medium	Medium	Medium
67	Hotter summers, with more days with maximum temperatures greater than 30°C may increase warm-weather tourism, resulting in increased use of recreational areas and visitor-serving infrastructure.	O	O	O	X	Medium	Medium	Medium
68	Increased precipitation intensity may damage crops, resulting in reduced agricultural productivity and increased risk to local food systems.		O	O	X	Medium	Medium	Medium
3	More spring precipitation may saturate soils and reduce ground stability, resulting in impaired performance of roads, trails, and structures and delays to construction and maintenance activities.	X	O		O	Low	Medium	Low
6	Earlier spring onset and later fall onset may extend construction season, resulting in increased flexibility for project scheduling and higher annual infrastructure delivery capacity.	X	O	O	O	Low	High	Low
8	Increasing humidity may extend concrete curing and drying times, resulting in reduced construction productivity and higher risk of material defects.	X			O	Low	High	Low
10	Hotter summers, with more days with maximum temperatures greater than 30°C may increase peak demand for potable water, resulting in competition among residential, irrigation, commercial, and recreational users.	X	O		O	Medium	High	Low
13	Hotter, more humid summers may reduce productivity and reliability of indoor industrial processes, resulting in operational inefficiencies and higher operating costs.	X	O		O	Low	High	Low
17	Warmer winters may decrease the number of freeze-thaw events, resulting in reduced physical stress and deterioration of built infrastructure.	X	O		O	Low	High	Low
19	Warmer winters may reduce peak heating demands, resulting in inefficiencies associated with oversized heating systems.	X	O		O	Low	High	Low
24	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may disrupt road, sidewalk, and transit operations, resulting in reduced mobility and increased safety risks.	X	O		O	Low	High	Low
29	More winter precipitation may increase the physical demands of snow and ice removal activities, resulting in elevated risk of injury and acute health events, particularly among older adults and people with underlying health conditions.	O	X		O	Medium	High	Low
31	Decreasing number of extreme cold days may reduce cold-related health risks, resulting in fewer cold-related injuries and reduced demand for emergency and warming services.	O	X		O	Low	High	Low
32	Increasing humidity may increase the risk of mould growth in buildings, resulting in degraded indoor air quality and increased respiratory health risks, particularly for vulnerable populations.	O	X		O	Low	Medium	Low
35	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase cumulative heat stress and reduce overnight recovery, resulting in elevated health risks, particularly for vulnerable populations.	O	X		O	Medium	High	Low

ID	Climate Impact Statement	Built	Sociocultural	Natural	Economic	Sensitivity	Adaptive Capacity	Vulnerability Rating
48	More precipitation may increase lake levels, resulting in prolonged inundation of coastal wetlands and nearshore habitats and associated changes to vegetation communities, wildlife use, and ecological function.	O	O	X	O	Medium	High	Low
51	Hotter, drier summers may reduce streamflows and baseflows, resulting in stress to aquatic ecosystems and constraints on water availability.	O	O	X	O	Low	Medium	Low
60	Earlier spring onset and later fall onset may extend the growing season, resulting in prolonged biological activity and vegetation growth.		O	X	O	Low	Medium	Low
63	Warmer winters may lower lake levels due to reduced ice coverage and increased evaporation, resulting in impacts to aquatic habitats and shoreline conditions.		O	X	O	Medium	High	Low
64	Warmer winters may alter animal migration and hibernation patterns, resulting in changes to species distribution and seasonal ecosystem dynamics.		O	X	O	Medium	High	Low

Notes:

X – Primary System; O – Secondary System

Appendix D – Risk Rating Charts

Table D-1 Likelihood Rating Chart (ICLEI Canada, 2025)

Likelihood	Rating	Recurrent Impact	Slow Onset
Almost Certain	5	At least once per year (Annual chance: 100%)	Almost certain – 95% or greater chance of occurrence in next 50 years
Likely	4	Once in 1 to 5 years (Annual chance: 20% to 100%)	Likely – 65% to 90% chance of occurrence in the next 50 years
Possible	3	Once in 5 to 10 years (Annual chance: 10% to 20%)	Possible – 35% to 65% chance of occurrence in next 50 years
Unlikely	2	Once in 10 to 50 years (Annual chance 2% to 10%)	Unlikely – 5% to 35% chance of occurrence in next 50 years
Very Unlikely	1	Once in 50 years or more (Annual chance: <2%)	Very unlikely – less than 5% chance of occurrence in the next 50 years

Table D-2 Consequence Scoring for Sociocultural Factors (ICLEI Canada, 2025)

Score	Public Health & Safety Concerns	Displacement	Disruptions to Daily Life	Loss of Identity, Traditions, and Cultural Practices
Catastrophic (5)	Large number of fatalities, serious injuries or illnesses, and persistent and serious mental health impacts	Large number of permanently displaced people	Large disturbances leading to permanent changes in people's normal routines and way of life at the community scale	Unprecedented loss of cultural identity (i.e., traditions, ceremonies, and community events) across the wider community (i.e., cancellation of flagship annual event)
Major (4)	Isolated cases of fatalities, or serious injuries, severe illnesses, and acute mental health crises	Isolated instances of permanently displaced people	Large disturbances leading to prolonged changes in people's normal routines and way of life	Significant loss of cultural identity (i.e., traditions, ceremonies, and community events) for multiple social groups
Moderate (3)	A small number of minor physical injuries, illnesses, or mental health concerns	Isolated instances of temporary displaced people on a widespread scale (e.g., evacuations due to wildfire smoke or flooding)	Moderate disturbances leading to short-term changes in people's normal routine and way of life in isolated areas	Moderate impact on cultural identity (i.e., traditions, ceremonies, and community events) for multiple social groups
Minor (2)	Near misses, minor injuries, and short-term mental health impacts	Isolated instances of localized and short-term displacement (e.g., staying with friends/family, going to cooling/warming centres)	Minor and short-term changes to people's normal routines and way of life	Minor impact on cultural identity (i.e., traditions, ceremonies, and community events) for a small number of social groups
Negligible (1)	Appearance of a threat but no actual harm	Appearance of a threat but no actual displacement	No changes to people's normal routines and daily life	Appearance of a threat but no actual impact on cultural identity (i.e., traditions, ceremonies, and community events)

Table D-3 Consequence Scoring for Economic Factors (ICLEI Canada, 2025)

Score	Property Damage	Local Economy and Growth	Livability and Cost of Living	Loss of Public Services
Catastrophic (5)	Catastrophic damage and costs incurred by the owner (\$\$\$\$\$)	Community-scale decline leading to widespread business failure, disrupted supply chains, and loss of employment (e.g., significant loss of tourism, local business closure, etc.)	Widespread, permanent and severe increase in cost of living and decline in community livability, causing significant hardship and extreme decline in quality of life	Community-scale and permanent decline in services and public administration (e.g., recreation areas destroyed, public health services reduced long-term, transit systems permanently disrupted)
Major (4)	Major damage and costs incurred by the owner (\$\$\$\$)	Community-scale stagnation such that businesses are unable to thrive (e.g., temporary decrease in tourism, temporary business closure, etc.)	Widespread and significant decline in quality of life within the community and increase in cost of living	Community-scale and temporary but severe decline in services and public administrative support
Moderate (3)	Moderate damage and costs incurred by the owner (\$\$\$)	Reduction in economic performance of businesses relative to current forecasts	Isolated but moderate increase in cost of living and decline in quality of life	Isolated but prolonged temporary decline in services and public administrative support
Minor (2)	Minor damage and costs incurred by the owner (\$\$)	Inconveniences that cause minor shortfall to businesses relative to current forecasts in isolated areas	Isolated and minor increase in cost of living and decline in quality of life	Isolated and minor decline in services and public administrative support for the community
Negligible (1)	No damage and costs incurred by the owner (\$)	No real impact to the local economy and growth	No real pressure on cost of living and quality of life	No measurable impact on current public services and administration

Table D-4 Consequence Scoring for Natural Factors (ICLEI Canada, 2025)

Score	Air	Water	Land	Biodiversity and Ecosystem Function
Catastrophic (5)	Very frequent periods of reduced air quality	Irreversible reduction in water quality or quantity	Irreversible damage to land, including permanent loss of soil health, vegetation cover, and cultural relationships with place	Major, irreversible loss of biodiversity and ecosystem functions at the community scale
Major (4)	Considerable increase in periods of reduced air quality in the medium term	Major, widespread reduction in water quality or quantity in the medium to long term	Major and widespread impacts to soil and vegetation, with long-term consequences for land use, stewardship, and cultural connection	Severe and widespread community-scale impacts that are potentially reversible with intensive restoration
Moderate (3)	Moderate increase in periods of reduced air quality in the short to medium term	Moderate reduction in water quality or quantity in the short to medium term	Moderate impacts to soil or vegetation, recoverable with targeted efforts over the short to medium term	Localized but moderate impacts that require significant efforts to restore in isolated areas
Minor (2)	Minor increase in periods of reduced air quality in the short term	Minor, localized reduction in water quality or quantity in the short term	Minor and localized impacts to soil or vegetation, limited in both duration and scope	Minor, isolated impacts that are reversible with targeted actions
Negligible (1)	Appearance of a threat but no real impact to air quality	Appearance of a threat but no real reduction in water quality or quantity	Potential threat observed, but no current impact to land health, vegetation, or cultural function	Emerging threat identified, but no measurable impact yet on biodiversity or ecosystem functions

Table D-5 Risk Spectrum for Consequence Categories (Sociocultural, Economic, Natural) (ICLEI Canada, 2025)

Score Range	Risk Level
5-16	Very Low
17-28	Low
29-40	Medium Low
41-52	Medium
53-64	Medium High
65-76	High
77-88	Very High
89-100	Extreme

Table D-6 Risk Spectrum for Overall Risk Scores (ICLEI Canada, 2025)

Score Range	Risk Level
5–50	Very Low
51-86	Low
87-122	Medium Low
123-158	Medium
159-194	Medium High
195-230	High
231-266	Very High
267-300	Extreme

Appendix E – Risk Register

Table E-1 High Priority Risks: Near Term (2021-2050)

ID	Climate Impact Statement	Recurrent/ Slow Onset	Near Term (2021-2050)	C _S	C _E	C _N	R _{S-NT}	R _{E-NT}	R _{N-NT}	R _{T-NT}	Vulnerability Rating	Vulnerable Populations
45	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may increase demand on emergency and municipal services, resulting in reduced response capacity during concurrent or prolonged emergencies.	Recurrent	4	18	16	13	72	64	52	188	High	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Unhoused populations; Mobility challenged
57	Increased precipitation intensity may increase runoff, resulting in surface contaminants transported to water bodies (streams, rivers, lakes) deteriorating aquatic habitats and drinking water sources, impacting recreational water use and culturally and spiritually significant activities.	Recurrent	4	15	16	14	60	64	56	180	Medium	Low-income households; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Indigenous; Unhoused populations.
12	Hotter summers with more frequent heat waves and tropical nights (>20°C) may reduce the effectiveness of passive cooling, resulting in increased reliance on mechanical cooling and increasing electricity demand.	Recurrent	4	14	13	16	56	52	64	172	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Unhoused population; Mobility challenged
26	Increased precipitation intensity may flood homes, resulting in displacement of residents, damage to residential property, and increased insurance and uninsured financial losses.	Recurrent	4	19	13	11	76	52	44	172	High	Low-income households; Outdoor workers; Elderly; Renters; Indigenous; Unhoused populations; Mobility challenged
36	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase the consequences of power outages during heat events, resulting in rapid indoor overheating and elevated health and safety risks.	Recurrent	4	13	12	14	52	48	56	156	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Indigenous; Unhoused population; Mobility challenged
21	Warmer, wetter winters may increase winter meltwater volumes, resulting in overloading of stormwater and sanitary systems.	Recurrent	4	14	14	10	56	56	40	152	Medium	
47	Increased precipitation intensity may increase inflow into wastewater treatment systems, resulting in treatment bypass events that degrade water quality in receiving waters.	Recurrent	4	14	12	12	56	48	48	152	High	Indigenous
49	Hotter summers, with more days with maximum temperatures greater than 30°C may deteriorate lake water quality with warmer water and increased algal growth, resulting in degraded lake water quality.	Recurrent	4	11	13	14	44	52	56	152	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Unhoused population; Indigenous
39	Hotter, more humid summers may increase competition for shaded and cooled public spaces, resulting in crowding, access constraints, and equity concerns.	Slow Onset	4	14	9	13	56	36	52	144	Medium	Most vulnerable populations: Low-income households; Outdoor workers; Immunocompromised; Elderly; Hospital/care facilities; Unhoused population; Mobility challenged
22	Warmer, wetter winters may increase snow and ice loading on roofs, canopies, and infrastructure, resulting in higher risk of structural damage and service disruptions.	Recurrent	4	11	14	6	44	56	24	124	Medium	Low-income households; Outdoor workers

Notes:

S – Sociocultural; E- Economic; N – Natural; C – Consequence; R – Risk; NT – Near-Term; **Red Shading** – High / Very High / Extreme Risk Rating; **Gold Shading** – Medium Risk Rating; **Green Shading** -Very Low / Low / Medium Low Risk Rating

Table E-2 High Priority Risks: Long Term (2051-2080)

ID	Climate Impact Statement	Recurrent/ Slow Onset	Long Term (2051-2080)	C _S	C _E	C _N	R _{S-LT}	R _{E-LT}	R _{N-LT}	R _{T-LT}	Vulnerability Rating	Vulnerable Populations
45	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may increase demand on emergency and municipal services, resulting in reduced response capacity during concurrent or prolonged emergencies.	Recurrent	5	18	16	13	90	80	65	235	High	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Unhoused populations; Mobility challenged
47	Increased precipitation intensity may increase inflow into wastewater treatment systems, resulting in treatment bypass events that degrade water quality in receiving waters.	Recurrent	5	14	12	21	70	60	105	235	High	Indigenous
12	Hotter summers with more frequent heat waves and tropical nights (>20°C) may reduce the effectiveness of passive cooling, resulting in increased reliance on mechanical cooling and increasing electricity demand.	Recurrent	5	14	13	16	70	65	80	215	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Unhoused population; Mobility challenged
36	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase the consequences of power outages during heat events, resulting in rapid indoor overheating and elevated health and safety risks.	Recurrent	5	13	12	14	65	60	70	195	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Indigenous; Unhoused population; Mobility challenged
21	Warmer, wetter winters may increase winter meltwater volumes, resulting in overloading of stormwater and sanitary systems.	Recurrent	5	14	14	10	70	70	50	190	Medium	
34	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase periods of poor air quality, resulting in elevated respiratory health risks and reduced outdoor activity.	Recurrent	5	13	12	13	65	60	65	190	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Indigenous; Unhoused population; Mobility challenged
49	Hotter summers, with more days with maximum temperatures greater than 30°C may deteriorate lake water quality with warmer water and increased algal growth, resulting in degraded lake water quality.	Recurrent	5	11	13	14	55	65	70	190	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Unhoused population; Indigenous
39	Hotter, more humid summers may increase competition for shaded and cooled public spaces, resulting in crowding, access constraints, and equity concerns.	Slow Onset	5	14	9	13	70	45	65	180	Medium	Most vulnerable populations: Low-income households; Outdoor workers; Immunocompromised; Elderly; Hospital/care facilities; Unhoused population; Mobility challenged
40	Hotter, drier summers may increase exposure to wildfire smoke and air pollution, resulting in degraded air quality and reduced safe access to outdoor environments.	Recurrent	5	13	12	11	65	60	55	180	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Unhoused population; Hospital/care facilities; Indigenous
57	Increased precipitation intensity may increase runoff, resulting in surface contaminants transported to water bodies (streams, rivers, lakes) deteriorating aquatic habitats and drinking water sources, impacting recreational water use and culturally and spiritually significant activities.	Recurrent	4	15	16	14	60	64	56	180	Medium	Low-income households; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Indigenous; Unhoused populations.
44	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage buildings and vehicles, resulting in reduction in areas where insurance coverage is available, increasing insurance coverage costs becoming unaffordable, increasing uninsured costs to repair or replace damaged property.	Recurrent	5	13	13	9	65	65	45	175	High	Low-income households; Outdoor workers; Renters; Unhoused population
54	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage trees and vegetation, resulting in cascading disruptions to parks, power supply, transportation routes, and other public services.	Recurrent	5	13	11	11	65	55	55	175	High	Low-income households; Outdoor workers; Elderly; Indigenous; Mobility challenged; Unhoused population
26	Increased precipitation intensity may flood homes, resulting in displacement of residents, damage to residential property, and increased insurance and uninsured financial losses.	Recurrent	4	19	13	11	76	52	44	172	High	Low-income households; Outdoor workers; Elderly; Renters; Indigenous; Unhoused populations; Mobility challenged
41	Warmer, wetter winters may increase rain-on-snow events, resulting in flooding of homes and properties.	Recurrent	5	12	11	11	60	55	55	170	High	Low-income households; Elderly; Renters; Unhoused population; Mobility challenged

ID	Climate Impact Statement	Recurrent/ Slow Onset	Long Term (2051-2080)	C _S	C _E	C _N	R _{S-LT}	R _{E-LT}	R _{N-LT}	R _{T-LT}	Vulnerability Rating	Vulnerable Populations
43	Warmer winters may increase exposure to infectious diseases, resulting in increased health risks.	Slow Onset	5	13	12	9	65	60	45	170	High	Low-income households; Immunocompromised; Elderly; Children; Hospital/care facilities; Indigenous; Unhoused population; Mobility challenged
50	Hotter, drier summers may increase stress on vegetation, resulting in reduced plant health and loss of ecosystem services.	Slow Onset	5	12	8	13	60	40	65	165	High	Low-income households; Outdoor workers; Elderly; Children; Renters; Indigenous; Unhoused population; Immunocompromised
55	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may accelerate erosion of shoreline and watercourses, resulting in loss of land stability and reduced availability of natural and developed shoreline areas.	Recurrent	5	11	11	11	55	55	55	165	High	Low-income households; Children; Unhoused population; Mobility challenged
25	Increasing frequency of extreme weather events may reduce recovery time between events, resulting in cumulative stress on infrastructure, services, and communities.	Recurrent	5	12	12	8	60	60	40	160	Medium	
61	Earlier spring onset and later fall onset may increase pest and invasive species pressures, resulting in greater stress on native ecosystems and agricultural systems	Slow Onset	5	12	9	11	60	45	55	160	Medium	Low-income households; Outdoor workers; Elderly; Children; Indigenous; Unhoused population; Immunocompromised
62	Hotter, more humid summers may increase the survival and spreading of invasive species, resulting in increased pressure on native ecosystems and biodiversity.	Slow Onset	5	12	9	11	60	45	55	160	High	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Indigenous; Renters
11	Hotter summers with more frequent heat waves and tropical nights (>20°C) may increase indoor overheating, resulting in reduced housing habitability and comfort for residents without adequate cooling.	Recurrent	5	12	8	11	60	40	55	155	Medium	Low-income households; Outdoor workers; Elderly; Children; Renters; Unhoused population; Mobility challenged
22	Warmer, wetter winters may increase snow and ice loading on roofs, canopies, and infrastructure, resulting in higher risk of structural damage and service disruptions.	Recurrent	5	11	14	6	55	70	30	155	Medium	Low-income households; Outdoor workers
30	More precipitation may increase lake levels, resulting in reduced access to beaches, waterfront trails, and culturally and recreationally important shoreline areas.	Recurrent	5	10	11	10	50	55	50	155	High	Outdoor workers; Children; Indigenous; Unhoused population; Mobility challenged
9	Hotter summers, with more days with maximum temperatures greater than 30°C may accelerate deterioration of pavement and building materials, resulting in reduced service life of infrastructure and buildings.	Slow Onset	5	8	11	11	40	55	55	150	Medium	Low-income households; Outdoor workers; Mobility challenged
20	Warmer, wetter winters may increase occurrence of mixed precipitation events such as freezing rain, resulting in hazardous travel conditions and service disruptions.	Recurrent	5	10	12	8	50	60	40	150	High	
33	Hotter summers, with more days with maximum temperatures greater than 30°C may reduce the feasibility and comfort of outdoor community events, resulting in reduced participation and increased risk to participant health and safety.	Recurrent	5	11	8	11	55	40	55	150	High	Low-income households; Outdoor workers; Elderly; Children; Renters; Indigenous; Unhoused populations; Mobility challenged; Immunocompromised; Hospital/care facilities
67	Hotter summers, with more days with maximum temperatures greater than 30°C may increase warm-weather tourism, resulting in increased use of recreational areas and visitor-serving infrastructure.	Slow Onset	5	9	7	12	45	35	60	140	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospital/care facilities; Unhoused population
4	More precipitation may raise lake and receiving water levels, resulting in operational challenges for wastewater treatment facilities and stormwater systems.	Recurrent	5	8	11	7	40	55	35	130	High	Low-income households; Unhoused population; Immunocompromised; Renters; Mobility challenged

Notes:

S – Sociocultural; E- Economic; N – Natural; C – Consequence; R – Risk; LT – Long Term; **Red Shading** – High / Very High / Extreme Risk Rating; **Gold Shading** – Medium Risk Rating; **Green Shading** -Very Low / Low / Medium Low Risk Rating

Table E-3 Medium Priority Risks: Near Term (2021-2050) and Long Term (2051-2080)

ID	Climate Impact Statement	Recurrent/ Slow Onset	Near Term (2021- 2050)	Long Term (2051- 2080)	C _S	C _E	C _N	R _{S-NT}	R _{E-NT}	R _{N-NT}	R _{T-NT}	R _{S-LT}	R _{E-LT}	R _{N-LT}	R _{T-LT}	Vulnerability Rating	Vulnerable Populations
23	Increased frequency of storm events (rain, snow, lightning, hail, freezing rain, windstorms) may damage power and communication infrastructure through ice and wind loading, resulting in more frequent outages and extended restoration times.	Recurrent	4	5	10	10	8	40	40	32	112	50	50	40	140	High	Low-income households; Outdoor workers; Immunocompromised; Elderly, Children; Renters; Hospital/care facilities; Mobility challenged
53	Warmer, wetter winters may increase occurrence of mixed precipitation events such as freezing rain, resulting in increased ice accretion, runoff, and physical stress on vegetation, soils, and aquatic systems.	Recurrent	4	5	9	10	9	36	40	36	112	45	50	45	140	Medium	Outdoor workers; Hospital/care facilities; Mobility challenged
2	Increased winter precipitation may increase winter maintenance requirements for transportation network and municipal facilities, resulting in reduced reliability of winter operations and service delivery.	Slow Onset	3	4	13	12	9	39	36	27	102	52	48	36	136	Medium	
68	Increased precipitation intensity may damage crops, resulting in reduced agricultural productivity and increased risk to local food systems.	Recurrent	4	4	11	13	10	44	52	40	136	44	52	40	136	Medium	Low-income households; Indigenous; Unhoused population
1	Increased precipitation intensity may flood roads, resulting in disrupted transportation networks and reduced reliability of goods, services, and emergency response.	Recurrent	4	4	12	13	8	48	52	32	132	48	52	32	132	Medium	Low-income households; Immunocompromised; Elderly; Outdoor workers; Hospital/care facilities; Unhoused population; Mobility challenged
56	Changes in precipitation patterns may increase runoff, resulting in reduced groundwater recharge and degraded groundwater quality.	Slow Onset	4	4	10	10	12	40	40	48	128	40	40	48	128	Medium	Immunocompromised; Hospital/care facilities; Indigenous; Unhoused population
5	More precipitation may increase lake levels, resulting in increased exposure of shoreline infrastructure, docks, trails, and waterfront facilities to wave action and flooding.	Recurrent	4	5	9	8	8	36	32	32	100	45	40	40	125	High	
42	Warmer winters may reduce reliability of winter-dependent community events, resulting in increased cancellations and reduced participation in winter programming.	Slow Onset	4	5	7	10	8	28	40	32	100	35	50	40	125	High	Outdoor workers
66	Earlier spring onset and later fall onset may increase tourism in shoulder seasons, resulting in increased use of public spaces and visitor-serving amenities.	Slow Onset	4	5	9	6	10	36	24	40	100	45	30	50	125	Medium	Outdoor workers
46	Increasing frequency and severity of climate-related events may contribute to cumulative stress and mental health impacts for residents and responders over time, resulting in increased demand for mental health and social support services and reduced individual and workforce resilience.	Slow Onset	4	5	10	8	6	40	32	24	96	50	40	30	120	High	Immunocompromised; Hospital/care facilities
37	Hotter summers and more frequent heat waves may increase heat-related illness and injury among outdoor workers and vulnerable populations, resulting in reduced safe work and activity periods, productivity losses, and increased pressure on health, emergency, and community services.	Recurrent	4	5	9	7	7	36	28	28	92	45	35	35	115	Medium	Low-income households; Outdoor workers; Immunocompromised; Elderly; Hospital/care facilities; Unhoused population
59	Decreasing number of extreme cold days may increase the survival of invasive species, resulting in increased pressure on native flora and fauna.	Slow Onset	3	4	9	8	11	27	24	33	84	36	32	44	112	Medium	Outdoor workers; Children; Indigenous

ID	Climate Impact Statement	Recurrent/ Slow Onset	Near Term (2021- 2050)	Long Term (2051- 2080)	C _S	C _E	C _N	R _{S-NT}	R _{E-NT}	R _{N-NT}	R _{T-NT}	R _{S-LT}	R _{E-LT}	R _{N-LT}	R _{T-LT}	Vulnerability Rating	Vulnerable Populations
65	Decreasing number of extreme cold days may reduce the reliability of winter tourism and cold-dependent economic activities, resulting in reduced seasonal economic activity and employment.	Slow Onset	3	4	7	11	7	21	33	21	75	28	44	28	100	High	Outdoor workers; Indigenous
18	Warmer winters may increase the number of freeze-thaw events, resulting in accelerated deterioration of roads, concrete structures, and other built infrastructure.	Slow Onset	3	2	14	14	13	42	42	39	123	28	28	26	82	High	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Renters; Hospitals/care facilities; Unhoused population; Mobility challenged.

Notes:
S – Sociocultural; E- Economic; N – Natural; C – Consequence; R – Risk; NT – Near Term; LT – Long Term
Red Shading – High / Very High / Extreme Risk Rating; **Gold Shading** – Medium Risk Rating; **Green Shading** -Very Low / Low / Medium Low Risk Rating

Table E-4 Low Priority Risks: Near Term (2021-2050) and Long Term (2051-2080)

ID	Climate Impact Statement	Recurrent/ Slow Onset	Near Term (2021-2050)	Long Term (2051-2080)	C _S	C _E	C _N	R _{S-NT}	R _{E-NT}	R _{N-NT}	R _{T-NT}	R _{S-LT}	R _{E-LT}	R _{N-LT}	R _{T-LT}	Vulnerability Rating	Vulnerable Populations
7	Increasing humidity may accelerate the deterioration of moisture-sensitive goods and materials, resulting in loss or damage to stored agricultural products and cultural artifacts.	Slow Onset	3	3	6	11	9	18	33	27	78	18	33	27	78	High	Low-income households; Indigenous; Unhoused population; Outdoor workers; Immunocompromised
14	Hotter, more humid summers may accelerate corrosion and reduce reliability of electrical and mechanical components, resulting in increased maintenance demands and service disruptions.	Slow Onset	4	4	6	8	4	24	32	16	72	24	32	16	72	Medium	Low-income households; Hospital/care facilities
15	Hotter, drier summers may increase the frequency and severity of wildfires, resulting in direct damage to natural environments, buildings, and critical infrastructure.	Recurrent	1	1	17	21	23	17	21	23	61	17	21	23	61	High	Low-income households; Outdoor workers; Immunocompromised; Elderly; Children; Hospital/care facilities; Unhoused population; Mobility challenged
16	Warmer winters may lower lake levels due to reduced ice coverage that may increase evaporation rates, resulting in operational challenges for drinking water treatment systems.	Recurrent	3	2	7	11	9	21	33	27	81	14	22	18	54	High	Low-income households; Children; Elderly; Unhoused population; Renters
27	Increased precipitation intensity may increase demand on emergency services, resulting in reduced response capacity during concurrent or cascading emergency events.	Recurrent	3	4	9	10	4	27	30	12	69	36	40	16	92	High	Immunocompromised; Elderly; Children; Hospital/care facilities; Unhoused population; Mobility challenged
28	Increased precipitation intensity may increase inflow into sanitary system, resulting in sewer backups that affect homes and businesses.	Recurrent	4	4	8	10	8	32	40	32	104	32	40	32	104	High	Low-income households; Elderly; Children; Renters
52	Warmer winters may increase the number of freeze-thaw events, resulting in increased reliance on road salt and de-icing practices.	Slow Onset	3	2	7	10	12	21	30	36	87	14	20	24	58	Medium	Outdoor workers; Indigenous
58	More fall precipitation may alter the timing and magnitude of streamflows, resulting in disrupted aquatic habitat conditions during critical fish spawning and early life stages.	Slow Onset	2	2	7	9	10	14	18	20	52	14	18	20	52	Medium	Indigenous

Notes:

S – Sociocultural; E- Economic; N – Natural; C – Consequence; R – Risk; NT – Near Term; LT – Long Term

Red Shading – High / Very High / Extreme Risk Rating; Gold Shading – Medium Risk Rating; Green Shading -Very Low / Low / Medium Low Risk Rating

Appendix F – Workshop Minutes

Project: Collingwood Community Climate Adaptation Plan

Meeting: Workshop #1

Date:

December 16, 2025

Location:

In person

Collingwood Public Library

Attendees:

Adam Gallant; Amber Leal, Beckett Frisch; Dan Thurman; Dave McNalty; Donald Cameron; Hanna Podbrazan; Karen Cubitt; Leah Murray; Leah O'Donnell, Mike Nancekivell; Nicole Yardy; Peggy Slama; Stephanie Ottewell; Summer Valentine, Tammy Hogg

Heather McGinnity; Jessica Angers; Daryush Esmaili

Meeting Minutes

1 MEETING GOALS AND OBJECTIVES

- Understand the role of the Resilient Collingwood Task Force in climate change adaptation planning and implementation
- Refresh knowledge and understanding of climate change action: mitigation vs. adaptation
- Build a baseline understanding of past climate experiences and current adaptation efforts
- Introduction to Systems Thinking: Built, Sociocultural, Economic, Natural
- Learn about Collingwood's climate profile
- Identify local climate impacts

2 WELCOME AND INTRODUCTIONS

The meeting opened with the Town of Collingwood's land acknowledgement, recognizing the First Nations who have walked upon and cared for these lands for more than 15,000 years, including the Anishinaabek, Haudenosaunee, and Ojibwe peoples, and the Lake Simcoe-Nottawasaga Treaty of 1818.

Participants introduced themselves by sharing their name, role, and one weather event that has stuck with them.

3 CLIMATE CHANGE & ADAPTATION PRIMER

Heather provided an overview of climate adaptation, including:

- Introduction to the workshop structure

- Overview of the climate profile for Collingwood
- Presentation of climate scenarios (RCP 4.5 and RCP 8.5)

Key concepts covered:

- Climate change science and global/Canadian perspectives
- Climate models and projections
- Greenhouse gas emissions and scenarios
- Mitigation vs. Adaptation
- Climate impacts on water, food, infrastructure, health, and ecosystems

Key Takeaway: Canada is warming at roughly twice the global average, and this has significant implications for local communities like Collingwood.

4 COLLINGWOOD CLIMATE ADAPTATION PROJECT

Why Develop a Climate Adaptation Plan?

The project was initiated due to several key drivers:

- Past and anticipated climate events
- Emerging vulnerabilities in infrastructure and services
- Funding opportunities (FCM Green Municipal Fund grant eligibility)
- Political and community pressure (declaration of climate emergency, Collingwood Climate Action Team)
- Financial and infrastructure resilience needs
- Organizational readiness

Project Scope:

- Community-wide Risk & Vulnerability Assessment
- Adaptation Plan development
- Engagement and outreach
- Integration into corporate values and processes

BARC Framework: The project follows ICLEI Canada's Building Adaptive and Resilient Communities (BARC) framework:

- **Milestone 1/Initiate:** Lay groundwork and collect data
- **Milestone 2/Research:** Identify and prioritize local climate impacts through vulnerability and risk assessments
- **Milestone 3/Plan:** Develop adaptation plan reflecting local risks, values, and priorities

5 RESILIENT COLLINGWOOD TASK FORCE

Purpose:

- Guide Collingwood through ICLEI's BARC milestones
- Provide strategic oversight to integrate climate risk and resilience across municipal services
- Build internal capacity to sustain adaptation planning beyond the project

Primary Functions:

- **Collaborate:** Share knowledge and coordinate actions across stakeholders
- **Advise:** Review findings and help identify adaptation priorities and feasible actions
- **Champion:** Promote integration of climate resilience into decision-making, budgets, and operations

Team Structure:

- Team Leader: Nicole Yardy
- Core Team: Staff from Engineering, Planning, Public Works, Finance, and Communications
- Additional internal and external partners will be involved as project advances

6 PARTICIPANT OBSERVATIONS AND NOTES

Nicole (Team Leader) noted:

- Heightened awareness due to different types of warming
- Town policies: Official plan has climate adaptation working in heat
- Association: Seems like more policy hand infrastructure
- Next steps: Moving from temporary to capacity
- Public water access
- RCI (Resilient Communities Initiative): Reducing the need for upgrades

7 INTRODUCTION TO SYSTEMS THINKING

The BARC framework uses systems thinking to understand how climate impacts affect the community across four interconnected systems:

Four Systems:

1. **Built Systems:** Infrastructure including roads, buildings, water/wastewater systems, energy
2. **Sociocultural Systems:** People, health services, education, cultural practices and places
3. **Economic Systems:** Businesses, workers, tourism, supply chains
4. **Natural Systems:** Forests, wetlands, waterways, shorelines, ecosystems

Key Principle: Climate impacts ripple across systems; siloed actions can create new risks, while integrated solutions build resilience.

8 CLIMATE PROFILE: TOWN OF COLLINGWOOD

Data Sources:

- Publicly available climate models (ClimateAtlas.ca)
- Regional climate studies
- Two emissions scenarios: RCP 4.5 (Low Carbon) and RCP 8.5 (High Carbon/Business as usual)
- Three time horizons: Baseline (1976-2005), Near term (2021-2050), Long term (2051-2080)

Historical Climate (Baseline 1976-2005):

- Average annual temperature: 7.2°C
- Cold winters and mild summers
- Moderate annual precipitation (~900 mm)
- Frequent freeze-thaw cycles
- Limited heat extremes (~1 heat wave/year, ~10 days above 30°C)

Climate Projections:

- Average temperature increasing by 1.9°C by 2050, and by 3.0°C by 2080
- Fewer cold days and freeze-thaw cycles; longer growing season
- Total annual precipitation increasing by 8-10% by 2080
- Winter precipitation increasing significantly (12-19% by 2080)
- More intense single-day precipitation events (15-18% increase by 2080)
- Increasing frequency and duration of heat waves
- More days with maximum temperature >30°C and tropical nights >20°C
- More intense storm events

Discussion: Participants were asked if this climate profile aligns with what they are already seeing in Collingwood.

9 GROUP ACTIVITY: IDENTIFYING & DEFINING LOCAL CLIMATE IMPACTS

Framework: Climate Impact Statements

- **If...** Climate Event/Hazard (e.g., significant precipitation)
- **Then...** Outcome (e.g., flooding)
- **So...** Consequences (e.g., damage to buildings, displacing occupants)

Activity Structure:

Phase 1 - Identifying Outcomes:

- Review flip chart sheets with identified climate events/hazards
- Consider outcomes associated with each climate event
- Groups wrote at least three outcomes for each climate event using sticky notes
- Groups rotated to other tables and added at least one more outcome for each event

Phase 2 - Identifying Consequences:

- Review climate events/hazards and outcomes
- Document outcomes and at least two consequences for each
- Note the systems affected by the climate impact statement (Built, Sociocultural, Economic, Natural)
- Groups rotated and added one additional consequence for each outcome identified

Key Considerations:

- Impacts are not felt equally across the community
- Vulnerable populations at higher risk: older adults, children, low-income households, those without AC, people with mobility limitations, renters, outdoor workers
- Consider how consequences may compound existing vulnerabilities

Example Provided: Extreme heat can lead to:

- Increased risk of heat-related illness
- Need for cooling centres for people without AC
- More hospital visits and first responder calls
- Increased energy demands for air conditioning
- More power outages as demand exceeds grid capacity
- Energy poverty for low-income families

10 KEY CONCEPTS DISCUSSED

Heather provided an overview of climate adaptation, introduced the workshop, and provided an overview of the climate profile, including Climate Atlas data and RCP 4.5 and RCP 8.5 scenarios.

Introduction to **Vulnerability** - how strongly systems are affected by climate impacts

Introduction to **Adaptive Capacity** - ability to cope or adjust (not the size of the impacts)

11 NEXT STEPS

1. Compile climate impact statements from today's workshop
2. Generate additional climate statements based on research
3. Circulate comprehensive list of climate impact statements to RCTF in advance of vulnerability assessment workshop
4. Workshop #2: Vulnerability Assessment scheduled for Wednesday, January 14, 2026

Project: Collingwood Community Climate Adaptation Plan

Meeting: Workshop #2

Date:

January 14, 2026

Location:

In person

Collingwood Public Library

Attendees:

Adam Gallant; Alex Prince; Beckett Frisch; Claire de Souza; Donald Cameron; Dave McNalty; Hanna Podbrazan; Jennifer Graham; Karen Cubitt; Ken Kaden; Leah O'Donnell; Matt Cameron; Michael Trueman; Mike Nancekivell; Nicole Yardy; Peggy Slama; Sandy Falcon; Stephanie Ottewell; Stephen Emo

Kerri MacDonald (Environment Network); Laura Vermader (Collingwood Climate Action Team (CCAT)); Ian Ockenden (NVCA)

Heather McGinnity; Jessica Angers; Daryush Esmaili

Meeting Minutes

1 WELCOME AND INTRODUCTIONS

The meeting opened with the Town of Collingwood's land acknowledgement.

Round Table Introductions - Systems Under Stress Theme: Participants were asked: *"When you think about recent weather events, where have you seen services or systems under stress even if they didn't fail?"*

Responses: Participants shared observations of climate-related stresses across municipal services, with recurring themes including extreme weather events (ice storms, heavy rain, wind, snow), infrastructure strain (flooding, frozen water services, power outages), and service pressures (emergency response, insurance claims, energy demand, evacuations). Systems under stress included water services, recreation facilities, housing, emergency services, transportation, forestry, IT infrastructure, and building operations, though most had not yet experienced complete failures.

Key Observation: Facilitator noted that many systems are under stress, but not necessarily experiencing failures. The workshop would build on these observations when examining projected climate conditions and pressures across Collingwood.

2 PROJECT OVERVIEW

Heather provided an overview of climate change and the project, including:

- Climate Modelling concepts
- RCP (Representative Concentration Pathway)

- Emission scenarios
- Mitigation vs. Adaptation
- Collingwood's adaptation plan
- BARC Framework and Resilient Collingwood Taskforce role

Questions from the group:

- "What does it look like in 2100?"

Key Adaptation Drivers for Collingwood:

- Increasing climate impacts affecting services and infrastructure
- Council and community direction (climate emergency declaration in 2019)
- Need to integrate climate risk into current and future projects
- Opportunity to build long-term resilience through collaboration
- Service reliability concerns
- Organizational readiness

Project Schedule:

- **Phase 1 (2025 Q3/Q4) - Project Kickoff: COMPLETED**
 - Consultation & Engagement Plan
 - RCTF Workshop 1
 - Early stakeholder engagement
- **Phase 2 (2025 Q4/2026 Q1) - Risk & Vulnerability Assessment: IN PROGRESS**
 - Local climate projections
 - RCTF Workshops 2, 3
 - Council & staff presentations
 - Outreach materials
- **Phase 3 (2026 Q1/Q2) - Adaptation Planning:**
 - RCTF Workshops 4, 5
 - Climate Adaptation Plan
 - Council presentation
 - Staff training & outreach materials

3 RESILIENT COLLINGWOOD TASK FORCE ROLES (REITERATED)

Primary Functions:

Collaborate:

- Bring together different perspectives
- Share knowledge across departments, services, and community members
- Connect insights across systems and services

Advise:

- Test whether findings align with operational and community experience
- Consider: What feels realistic? Where are gaps? What considerations should shape adaptation priorities?

Champion:

- Carry work forward
- Promote integration of climate resilience into budgets, planning, and day-to-day operations
- Sustain momentum beyond this project

4 WORKSHOP PURPOSE & OBJECTIVES

What we are doing:

- Validating and refining climate impact statements
- Assessing vulnerability across systems using sensitivity and adaptive capacity
- Building a shared understanding of priority climate risks for Collingwood

Areas of focus:

- Operational and community perspectives
- Focus on how systems and services are affected
- Insights, not perfect answers

How this supports the project:

- Strengthens the vulnerability assessment
- Grounds analysis in local experience
- Informs priority risks and next steps

5 CLIMATE PROFILE & PROJECTED IMPACTS (SUMMARY)

Climate Projections for Collingwood:

- **Baseline (1976-2005):** Average annual temperature 7.2°C
- **Near Term (2021-2050):** 9.3°C (increase of 1.9°C)
- **Long Term (2051-2080):** 11.5°C (increase of 3.0°C)

Key Climate Trends:

- Rising temperatures year-round, with greater warming in winter
- More precipitation annually (8-10% increase by 2080)
- Significant increase in winter precipitation (12-19% by 2080)
- More intense precipitation events (15-18% increase by 2080)
- Increasing frequency and duration of heat waves
- Longer growing season
- More intense storm events

Climate-Related Hazard Themes Identified:

- Heat and air quality stresses
- Water availability and drought pressures
- Flooding and excess water
- Shoreline erosion and fluctuating lake levels
- Storm and wind damage
- Winter stress on infrastructure and services
- Compounding and cumulative effects

6 SYSTEMS THINKING & COMMON CLIMATE OUTCOMES

Four Systems Reviewed:

1. **Built:** Transportation, underground services, buildings, energy
2. **Sociocultural:** People, health, education, social services, cultural places
3. **Economic:** Workers, commerce, industry, tourism, supply chains
4. **Natural:** Shorelines, wetlands, watersheds, forests, urban green spaces

Common Climate Outcomes Across Systems:

- **Built System:** Service strain and maintenance pressure; Reduced service reliability during extremes; Accelerated asset deterioration

- **Sociocultural System:** Emergency and health care service strain; Health, safety, and wellbeing impacts; Access and mobility disruptions
- **Economic System:** Higher operating and recovery costs; Business disruption; Household financial stress
- **Natural System:** Ecosystem degradation; Invasive species expansion; Loss of recreational and cultural value

Key Point: Climate impacts often affect multiple systems simultaneously. The degree of impact and ability to respond varies across systems.

7 UNDERSTANDING VULNERABILITY

Definition: Vulnerability describes how strongly a system is affected by climate impacts and reflects both sensitivity and adaptive capacity.

Two Components:

Sensitivity: How strongly are we affected?

- **Low:** Impacts are limited or easily absorbed
- **Medium:** Noticeable disruption; impacts manageable with effort
- **High:** Strongly affected; impacts difficult to manage or recover from
- *Note: Sensitivity focuses on severity of impact, not likelihood*

Adaptive Capacity: Ability to prepare, respond, and recover

- **High:** Well-positioned to prepare, respond, and recover
- **Medium:** Can respond and recover, but with constraints, delays, or trade-offs
- **Low:** Limited ability to respond or adjust; impacts likely to persist or worsen
- *Note: Adaptive capacity focuses on ability to cope and adjust, not size of impact*

Vulnerability Matrix: High sensitivity + Low adaptive capacity = High vulnerability

Low sensitivity + High adaptive capacity = Low vulnerability

Most impacts fall somewhere in between

Purpose: Identify climate impacts in medium to high vulnerability range to carry forward into risk assessment for prioritization.

8 BREAKOUT SESSIONS: VULNERABILITY ASSESSMENT

Part 1: Sensitivity Assessment

Groups were asked to:

1. Review climate impacts
2. Consider system effects; revise as appropriate

3. Assign a qualitative sensitivity rating (Low/Medium/High)
4. Document rationale for the rating
5. Optional: Document additional climate impact statements not yet captured

Part 2: Adaptive Capacity Assessment

Groups were asked to:

1. Review existing capacity available for the climate impact
2. Consider response and recovery capabilities
3. Assign a qualitative adaptive capacity rating (Low/Medium/High)
4. Document rationale for the rating
5. Note particular concerns relating to:
 - Vulnerable populations
 - Coordination with external partners
 - Regulated services
6. Optional: Determine overall vulnerability rating and note confidence level

Guidance Provided:

- Aim for shared, reasonable judgement (not perfect consensus)
- Focus on how things actually work
- Flag concerns about vulnerable populations, external dependencies, and regulated services

9 KEY TAKEAWAYS FROM BREAKOUT SESSIONS

Discussion Questions:

- Which climate impacts stood out as most vulnerable – and why?
- Were there impacts that ranked higher or lower than expected?
- What factors most influenced vulnerability ratings?

Facilitator Note: Focus on surprises, challenges in scoring, and consistent vulnerabilities rather than comprehensive reporting.

10 NEXT STEPS

1. Compile vulnerability assessment results from today's workshop
2. Circulate list of high, medium, and low vulnerability climate impacts in advance of risk assessment workshop
3. **Workshop #3: Risk Assessment scheduled for Wednesday, February 4, 2026**

Project: Collingwood Community Climate Adaptation Plan

Meeting: Workshop #3: Risk Assessment

Date:

February 3, 2026

Location:

In person

Collingwood Public Library

Attendees:

Adam Gallant; Alex Prince; Beckett Frisch; Claire de Souza; Donald Cameron; Dave McNalty; Hanna Podbrazan; Jennifer Graham; Karen Cubitt; Ken Kaden; Julie Kaden; Leah O'Donnell; Matt Cameron; Michael Trueman; Mike Nancekivell; Nicole Yardy; Peggy Slama; Sandy Falcon; Stephanie Ottewell; Stephen Emo

Kerri MacDonald (Environment Network); Laura Vermader (Collingwood Climate Action Team (CCAT)); Ian Ockenden (NVCA); Amy Bellinger (Escarpment Corridor Alliance); Nathan Westendorp (Simcoe County)

Heather McGinnity; Jessica Angers;

Meeting Minutes

1 WELCOME AND INTRODUCTIONS

The meeting opened with the Town of Collingwood's land acknowledgement.

Round Table Introductions – Mitigation and Adaptation Theme: Participants were asked: *"How does thinking about climate change make you feel?"*

Responses: Participants shared the sentiment that climate change drives feelings of anxiousness, hope, and concern. A particular area of concern is around the increasing role and burden on lower-tier municipalities to adapt to climate change without resources to support those actions, and insufficient leadership demonstrated by higher levels of government.

Key Observation: Facilitator noted that this mix of feelings is typical. The workshop would provide a path forward in working through those feelings and developing meaningful actions in response to valid concerns. Privilege was also identified as a key factor in how these changes can impact someone.

2 PROJECT OVERVIEW

Heather provided an overview of climate change and the project, including:

- Climate Modelling concepts
- RCP (Representative Concentration Pathway)
- Emission scenarios

- Mitigation vs. Adaptation
- Co-benefits
- Role of the Resilient Collingwood Taskforce, and how the CCAP can help Collingwood identify actions that have co-benefits.

Project Schedule:

- **Phase 1 (2025 Q3/Q4) - Project Kickoff: COMPLETED**
 - Consultation & Engagement Plan
 - RCTF Workshop 1
 - Early stakeholder engagement
- **Phase 2 (2025 Q4/2026 Q1) - Risk & Vulnerability Assessment: IN PROGRESS, NEAR COMPLETION**
 - Local climate projections
 - RCTF Workshops 2, 3
 - Council & staff presentations
 - Outreach materials
- **Phase 3 (2026 Q1/Q2) - Adaptation Planning: NEXT PHASE**
 - RCTF Workshops 4, 5
 - Climate Adaptation Plan
 - Council presentation
 - Staff training & outreach materials

3 KEY FINDINGS FROM THE VULNERABILITY ASSESSMENT

Climate Trends:

- Collingwood will continue experiencing warming over time, but there are climate impacts beyond increased baseline temperatures including:
 - *Precipitation patterns across the year.*
 - *Persistence of snow and ice.*
 - *Performance of infrastructure across the year.*
 - *How ecosystems function across all seasons.*
- *This is considered across three time horizons:*
 - *Baseline*
 - *Near Term*
 - *Long Term*

Common Outcomes

Assessing Vulnerability

- Evaluate across both Adaptive Capacity and System Sensitivity
 - High Sensitivity + Low Adaptive Capacity = High Vulnerability
 - Low Sensitivity + High Adaptive Capacity = low vulnerability
- Assessed across four systems:
 - Built
 - Sociocultural
 - Natural
 - Economic
- Most climate impacts will impact multiple systems, though one system is typically most effected.
- This can guide understanding of where services and systems may be more strained under those climate conditions, but does not necessarily mean they are failing.

Key Insights:

- No events were identified as:
 - Low-impact and hard to manage.
 - High-impact and well prepared for.
- Responses are primarily reactive rather than proactive.
- Cross-system effects are common, and impacts cascade across systems.
- Costs and coordination can be challenging, and improved through proactive planning.
- There were 17 low vulnerability impacts that were set aside to allow focus on higher-impact, higher-priority risks.
- Vulnerability screen reflects relative priority, not importance.
- Deeper understanding of the extent of service and community disruption will be built through the risk assessment.

4 RISK ASSESSMENT REFRESHER

BARC Approach

- Risk = Likelihood x Consequence
- BARC is focused on community and service outcomes, not individual assets.
- BARC assess how risk impact individual systems as well as how those different systems work together to contribute to a risk
- It emphasizes manageability and recovery, and helps to focus planning efforts.

Likelihood

- Two perspectives included:
 - Recurrent impacts: can happen more than once (e.g. storm surge flooding)
 - Slow Onset impacts: Only happens once (e.g. loss of an animal species, etc.)
- Scored from 1 (very unlikely) to 5 (almost certain) for both perspectives.

Consequence

- Multiple consequence scores, one for each:
 - Sociocultural factors: Public Health & Safety, Displacement, Disruption to daily life, loss of identity, traditions and cultural practices.
 - Natural Factors: Air, water, land and biodiversity & ecosystem functions.
 - Economic Factors: Property damage, local economy & growth, livability & cost of living, loss of public services.

Final Scoring

- Risk Total = Likelihood x (Sociocultural Consequence + Natural Consequence + Economic Consequence)
- Risks scoring in the medium category through to extreme are carried through to risk planning efforts.

5 BREAKOUT SESSIONS: RISK ASSESSMENT

Climate Risk Assessment

Groups were asked to:

1. Review climate impacts and system effects
2. Validate the climate likelihood rating for both near term and future projections.
3. Document rationale for scoring each of the factors.
4. Calculate the total risk scores for both near and long term.

6 KEY TAKEAWAYS FROM BREAKOUT SESSIONS

Discussion Questions:

- Was there any unexpected results from your scoring?
- Were there risks that felt particularly hard to score?
- Which risk factors, or climate impacts, were you most confident about? Least confident?

Facilitator Note: Focus on surprises, challenges in scoring, and consistent vulnerabilities rather than comprehensive reporting.

7 NEXT STEPS

1. Compile risk assessment results from today's workshop
2. Present project update and findings to staff and council.
3. Host a public engagement session to validate risk assessment findings.
4. Move into adaptation planning for priority climate risks.