

Climate Change Risk Assessment and Adaptation Strategy

Municipality of North Cowichan



Prepared for

Municipality of North Cowichan
7030 Trans Canada Highway
Box 27
Duncan, BC V9L 6A1

Prepared by

Urban Systems Ltd.
312-645 Fort St.
Victoria, BC V8W 1G2

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Acknowledgments

The Municipality of North Cowichan is situated on the traditional, unceded territories of the Quw'utsun First Nation, which includes the Cowichan Tribes, the Halalt First Nation, the Lyackson First Nation, the Penelakut Tribe, and the Stz'uminus First Nation and, of the Snuneymuxw First Nation, all of whom have occupied and stewarded these lands for millennia and continue to do so today. North Cowichan continues to engage with these Nations in an ongoing dialogue to create new ways to ensure a healthy future for all residents and work collaboratively to foster more resilient and connected communities.

North Cowichan is grateful for the extensive input provided to this project by staff from Quw'utsun First Nations, Cowichan Valley Regional District, Island Health, Social Planning Cowichan, Western Forest Products, Paper Excellence, and School District #79, North Cowichan's Environmental Advisory Committee and Agricultural Advisory Committee members, and the many community members who provided response to the public engagement. Work on this project was completed thanks to the financial support provided by the Province of BC through the Union of BC Municipalities (UBCM) Disaster Risk Reduction-Climate Adaptation program.



1. Taking Action for our Community

The Municipality of North Cowichan (“Municipality”, “North Cowichan”) is a community of communities offering services to a diversity of areas, each with unique values, character, objectives, and needs. The communities are set in spectacular natural environments defined by forests, rivers, lakes, coastline and farmland. Collectively, the Municipality’s vision, defined by North Cowichan’s Official Community Plan, is:

As a steward and leader of environmental and social well-being, we will prioritize the conservation of our natural areas, provide supports for a thriving local economy and foster resilient, welcoming and inclusive communities. North Cowichan’s decisions and relationships will be collaborative, transparent, and demonstrate resilience in the face of future challenges and opportunities.¹

North Cowichan has already experienced the impacts of a changing climate, and trends in climate data indicate these impacts will persist in the coming years. The Municipality acknowledged the climate emergency in 2019 and has integrated climate action throughout the Official Community Plan, recognizing the critical nature to act in response to the threat posed by climate change. Therefore, North Cowichan is committed to taking proactive measures to prepare the Municipality’s services for changing climate conditions while protecting and preserving the region’s communities.

This strategy is a roadmap for North Cowichan’s climate adaptation efforts, providing direction for staff and articulating the Municipality’s commitment to engagement and collaboration with the Quw’utsun and Snuneymuxw First Nations, the region’s communities, other levels of government, and partner organizations.

North Cowichan is an implementation partner of the Cowichan Valley Regional District’s Regional Climate Change Adaptation Strategy adopted by the Board in 2021. This Strategy includes climate projections and impacts analysis, vulnerability and risk assessments, a climate change adaptation and risk management strategy, a greenhouse gas mitigation strategy, and an implementation plan. North Cowichan’s climate adaptation work was scoped to build from CVRD’s regional work by tailoring strategies specific to our community’s context and focusing attention on municipal service delivery.

1 Municipality of North Cowichan. (2021). [Official Community Plan](#).



2. Collaborating to Adapt

Climate change knows no borders, and its impacts are felt broadly. The effectiveness of North Cowichan's climate action relies on the collective efforts of different levels of government, First Nations, citizens, businesses, industries, organizations, and institutions. As such, North Cowichan's climate adaptation is inextricably linked to the work each of these groups is doing with respect to climate change. North Cowichan's climate adaptation is rooted in scientific knowledge, draws on support from senior levels of government, and requires continuous and ongoing collaboration at local and regional levels (Figure 1).

Jurisdictional Responsibilities

While climate change knows no borders, North Cowichan's jurisdictional context defines what can and cannot be done at the municipal level to address these impacts, and it is important to understand the respective roles of regional and provincial levels of government. North Cowichan is responsible for infrastructure, services, and land use within the borders of the municipality; this municipality lies within the Cowichan Valley Regional District (CVRD), which has similar responsibilities within its own boundaries. This is why it is important for both North Cowichan and the CVRD to have distinct but complementary adaptation strategies.

Emergency Management Cowichan (a department of the Cowichan Valley Regional District) provides the oversight and delivery of emergency preparedness planning, programs, resources, incident response, and recovery support within the CVRD, including North Cowichan. The Province of British Columbia has jurisdiction over several important areas of land use and resource management for North Cowichan, including agricultural land and groundwater sources. Therefore, coordination with the CVRD and the province is critical to ensure these areas are appropriately considered in adaptation and emergency management planning processes.

The initial phase of this work sought a community/region-wide perspective on climate change impacts to inform future phases. However, to align the strategy with the responsibilities and jurisdiction of North Cowichan, the vulnerability and risk assessment focused on the interaction of key climate hazards (What Can We Expect to See? section) with North Cowichan's municipal services. While the context around other community sectors is broadly understood, a detailed vulnerability and risk assessment for these sectors was outside the scope of the project as the CVRD adaptation strategy addresses the broader community-wide impacts. However, North Cowichan is collaborating with the CVRD to implement the regional strategy.

Indigenous peoples have unique strengths that support responding to environmental and climate changes. North Cowichan is committed to collaborating to implement climate adaptation actions that align with local First Nations' priorities and needs.

“Indigenous rights and climate action are intimately intertwined. Local governments seeking to enact climate change mitigation or prevention measures can benefit from millennia of local Indigenous knowledge and work in allyship with Indigenous governments to strengthen efforts for the betterment of their respective communities.”

- Climate Caucus. (2024). *Aligning Local Government Climate Action with UNDRIP.*

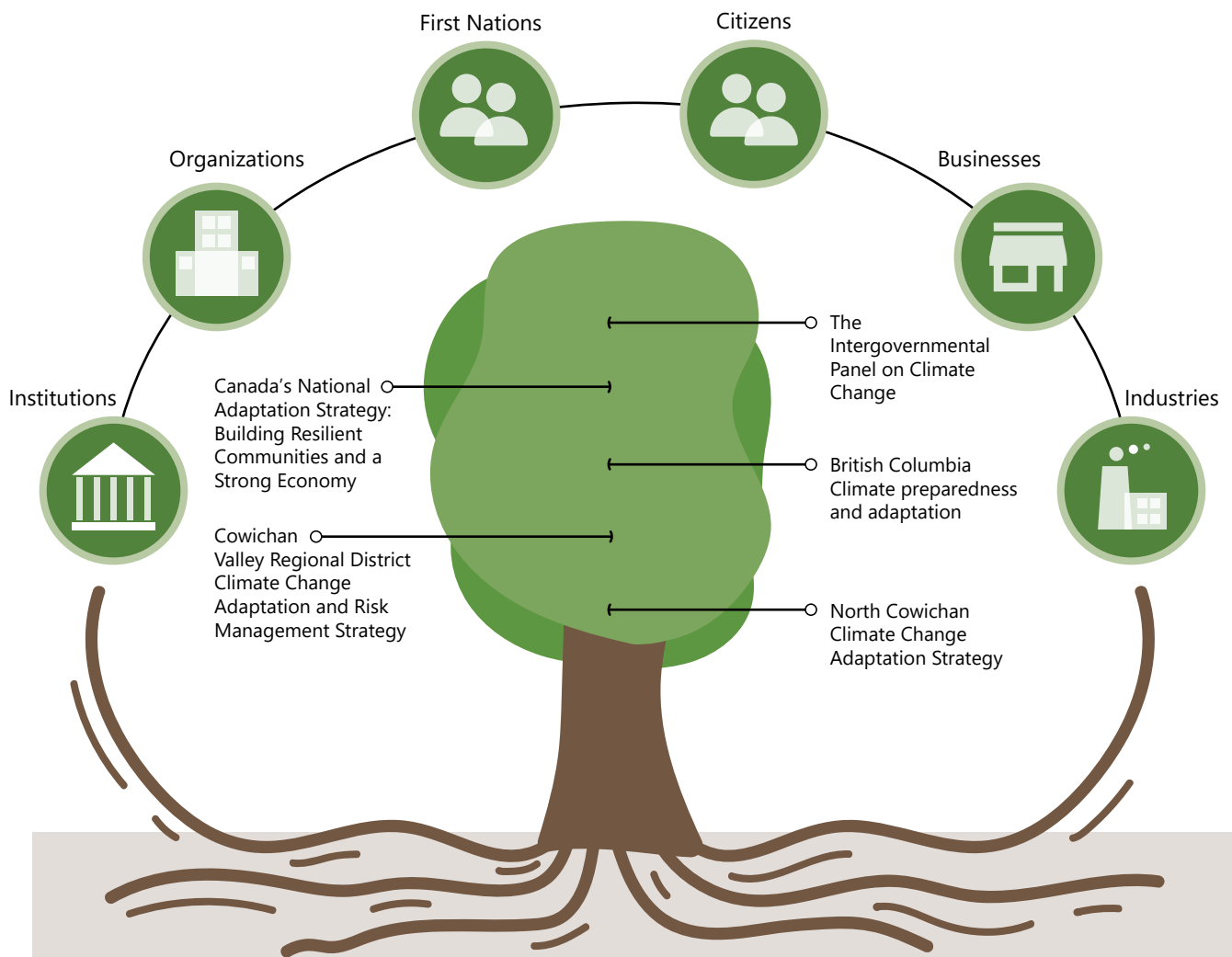


Figure 1. North Cowichan's interconnected climate adaptation strategy

3. North Cowichan's Process for Adaptation

Climate change is already impacting communities across British Columbia² and North Cowichan is no exception. North Cowichan has already begun adapting to the impacts of climate change. However, there are opportunities to both build on North Cowichan's adaptation strengths and identify and address gaps.

Uncertainty in climate projections is not whether the climate is changing³ but rather *where and when* the worst impacts will be felt. While it is clear that adapting to climate change is necessary, the specific actions and when they should be undertaken are not as obvious. Additionally, there is no one-size-fits-all approach to climate adaptation planning. The unique geographical, social, economic, and environmental factors that define North Cowichan require a tailored strategy that is representative of the community's needs and objectives.

To account for uncertainty and ensure alignment with North Cowichan's needs and objectives, North Cowichan's climate adaptation planning is grounded in the principles outlined below.



Guiding Principles: A process for North Cowichan, by North Cowichan

- ▶ **Build on North Cowichan's strengths**
Acknowledge and celebrate North Cowichan's strengths, and use them as a foundation to advance North Cowichan's adaptation to climate change.
- ▶ **Focus on efforts that balance effort and impact**
Align with existing decision-making processes, resources, and expertise to advance North Cowichan's adaptation efforts in efficient and effective ways.
- ▶ **Draw on scientific and local knowledge**
Integrate climate science, Indigenous knowledge, and residents' lived experience of climate change, using bottom-up approaches to elicit and integrate diverse community perspectives.
- ▶ **Collaborate with North Cowichan's neighbours**
Prioritize the involvement of First Nations, local residents, not-for-profits, other jurisdictions, and businesses throughout the project.

2 Government of Canada. (2022). *Canada in a Changing Climate: Regional Perspectives Report*. British Columbia.

3 Lynas, M., Houlton, B. Z., & Perry, S. (2021). *Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature*.

This document represents a snapshot in time in which we have taken the first steps to understand and assess climate impacts and identify adaptation pathways, objectives and actions. Climate adaptation is a process that involves continuous learning and necessitates iterative refinement and adjustment based on new information, changing circumstances, and an evolving understanding of climate impacts. Because of this,

North Cowichan's approach to climate adaptation must be robust and flexible, building the capacity to respond to unpredictable events

and changes in the community context and incorporate new information as it becomes available. This process is outlined by North Cowichan's adaptation planning process (Figure 2).



Plan

In the initial **Understand and Assess** phase, the focus is on gaining a comprehensive understanding of the climate risks and contextual factors. This helps set clear adaptation goals. Based on this assessment, the Municipality can **Explore Options** to identify current adaptation efforts, successes, gaps, and adaptation action opportunities. With these options outlined, the next phase involves evaluating the adaptation actions in order to **Outline Adaptation Pathways** that will provide strategic direction to the potential adaptation actions. Using appropriate criteria, the Municipality will **Decide** which adaptation actions along each pathway should be pursued.

Act

Once the Municipality has decided which actions along the Adaptation Pathways to pursue, the focus shifts to **Implementing the Adaptation Actions**. Continuous **Monitoring** of adaptation progress and outcomes is a critical precursor to **Evaluating Adaptation Progress**, identifying challenges early on, and ensuring that outcomes align with intended goals and community vision. Building upon the evaluation findings, North Cowichan can then **Decide** whether the adaptation strategy requires updates or modifications.

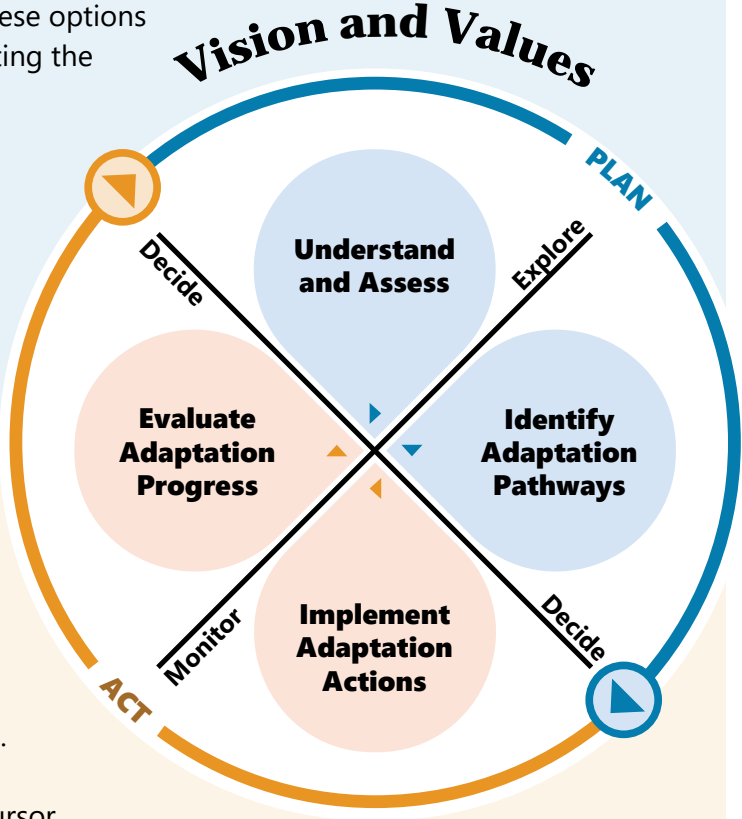


Figure 2. North Cowichan's climate adaptation planning process

The remainder of this document outlines the Plan portion of the adaptation process, as well as providing considerations for the Act portion. It provides a summary of the Municipality's climate risk and vulnerability assessment and contextual factors elicited from engagement with First Nations, community members, and stakeholders. In doing so, this document serves as a foundation for the Municipality to continue the adaptation process through implementation, evaluation, and beyond.

4. Climate Change in North Cowichan

What Have We Observed?

North Cowichan has already felt the impacts of climate events in our communities.

Flooding

In 2021, an atmospheric river delivered approximately 157mm of rain over just three days⁴, resulting in what some locals described as the worst flooding they had seen in 15 years. The flooding caused Cowichan Valley Regional District to declare a local state of emergency for many areas, including North Cowichan (Figure 3).



4 Municipality of North Cowichan. (2021). [2021 Annual Report](#).

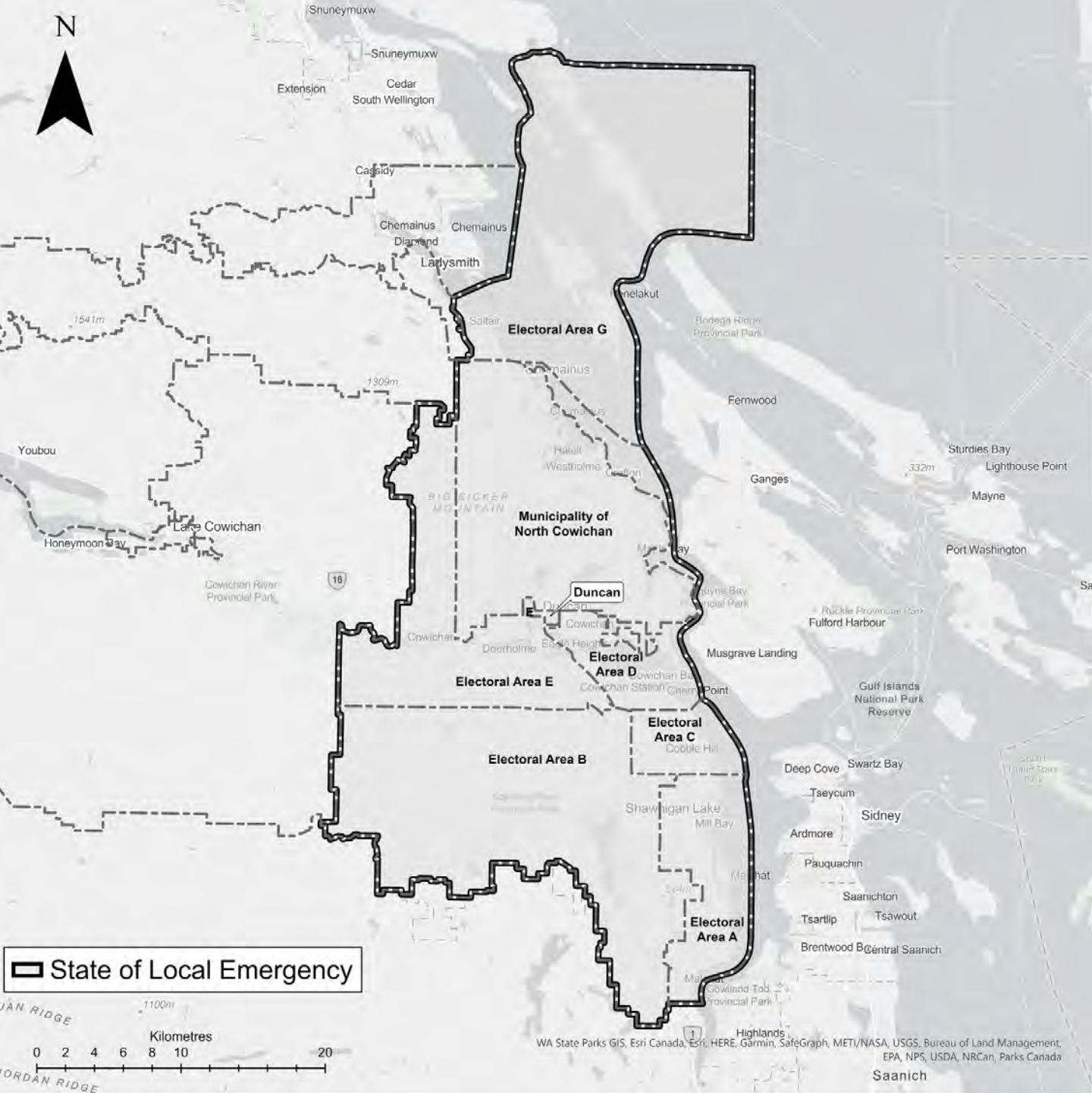


Figure 3. Local State of Emergency Map⁵

Flooding was extensive and the largest impacts were felt on the Halalt First Nation and areas around Russell Farm, both adjacent to the Chemainus River, with water overflowing the river banks. North Cowichan’s response and post-event recovery efforts were extensive, and several roads were closed as flooding subsided. Mays Road was closed for several months for structural repairs.

5 Cowichan Valley Regional District. (2021). *Declaration of State of Local Emergency*.



“This rain and flood was one of the worst recorded, both here and around the province, and I want to thank residents and businesses for their patience and resilience over these past two days. I also want to recognize staff who worked around the clock to keep roads and utilities open and safe.”

- Former Mayor, Al Siebring on November 16, 2021 – the day following record-breaking rain across British Columbia





4

Wildfire

On August 8, 2018, a wildfire was ignited on Maple Mountain. Fire department crews from Chemainus, Duncan, North Cowichan’s South End, Sahtlam, Cowichan Bay and Ladysmith came together to respond to the fire, with support from the BC Wildfire Service. Hot temperatures, wind, and dry forest conditions contributed to the rapid growth of the fire. At its peak, the fire spanned 5.9 hectares. Fire crews worked 24-hour shifts to contain the flames, with as many as 100 personnel on scene at a time. The wildfire response ended 7 days after the initial call and was estimated to cost over \$330,000. While arson was the suspected cause of the wildfire, due to climate change, the environmental conditions that allowed the wildfire to propagate so rapidly are increasingly present in the forests surrounding North Cowichan today.^{6,7}



5

Heatwaves

In late June 2021, a heat dome caused local temperatures to skyrocket for a period of 27 days, during which local temperatures hit a record-breaking 41.9 degrees Celsius.⁸ North Cowichan staff and regional emergency response partners opened cooling centres and provided other resources to offer relief from extreme heat conditions. The 2021 heat dome had implications for service delivery, for example, altered work schedules and interruptions for outdoor workers. While they issued critical guidance for reducing heat-health risk, Island Health reported 48 heat-related deaths between June 25 and July 1, 2021.⁹

6 Bodger, D. (2021). No charges in suspected arson that sparked 2018 Vancouver Island wildfire. *Saanich News*.
7 Bodger, D. (2019). Crofton fire chief recounts details of Maple Mountain wildfire. *Ladysmith Chemainus Chronicle*.
8 Municipality of North Cowichan. (2021). *2021 Annual Report*.
9 Island Health. (2023). *Medical Health Officers’ Newsletter – Health considerations: Climate Change and Hotter, Drier Summers*.

Drought

Like many regions in the province, water restrictions have become a regular feature of summers in North Cowichan. During periods of drought conditions, North Cowichan restricts watering and other outdoor water uses according to the 4 stages of water restrictions.¹⁰

North Cowichan's primary water supply is sourced from groundwater aquifers. The aquifers have not been impacted by recent local surface water shortages. In fact, water levels in the aquifer have been above average. Despite the resilience of the aquifers, North Cowichan is still required to follow provincial drought restrictions, in addition to other water management considerations (see page 12). Ultimately the drought conditions do create the need for heightened responsibility and care toward water use during these periods to ensure aquifers remain healthy and to align with provincial water shortage response requirements.



¹⁰ Municipality of North Cowichan. (2024). [Water Connects Us](#).



How is North Cowichan managing water supply?

North Cowichan implements water restrictions during drought periods for several reasons, including, but not limited to:

- ▶ Lowering peak water demand primarily attributed to lawn watering and other outdoor usages, which generally increase by 2-4x during the spring.
- ▶ Keeping reservoirs topped up to ensure there is sufficient water supply in case of a fire or other emergencies.
- ▶ Ensuring withdrawals do not exceed the amounts authorized by the water license from the Provincial government.
- ▶ Preserving water supply (aquifers and surface water supplies) to maintain water quality and quantity for the long-term.

Staff continually monitor the state of water system supplies (aquifers and surface water), infrastructure, and demand. North Cowichan's analysis of water supplies, in conjunction with the long-term population growth projections, indicates that there are no significant concerns with the water supply in North Cowichan if the community continues to practice responsible water stewardship.

Invasive Species

Invasive species are a significant threat to biodiversity in North Cowichan.¹¹ Invasive species such as Scotch broom and American bullfrogs have spread throughout the region, displacing native species, which disrupts local ecosystems and food webs. Invasive species also impact human and animal health and safety and the local economy (property values, industry, infrastructure, recreational opportunities) by consuming time and finances required to control further spread, increasing fire risk, promoting erosion, and harming livestock and companion animals.¹² As the climate changes, some invasive species may become the new normal as ecosystems and species migrate.



11 Municipality of North Cowichan. (2024). *Native and Invasive Species*.

12 Municipality of North Cowichan. (2024). *Native and Invasive Species*.

What Can We Expect to See?

Projections

To effectively prepare for future conditions, it is important to understand how changing temperatures and precipitation will be experienced locally. This includes seasonal changes and the likelihood and severity of potential future climate hazards. Climate research has sought to do exactly this – outlining climate patterns that North Cowichan can expect to see in the future.^{13,14,15}



3°C increase in annual average temperature by the 2050s.



Warmer winters with less snow (63% decrease in number of frost days).



Increased rain falling less frequently, but in more intense storm events (30-65% more precipitation on very wet days).



Sea level rise (1-2.5m).



Longer, hotter, drier summers and more heatwaves (more than doubling the average number of summer days above 25°C).



Longer growing season for crops (28% increase).

13 Cowichan Valley Regional District. (2017). *Climate Projections for the Cowichan Valley Regional District*.

14 Cowichan Valley Regional District. (2019). *Risk Assessment of Floodplains and Coastal Sea Level Rise: Strategic Climate Risk Assessment for the Cowichan Valley Regional District*.

15 Municipality of North Cowichan. (2022). *Official Community Plan*.



These climate projections highlight the urgent need for proactive adaptation measures. While some of these projections align directly with the impact of climate hazards North Cowichan has already experienced (for example, increasing annual average temperatures and heatwaves), other impacts are not made as apparent by the above projections. These “indirect impacts” are no less serious and include, for example:

- Increased likelihood of wildfires and surface water shortages due to dry ecosystem conditions.
- Increased likelihood of landslides due to erosion, flooding, and changing soil conditions.
- Increased invasive species spread due to long-term ecosystem shift.

Direct and indirect impacts of climate change are evaluated by first identifying the climate hazards of concern. In North Cowichan, these include:



Coastal Storm
Surge



Flooding



Landslides



Wildfire



Heatwaves



Water
Shortages



Extreme
Cold



Extreme
Wind



Invasive
Species



What happens when climate hazards collide? A look at climate hazard interactions

The interaction of climate hazards presents a complex web of challenges for communities and ecosystems, often manifesting in two main ways: cascading and overlapping effects.

Cascading effects can be thought of as a chain reaction, where one climate hazard sets off a series of events that amplifies the overall impact either by worsening or hampering recovery from the initial hazard or creating new hazards. For example, wind events can worsen wildfire, causing rapid spread. Wildfires damage vegetation and soil, making the ground less capable of absorbing rainwater. This decrease in absorption capacity leads to increased runoff during rainfall, which elevates the risk of flooding in wildfire-affected areas.

“Dying cedar and now the Coastal Douglas fir trees. Summer after summer of droughts and a heat dome have been very hard on trees. This leads to soil instability and that makes the floods worse.”

Source: Resident of North Cowichan, 2023

Overlapping effects arise when multiple hazards converge. These simultaneous hazards can strain resources, intensify risks, and hinder response efforts. For example, conditions conducive to wildfires are more likely to occur during periods of drought.



Community Perspectives

Residents of North Cowichan have experienced first-hand the effects of climate change. The Municipality's climate adaptation approach is shaped by these lived experiences, contributing to a holistic understanding of the Municipality's climate adaptation needs as well as inspiring pathways to fulfilling them. The following captures the diverse perspectives that have been captured in the development of North Cowichan's Climate Adaptation Strategy.



What comes to mind when you picture climate change?

Climate change narratives have often been dominated by the disastrous impacts on the environment - melting sea ice, wildfires, heatwaves, and floods. However, in addition to the environmental impact of climate change, North Cowichan faces a wide range of direct and indirect impacts on health, well-being, culture, and economy. North Cowichan residents have identified these various impacts, including:

- ▶ **Damage to the natural environment** resulting from climate events such as flooding, landslides, and heatwaves.
- ▶ **Inability to enjoy the outdoors and community amenities** due to heatwaves, flooding, and water restrictions.
- ▶ **Stress on local farmers' businesses and livelihoods** due to flooding, fires, and water restrictions.
- ▶ **Increased home ownership costs** due to rising insurance rates to cover climate hazard risks.
- ▶ **Financial losses and property damage** due to climate events.
- ▶ **Increased operations and maintenance costs** due to the stress of climate events on aging infrastructure.
- ▶ **Strain on physical and mental health** due to extreme weather events.
- ▶ **Disruption to essential municipal systems and services (transportation, electricity, utilities)** due to flooding, landslides, extreme heat, and drought.
- ▶ **Exacerbation of socio-economic inequities and vulnerabilities (First Nations, youth, seniors, people living alone, unhoused populations)** due to climate-related hazards.

Source: Public Engagement, 2023



Asking North Cowichan Youth: How does climate change impact the activities that you enjoy most?

“Not being able to play outside or go to sports when it’s too hot.”

“When I can’t play hockey or lose WiFi in a big storm.”

“Floods have affected my life.”

Source: North Cowichan Youth, 2023





North Cowichan's Climate Risks and Vulnerability

North Cowichan's unique characteristics influence its vulnerability and exposure to the impacts of climate change on the services, residents, natural systems, infrastructure, buildings, economy, and social systems that define the community. These characteristics include:

- North Cowichan's "community of communities" creates a distributed settlement pattern across the region, with many residents living in rural forested areas.
- North Cowichan is a coastal community that is also rich in watercourses and wetlands (such as the Chemainus River and Somenos Marsh).
- North Cowichan encompasses forests, mountains, and farmland, including the Municipal Forest Reserve. The Cowichan Valley is one of the most significant agricultural hubs on Vancouver Island, producing vegetables, berries, and dairy products for the region.¹⁶
- North Cowichan is the fifth-oldest municipality in BC, and historic development would not have considered the risks that we face today from climate change.

The Municipality's vulnerability and exposure to climate hazards have been assessed and summarized into the following five themes.

¹⁶ Cowichan Region Economic Development Commission. (2010). [Cowichan Region Area Agricultural Plan](#).

Community and Lifestyle

Climate hazards affect both physical and social landscapes. These impacts include:

- Power outages disrupting daily life and critical services.
- Damage to the natural environment and increased demand for facilities to offer cooling during heatwaves.
- Drought conditions affect residents' and businesses' water use.

Natural Environment

Climate change is threatening the well-being of aquatic and terrestrial ecosystems and this threat will increase in years to come. Extreme weather events, water shortages, invasive species, wildfires, and flooding will threaten local ecosystems through:

- Displacement and/or damage to biodiversity and established terrestrial and aquatic habitats.
- Long-term ecosystem changes lead to species migration, as certain invasive species establish permanence in the ecosystem and other species are unable to thrive.
- Damage to the Municipal Forest Reserve, a major natural asset and recreational amenity.
- Deterioration in lake water quality (e.g., algae blooms), affecting ecosystems and human health.



“

Island Health: Ecosystem Health

“Our ecosystem is our health system. Making our territory as healthy as it can be is fundamental for the community’s health.”

Source: Resident of North Cowichan, 2023



🔍

More than half of North Cowichan residents have experienced negative health impacts of climate change, or know someone who has.

Source: Public Engagement, 2023

Local Economy

North Cowichan's local economy could be significantly impacted by climate hazard events. These impacts include:

- Long-term sea-level rise and storm surge events affect the operations of major employers located along the coastal area.
- Restrictions on development in certain areas due to increased wildfire protection requirements, increased capital costs, and insurance premiums.
- Drought, extreme wind, and other climate hazards including impacting agriculture and food security in the region.

Municipal Services

Many of the municipal services provided to the community may be disrupted by the impacts of climate change. These impacts include:

- Infrastructure damage and major service interruptions during the response and recovery periods following major climate hazard events.
- Limitations on outdoor work activity during climate events, affecting routine municipal functions such as park maintenance and construction/repair projects.

Public Health and Safety

Climate change poses risks to community safety by impacting key networks and assets. These impacts include:

- Damage or service interruptions to built assets such as road networks, drinking water systems, and flood protection systems.
- Impacts on natural assets like terrestrial and riparian habitats due to flooding and coastal storm surge events.
- Heightened risks of landslides affecting existing and planned developments and transportation routes
- Risks to public safety and the environment from tree blowdowns caused by extreme winds in urban and forested areas.

For additional information on identified risks please see **Appendix A**.



What Can We Do?

North Cowichan is already taking action to address climate change and is well-positioned to take additional action to reduce its contribution to climate change and prepare for its impacts.

These actions fall within two primary categories: adaptation and mitigation.



Did you know?

In July 2019, North Cowichan officially acknowledged that we are facing a climate emergency. This acknowledgment is embedded as one of nine guiding principles underpinning the Official Community Plan and expresses an intention to “ensure all municipal decisions are made through the lens of the climate emergency”.



“North Cowichan has an opportunity to be a leader.

I hope that our elected officials will do everything within their power, adopt all best practices to help mitigate the impacts of climate change on North Cowichan, on our community.

Any costs attached to these initiatives would be insignificant relative to the costs of doing nothing, denying climate change, a business-as-usual approach. We need to be excellent stewards of this land, our beautiful community.”

Source: Resident of North Cowichan, 2023



Adaptation and Mitigation

Mitigation focuses on reducing greenhouse gas (GHG) emissions to ensure that we are not making the problem worse. For more information on North Cowichan’s mitigation efforts, refer to the *Climate Action and Energy Plan*.¹

Adaptation involves addressing the climate hazards associated with climate change through a wide range of potential actions. It includes adjusting after the fact and preparing for expected climate change before it happens. Adaptation is about both moderating harm and taking advantage of new opportunities (e.g., longer growing seasons).

Examples of both are outlined below in Figure 4.

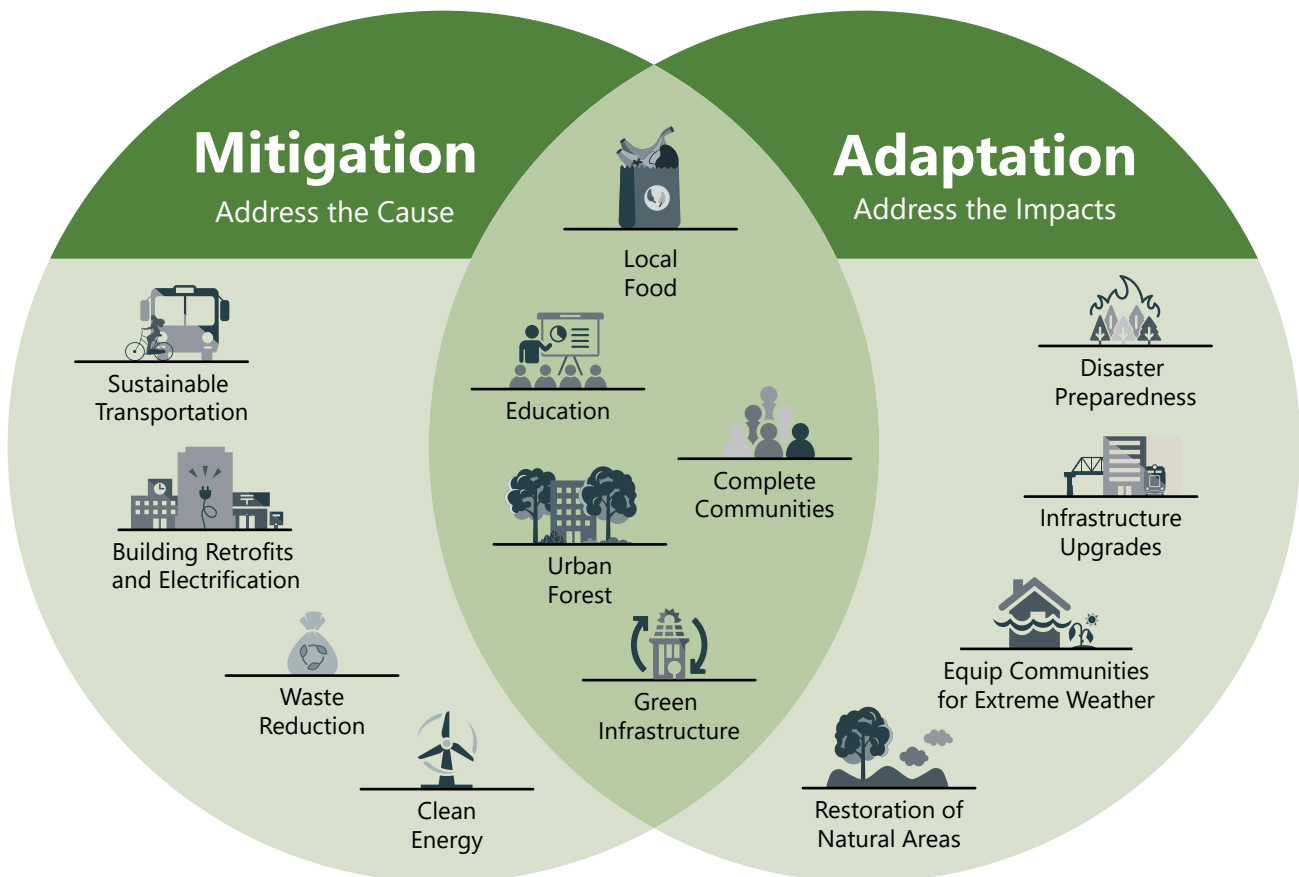


Figure 4. Examples of climate change mitigation and adaptation

This Strategy’s focus is on adaptation planning, ensuring that North Cowichan is building local capacity to proactively avoid and reduce the impacts of climate change on the region’s communities.

There is much to be gained by taking adaptation action so that we can protect the people and places that define North Cowichan and preserve them for future generations. The Canadian Climate Institute estimates that for every \$1 invested today in adaptation measures, \$13-15 is saved in years ahead from direct and indirect benefits.¹⁷ In other words, investing in adaptation efforts now can drastically contribute to a faster and more cost-efficient recovery from climate hazard events, thus supporting communities of North Cowichan in securing an affordable and healthy future (Figure 5).



“Because the climate is changing, and will continue to change, local governments will find themselves adapting to the changes, whether they have planned to do so, or not. What is at stake is how successful local governments will be at minimizing the potential negative impacts of climate change on their communities, and realizing any opportunities that may arise.”

- West Coast Environmental Law. (2012). *Preparing for Climate Change: An implementation Guide for Local Governments in British Columbia*

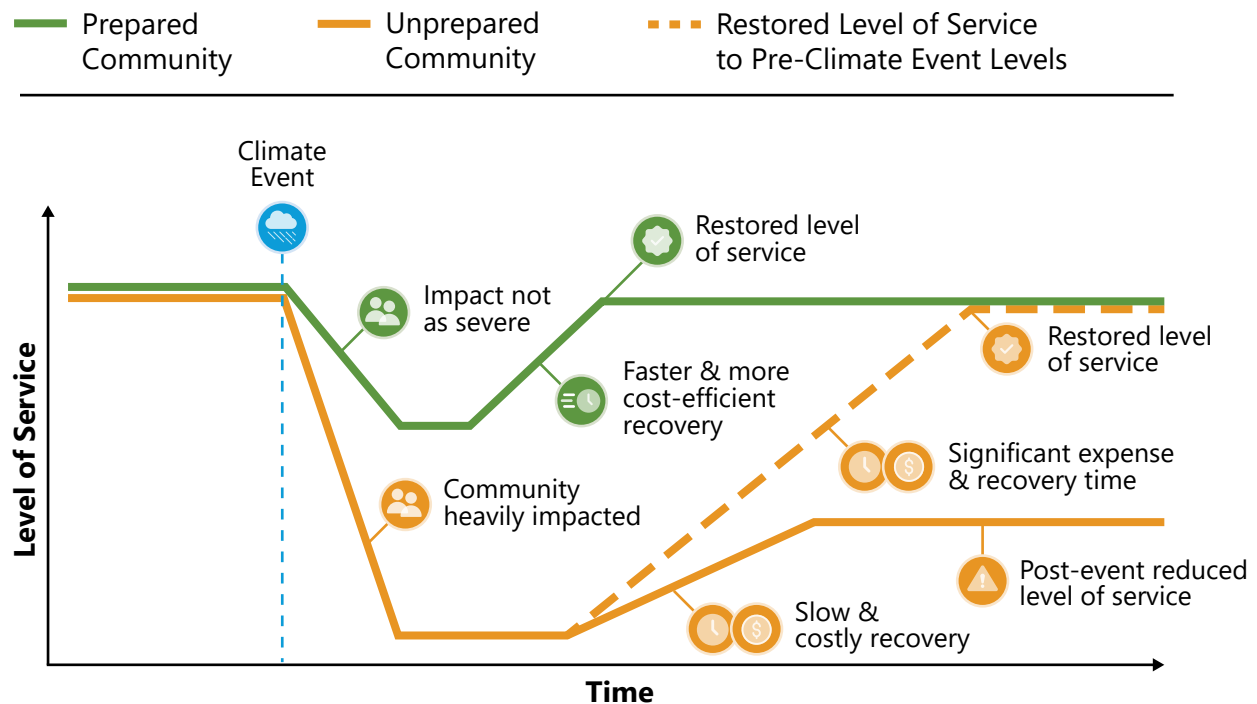


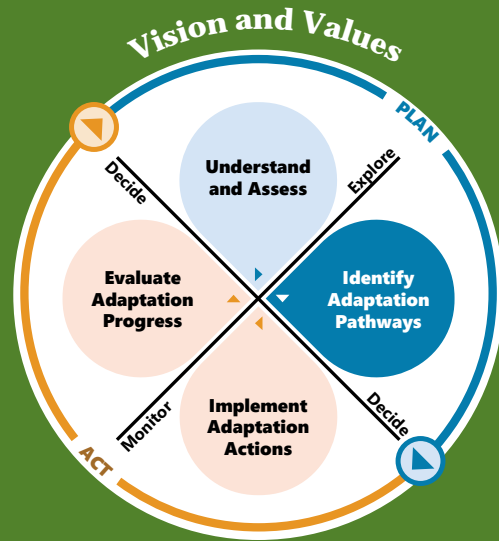
Figure 5. Climate resilient municipal services. Graphic adapted from Federation of Canadian Municipalities' Operations and Maintenance for Climate Resilience resource.

17 Canadian Climate Institute. (2022). Damage Control: Reducing the costs of climate impacts in Canada.

5. Preparing North Cowichan

Identify Adaptation Pathways

North Cowichan’s adaptation pathways provide strategic direction for implementing adaptation actions. Each pathway aligns with the community’s vision. The pathways are complementary and interrelated. Travelling these parallel pathways together ensures a holistic and integrated response to climate change.



- 
Pathway 1
 Maintaining and Enhancing Municipal Services
- 
Pathway 2
 Preserving and Restoring the Environment
- 
Pathway 3
 Amplifying Action Through Collaboration

For all future actions outlined within the pathways, a high-level, order of magnitude cost is estimated using the following scale:



Minor capital (\$500K or less) or operating cost



Medium capital 500K-5M



Major capital 5M+



Adaptation Pathway #1

Maintaining and Enhancing Municipal Services

North Cowichan acknowledges the imperative of readiness and responsiveness to the impacts of climate hazards. The first adaptation pathway focuses on maintaining the continuity and effectiveness of the services essential for North Cowichan's well-being. Actions along this pathway contribute to the preparedness and response of municipal services to climate hazards.

Objectives

- 1 Protect the health and well-being of community members and staff
- 2 Integrate climate adaptation into planning and policy
- 3 Enhance the resilience of built assets and services
- 4 Maintain the continuity of critical services
- 5 Expand staff training and resources to support adaptation



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Objective 1: Protect the health and well-being of community members and staff

Actions

- 1.1 Implement actions from the Parks & Trails Master Plan (2017 and future updates) to reinforce and include protection of green networks to moderate urban heat effects and foster broad ecosystem services (including air and water filtration, biodiversity, and soil stabilization).
- 1.2 Implement North Cowichan's Occupational Health and Safety Program heat response guidelines that outline procedures to prevent employees from being exposed to situations that could cause heat stress.
- 1.3 Undertake danger tree assessments, trail inspections and maintenance in response to damage caused by climate events.
- 1.4 Increase tree density near playgrounds to offer shade and ecosystem benefit, where possible. \$
- 1.5 Evaluate the required HVAC upgrades needed for facilities to support customer and staff comfort during heatwaves. \$
- 1.6 Explore feasibility of an urban forest strategy. \$

● Underway ● Early Stages ● Future



Objective 2: Integrate climate adaptation into planning and policy

Actions

- 2.1 Develop zoning bylaw guidelines for the protection of riparian areas and critical habitats.
- 2.2 Model water supply and system to meet future growth requirements.
- 2.3 Provide awareness and supporting programs to encourage homeowners to install heat pumps.
- 2.4 Review and adjust Hazard Lands Development Permit Area Guidelines (DPA-4) to enhance climate hazard considerations and explore flexibility in development guidelines where appropriate.
- 2.5 Review and update Development Permit landscaping guidelines to support resilience to drought, mitigate flooding and enhance ecosystems.
- 2.6 Update Official Community Plan hazard and environmental mapping as new information becomes available. \$
- 2.7 Update subdivision servicing and zoning bylaws, engineering standards, and development policies to reflect climate resilient standards and best practices. \$
- 2.8 Develop flood protection programs to set the direction for the level of service in conjunction with the CVRD and Duncan. \$
- 2.9 Identify options to mitigate the impact of wildfire risk management on developable areas and development project viability. \$
- 2.10 Consider updating the Official Community Plan to include direction for post-disaster recovery. \$

17



Underway



Early Stages



Future

Objective 3: Enhance the resilience of built assets and services

Actions




- 3.1 Relocate Joint Utility Board (JUB) Sewage outfall from the Cowichan River to Cowichan Bay to mitigate low dilution potential during low water conditions and mitigate flooding of the JUB Sewage Treatment Plant from backflow through the outfall pipe.
- 3.2 Prioritize planting drought-resistant landscaping in new developments, municipal capital projects, and parks to reduce unnecessary demand on municipal water systems.
- 3.3 Develop a Drought Management Plan for drinking water systems.
- 3.4 Collaborate with the City of Duncan, First Nations, and the Ministry of Environment and Climate Change Strategy to investigate additional drinking water supply options.
- 3.5 Apply a climate lens to upcoming asset management plans, and operations and maintenance plans.



There is significant overlap between climate adaptation actions and asset management actions (both engineered and natural). An increase to the level of maintenance provided or earlier asset renewal and replacement may help mitigate climate hazard impacts on our infrastructure-based services or natural assets. Funding and resources dedicated towards these activities can realize benefits for both asset management and climate adaptation.

- 3.6 Update the Master Drainage Plan (1981) and integrate climate change projected storm flows.
- 3.7 Undertake capital projects to reduce leaks in the municipal water system and upgrade reservoir and pump capacity.
- 3.8 Conduct a review of FireSmart practices for critical infrastructure systems and enhance annual FireSmart maintenance activities.



 Underway  Early Stages  Future






- 3.9 Conduct a detailed assessment of climate change impacts on long-term aquifer sustainability and recharge. \$
- 3.10 Review and enhance maintenance procedures for drainage and flood infrastructure. \$
- 3.11 Evaluate alternative pipe material for water, sewer and drainage systems to reduce vulnerability to wildfire. \$
- 3.12 Evaluate alternative turf practices to reduce the vulnerability of sports fields and parks facilities to extreme heat. \$
- 3.13 Conduct a detailed assessment of climate risks to transportation routes and develop adaptation strategies. \$
- 3.14 Conduct an assessment of critical water and sanitary system assets' vulnerability to landslide, flooding and wildfire risk. \$
- 3.15 Reassess and enhance flood protection measures for South End/ Crofton/Chemainus water and sanitary system. \$\$

Underway
 Early Stages
 Future




Objective 4: Maintain the continuity of critical services




Actions

- 4.1 Develop and maintain alignment with CVRD on water shortage planning and response.
- 4.2 Explore and pilot strategies for adjusting the timing and approach to aquatic centre closure, maintenance and refill period in response to water shortage conditions.
- 4.3 Evaluate upgrade opportunities to improve irrigation efficiencies for municipal properties.
- 4.4 Develop Business Continuity plans for critical systems and services. 
- 4.5 Install emergency shut-off valves to support water system response during extreme events. 
- 4.6 Upgrade HVAC systems that support critical systems to accommodate extreme heat events. 

Objective 5: Expand staff training and resources to support adaptation

Actions

- 5.1 Train staff with skills needed to assess urban trees and the Municipal Forest Reserve for risks to public safety.
- 5.2 Continue to engage local First Nations to add capacity and redundancy for high-demand silvicultural adaptation activities (e.g., wildfire fuel reduction).
- 5.3 Improve staff knowledge to address invasive species by increasing awareness training. 
- 5.4 Develop a fact sheet on the urban heat island effect for staff, residents and developers. 
- 5.5 Develop procedures and staff training for asset restart following power outages. 

 Underway
  Early Stages
  Future



Adaptation Pathway #2

Preserving and Restoring the Environment

North Cowichan recognizes the essential role of the natural environment in community well-being. The second adaptation pathway emphasizes proactive measures to enhance the resilience of the region's ecosystems. Actions along this pathway involve stewardship, preservation, protection and enhancing the resilience of the natural environments to climate hazards.

Objectives


- 6 Steward and preserve ecosystem functions
- 7 Foster climate resilient natural systems








Objective 6: Steward and preserve ecosystem functions




Actions

- 6.1 Restore and preserve biodiversity.
- 6.2 Enhance water monitoring initiatives for lake ecosystems.
- 6.3 Control invasive species listed in the Nuisance Abatement and Cost Recovery Bylaw and assess treatment priorities with adjacent land managers periodically.
- 6.4 Monitor, preserve and restore saltwater/marsh areas to enhance coastal protection. 

Objective 7: Foster climate resilient natural systems

Actions

- 7.1 Develop and implement a Municipal Natural Assets Management Plan.
- 7.2 Implement the Community Wildfire Protection Plan (CWPP) and advance fuel hazard reduction treatments in identified high risk areas.
- 7.3 Enhance slope stability by preserving trees on vegetated steep slopes. 
- 7.4 Consider tree planting in the Municipal Forest Reserve early in the fall to enhance the resilience of younger trees to extreme heat impacts. 
- 7.5 Support ecosystem resilience during heatwaves by planting and preserving shade trees in riparian areas. 

 Underway
  Early Stages
  Future



Adaptation Pathway #3

Amplifying Action Through Collaboration

Regional collaboration and community cohesion are critical to addressing the impacts of climate change in North Cowichan. The third adaptation pathway focuses on developing the partnerships and processes necessary to enhance North Cowichan's adaptive capacity. Actions along this pathway focus on engagement, communication and collaboration to amplify the efforts of regional partners and community members.




Objectives




- 8 Facilitate community climate adaptation action
- 9 Develop lasting partnerships to advance action
- 10 Provide support for a climate-resilient economy



Objective 8: Facilitate community climate adaptation action

Actions

- 8.1 Engage with landowners on land use practices to reduce flood and wildfire risk and protect adjacent properties and infrastructure.
- 8.2 Provide tools to support the public in reporting fallen trees or debris on trails.
- 8.3 Collaborate with Emergency Management Cowichan to provide information to support homeowner preparedness initiatives and neighbourhood resilience programs.
- 8.4 Enhance water conservation through improved communication strategies and enforcement of the Waterworks Bylaw No. 3620.
- 8.5 Enhance and expand collaboration with local stewardship groups to increase community involvement in invasive species management, prevention, and restoration efforts. 
- 8.6 Encourage private property owners to participate in invasive species management by establishing cost-sharing agreements for the treatment of priority species listed in the Nuisance and Abatement Bylaw. 
- 8.7 Collaborate with Island Health and other partners to provide information about health and safety during heatwaves. 







 Underway  Early Stages  Future






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Objective 9: Develop lasting partnerships to advance action

Actions

- 9.1 Collaborate with Emergency Management Cowichan to develop and implement emergency response plans and post-disaster recovery plans.
- 9.2 Collaborate with federal, provincial, regional, and First Nations governments, and adjacent land managers on invasive species management efforts.
- 9.3 Work with the CVRD and implement Flood Construction Levels and zoning for the Lower Chemainus Watershed Floodplain Management Plan.
- 9.4 Participate in the CVRD-led Cowichan Region Climate Adaptation Advisory Group and Regional Airshed Leadership Team.
- 9.5 Collaborate with landowners, First Nations, provincial and federal governments to implement watershed health initiatives for the Chemainus River.
- 9.6 Collaborate with the CVRD to install river alarm systems for the Cowichan and Chemainus Rivers, and update and implement the Cowichan Integrated Flood Management Plan. 
- 9.7 Work with BC Hydro to enhance coordination during power outages and support for more reliable grid operations. 
- 9.8 Engage with Quw'utsun and Snuneymuxw First Nations to identify opportunities to collaborate on adaptation. 
- 9.9 Collaborate with regional partners to incentivize land development and resource extraction activities that preserve riparian areas and minimize the influence on flooding. 
- 9.10 Collaborate with CVRD to support CVRD Drinking Water and Watershed Protection Strategy 2020-2030 implementation. 
- 9.11 Engage with social support groups to collaborate on amplifying climate resilience for vulnerable populations. 

 Underway  Early Stages  Future



Objective 10: Provide support for a climate resilient economy

Actions

- 10.1 Engage with the Agriculture Advisory Committee to collaborate on implementing climate resilience in a way that also strengthens the local economy.
- 10.2 Collaborate with CVRD and coastal businesses to support resilience to coastal storm surge/sea level rise.
- 10.3 Collaborate with the CVRD to amplify support for local businesses and tourism industries to explore adaptation options and business continuity planning.
- 10.4 Prepare information sheet on resources available to the agriculture sector in emergency situations.



Underway



Early Stages



Future

Implement Adaptation Actions

Implementing This Strategy

Increasingly, Canadian municipalities are aware of the need to adapt to climate change. Effectively preparing for and responding to climate change requires that plans and strategies be put into action. North Cowichan's Climate Adaptation Strategy will be implemented by incrementally mainstreaming the actions along each adaptation pathway into the Municipality's planning and decision-making processes.



The actions in this strategy are all considered a priority as they address the highest climate risks. The timing and associated costs for implementing the actions will be determined through each municipal department's annual business planning process. Each municipal department prepares an annual business plan which includes a climate change adaptation and mitigation lens. Staff will bring forward prioritized and budgeted climate adaptation actions in their annual business plans. This ongoing practice will ensure the actions are implemented strategically from year to year as conditions change.



Evaluate Adaptation Progress

The overarching aim of the actions along North Cowichan's Adaptation Pathways is to reduce climate risks and increase climate resilience. However, knowing whether these goals are being met is complex in large part because climate adaptation is a process, not an objective. Adapting to climate change is an iterative process and requires continuous learning and adjustment. As a result, unlike areas where success can be measured in clear, standardized metrics (for example, childhood literacy), successful climate adaptation requires an ability to respond to and manage changing climate and community conditions.

As a result, evaluating adaptation progress is an integrated part of North Cowichan's Adaptation Process. In this sense, monitoring and evaluating North Cowichan's adaptation progress involves exploring key questions and measuring progress and effectiveness as part of continuous work on climate adaptation.



Exploring Key Questions

1. What does success look like to North Cowichan?

Measures of successful climate adaptation are dynamic and context- and community-dependent. Defining success in North Cowichan's climate adaptation context involves understanding the Adaptation Pathways and Objectives. This clarity helps guide adaptation actions and measure progress.

2. What resources does North Cowichan have available?

Monitoring and evaluating require resources, both in terms of funding and expertise. They also require good information *and* sufficient capacity to assess it, interpret the results, and make informed decisions based on those findings.

3. Who is impacted by climate change and who benefits from adaptation?

Different people experience the impacts of climate change differently. Monitoring and evaluation approaches that consider who is most impacted by climate change and who benefits from the adaptation action(s) help make adaptation strategies more effective and equitable.

4. How does North Cowichan hold itself accountable to the outcomes of adaptation investments?

Setting clear expectations, defining measurable outcomes, and establishing mechanisms and processes to assist in robust monitoring and evaluation all help maintain accountability when determining whether adaptation actions are achieving their desired outcomes.

5. What additional benefits come from adaptation?

Many adaptation actions have additional positive impacts beyond addressing a single climate risk. Accounting for co-benefits can lead to more comprehensive adaptation strategies with wide-reaching positive impacts and greater community buy-in.

6. How can we remain flexible and responsive to changes?

Change is constant in the context of climate adaptation. Approaches to monitoring and evaluation should help, not hinder, responsiveness.



Shifting baselines and goalposts

Shifting baselines refers to the idea that environmental conditions change over time, which can make it difficult to define what success looks like. Additionally, shifting goalposts means that targets for success can also change as our understanding of climate change and its impacts evolves. This dynamic nature can make it difficult to set and maintain clear goals to guide the adaptation strategy.

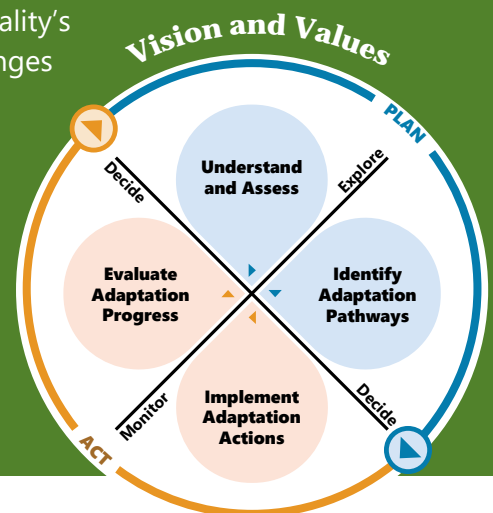
Measuring Progress and Effectiveness

As part of an annual review process, implementation progress and action effectiveness will be measured using the following framework.

| | Assess Implementation Progress | Assess Action Effectiveness |
|---------|--|---|
| Purpose | Assess the extent to which the adaptation plan has been put into action. | Assess the outcomes and impacts of climate adaptation actions. |
| Process | Track the implementation of adaptation measures across various departments and the degree to which collaborative efforts have been undertaken by evaluating the involvement of different sectors, the level of community engagement, and the integration of climate impact considerations. | Analyze changes in community conditions, such as vulnerability to climate risks, and the effectiveness of measures in achieving adaptation objectives by examining the operationalization of adaptation planning and the level of awareness and empowerment within the community. |
| Outcome | Insights into how well the adaptation plan is being executed, the level of commitment from different sectors, and any challenges encountered during implementation. | Insights into whether the implemented actions are achieving their intended objectives, the overall effectiveness of the adaptation efforts, and areas for improvement. |

Updating Our Strategy

The evaluation of adaptation progress supports the Municipality's ability to make informed decisions about any necessary changes to the adaptation strategy, for example, as new climate information is made available, as North Cowichan navigates climate hazard events, or as it integrates lessons learned from completed adaptation actions. These decisions ultimately lead back to the first phase of the climate adaptation planning process - Understanding and Assessing climate risks and contextual factors – from which North Cowichan can continue the iterative process of adapting to the changing climate.



Images

- Image 1. Municipality of North Cowichan
- Image 2. David Conway
- Image 3. Bodger, D. (2021). *Rain finally subsides, but flood damage extensive in Cowichan region*. Chemainus Valley Courier.
- Image 4. Municipality of North Cowichan
- Image 5. Greater Victoria News Staff. (2021). *Summer heat dome killed 48 on Vancouver Island: BC Coroners Service*. Nanaimo News Bulletin Daily.
- Image 6. Christensen, K. (2020). *Cowichan Valley Poised to Avoid Summer Drought*. My Cowichan Valley Now.
- Image 7. Municipality of North Cowichan. (2023). *Invasive Plant Species Fact Sheet: Gorse*.
- Image 8. Municipality of North Cowichan
- Image 9. Municipality of North Cowichan
- Image 10. Municipality of North Cowichan
- Image 11. Municipality of North Cowichan
- Image 12. Municipality of North Cowichan
- Image 13. Shaun Chadburn
- Image 14. Municipality of North Cowichan
- Image 15. Municipality of North Cowichan
- Image 16. Municipality of North Cowichan
- Image 17. Municipality of North Cowichan
- Image 18. Municipality of North Cowichan
- Image 19. Municipality of North Cowichan
- Image 20. Municipality of North Cowichan
- Image 21. Municipality of North Cowichan
- Image 22. Municipality of North Cowichan
- Image 23. Municipality of North Cowichan
- Image 24. Municipality of North Cowichan
- Image 25. Municipality of North Cowichan

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Climate Adaptation Strategy

Municipality of North Cowichan
northcowichan.ca

Appendix A

Risk Register



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Risk Register

Introduction

The following tables were used by staff to evaluate the risk statements that were identified in the vulnerability and risk assessment process.

The Risk Register sheet is the outcome of the climate risk assessment. It records the identified and evaluated risks to MNC's services which supported the development of adaptation actions.

| Likelihood | Description |
|---------------------|--|
| 1 Very Unlikely | The hazard is highly unlikely to occur, with no recorded instances in the past in North Cowichan. An extreme event would need to occur for the risk to be realized. Climate change indicators are not expected to influence the likelihood of the hazard. |
| 2 Unlikely | The hazard has a low likelihood of occurring, with occasional or rare instances in the past in North Cowichan. An extreme event would need to occur for the risk to be realized. Climate change indicators have a minor influence on the likelihood of the hazard. |
| 3 Possible | The hazard has a reasonable chance of occurring, with occasional instances in the past in North Cowichan. A severe event would need to occur for the risk to be realized. Climate change indicators suggest a potential increased likelihood of the hazard. |
| 4 Likely | The hazard is likely to occur, with multiple instances in the past in North Cowichan. A minor to severe event would need to be occur for the risk to be realized. Climate change indicators show an increased likelihood of conditions conducive to the hazard. |
| 5 Almost Certain | The hazard is highly likely to occur, with a history of frequent occurrences in North Cowichan. A minor event would result in the risk being realized. Climate change indicators show a strong increasing trend of conditions conducive to the hazard. |

| Severity | Public Health & Safety | Local Economy & Growth | Community & Lifestyle | Environment & Sustainability | Public Administration |
|----------|--|--|---|--|--|
| 1 | Minimal Appearance of a threat but no actual harm | Minor shortfall relative to current forecasts | There would be minor areas in which the region was unable to maintain its current services | No environmental damage | There would be minor instances of public administration being under more than usual stress but it could be managed |
| 2 | Minor Serious near misses or minor | Individually significant but isolated areas of reduction in economic performance relative to current forecasts | Isolated but noticeable examples of decline in services | Minor instances of environmental damage that could be reversed | Isolated instances of public administration being under severe pressure |
| 3 | Significant Small number of injuries | Significant general reduction in economic performance relative to current forecasts | General appreciable decline in services | Isolated but significant instances of environmental damage that might be reversed with intensive efforts | Public administration would be under severe pressure on several fronts |
| 4 | Major Isolated instances of serious injuries or loss of life | Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth | Severe and widespread decline in services and quality of life within the community | Severe loss of environmental amenity and a danger of continuing environmental damage | Public administration would struggle to remain effective and would be seen to be in danger of failing completely |
| 5 | Massive Large numbers of serious injuries or loss of lives | Regional decline leading to widespread business failure, loss of employment and hardship | The region would be seen as very unattractive, moribund and unable to support its community | Major widespread loss of environmental amenity and progressive irrecoverable environmental damage | Public administration would fall into decay and cease to be effective |

Risk Register

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|------------------------------------|--|------------------|-------------------|-------------|--------------------------------------|
| 1 | Extreme Wind | Extreme wind events increase blowdown in forested areas | 5 | 4 | 20 | 1.3, 5.1, 8.1, 9.2 |
| 2 | Invasive Species | Invasive species threaten all habitats and all ecosystems | 5 | 4 | 20 | 6.1, 6.3, 8.5, 8.6, 9.2, 9.5 |
| 3 | Heatwaves | Heatwaves impact lakes and ponds health by increasing risk of anoxia and blue/green algae | 5 | 4 | 20 | 6.2, 7.5, 9.5 |
| 4 | Water Shortages | Surface water shortages lead to stagnant lakes and increase blue green algae prevalence and reduced dissolved oxygen levels, which result in loss of aquatic habitat for dependent species | 5 | 4 | 20 | 2.2, 6.1, 6.2, 9.5, 9.10 |
| 5 | Severe Wildfire | Developable area is limited due to increased wildfire protection requirements, capital costs and insurance issues | 4 | 4 | 16 | 2.4, 2.6, 2.9, 7.2 |
| 6 | Coastal Storm Surge/Sea Level Rise | Sea level rise and storm surge leads to disturbances in established natural habitats | 5 | 3 | 15 | 2.1, 6.4 |
| 7 | Flooding | Flooding damages terrestrial and riparian habitats | 5 | 3 | 15 | 2.1, 2.5, 3.6, 6.2, 9.9 |
| 8 | Severe Wildfire | Severe wildfire damages/destroys built and natural recreation assets. | 3 | 5 | 15 | 2.6, 7.1, 7.2 |
| 9 | Severe Wildfire | Severe wildfire disrupts business continuity | 3 | 4 | 12 | 2.6, 3.14, 4.4, 7.2, 8.3, 10.3 |
| 10 | Extreme Wind | Extreme wind events damage natural assets (ex. Urban trees) | 4 | 3 | 12 | 1.3, 5.1, 7.3, 8.1 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|-----------------|--|------------------|-------------------|-------------|---|
| 11 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that damage terrestrial/aquatic habitats | 4 | 3 | 12 | 2.1, 2.6, 6.1, 6.2, 7.3, 9.5 |
| 12 | Severe Wildfire | Severe wildfires damage terrestrial habitats | 4 | 3 | 12 | 2.1, 2.6 |
| 13 | Water Shortages | Demand for water exceeds the capacity of the water system to maintain minimum levels of service | 3 | 4 | 12 | 3.2, 3.3, 3.4, 3.7, 3.9, 4.1, 8.4, 9.10 |
| 14 | Flooding | Flooding damages and/or impacts access to critical infrastructure components of the water system | 3 | 4 | 12 | 2.2, 2.6, 3.6, 3.15, 4.5 |
| 15 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that damage existing development | 4 | 3 | 12 | 2.4, 7.3 |
| 16 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that damage/block roads that are critical to the transportation network | 4 | 3 | 12 | 2.4, 3.13, 7.3 |
| 17 | Flooding | Extreme rainfall events and/or high river flows cause flood damage to roads that are critical to the transportation network | 4 | 3 | 12 | 2.2, 2.6, 3.6, 3.10, 3.13, 9.6 |
| 18 | Flooding | Extreme rainfall and riverine flooding overwhelm drainage systems resulting in damage to adjacent properties and infrastructure (infrastructure) | 4 | 3 | 12 | 2.2, 2.5, 2.8, 3.6, 3.10, 3.14, 8.1, 9.6, 9.9 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|------------------------------------|---|------------------|-------------------|-------------|--------------------------------------|
| 19 | Heatwaves | Extreme heat events result in reduced operations and maintenance efforts for parks/fields and facilities for staff health and safety considerations. | 5 | 2 | 10 | 1.2, 3.1, 3.12, 5.4, 8.7, 9.5 |
| 20 | Water Shortages | During a water shortage, lower flow in rivers leads to reduced dilution for effluent and potential permit compliance issues | 5 | 2 | 10 | 2.1, 3.9, 9.10 |
| 21 | Severe Wildfire | Severe wildfires damage/destroy critical components of the drinking water system | 2 | 5 | 10 | 3.8, 3.11, 3.14, 4.5, 7.2 |
| 22 | Flooding | Flooding from extreme rain or high riverine flow events damages recreation assets | 3 | 3 | 9 | 2.6, 3.6, 9.6 |
| 23 | Coastal Storm Surge/Sea Level Rise | Coastal flooding events impact large tax base of employers in vulnerable locations | 3 | 3 | 9 | 2.6, 6.4, 10.2 |
| 24 | Severe Wildfire | Clean up of waste post-wildfire would be beyond the capacity of existing waste services. | 3 | 3 | 9 | 7.2 |
| 25 | Flooding | Extreme rainfall results in inflow and infiltration resulting in sewage back ups in homes, liftstations, storm sewer and impacts treatment processes. | 3 | 3 | 9 | 2.2, 3.1, 3.6, 3.14 |
| 26 | Coastal Storm Surge/Sea Level Rise | Storm surges lead to flooding that closes/damages coastal roads and sidewalks | 3 | 3 | 9 | 2.6, 3.6, 6.4, 10.2 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|-----------------|---|------------------|-------------------|-------------|--------------------------------------|
| 27 | Severe Wildfire | Severe wildfire weakens tree root systems, increasing risk of landslides in geohazard prone areas | 3 | 3 | 9 | 7.2, 7.3 |
| 28 | Severe Wildfire | Severe wildfire in Municipal Forest Reserve (MFR) prevents access to critical infrastructure | 3 | 3 | 9 | 3.8, 5.2 |
| 29 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that damage significant portions of forested areas | 2 | 4 | 8 | 7.3 |
| 30 | Flooding | Flooding events cause culvert blockages and road washouts in forested areas, preventing access | 4 | 2 | 8 | 3.10 |
| 31 | Water Shortages | Reduced surface water availability during water shortages leads to increased tree mortality in sensitive species | 4 | 2 | 8 | 3.2, 6.1, 7.3, 9.10 |
| 32 | Extreme Wind | Extreme wind events lead to power outages, causing damages to key recreation assets and interrupting service | 4 | 2 | 8 | 1.3, 5.1, 5.5, 9.7 |
| 33 | Extreme Wind | Wind event generates debris volumes exceeding the capacity of current service levels | 4 | 2 | 8 | 1.3 |
| 34 | Severe Wildfire | Severe wildfires damage/destroy critical wastewater infrastructure | 2 | 4 | 8 | 2.6, 3.8, 3.11, 3.14, 7.2 |
| 35 | Severe Wildfire | Severe wildfires damage/destroy critical components of the drainage/flood protection system | 2 | 4 | 8 | 2.6, 3.8, 3.11, 3.14, 7.2 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|------------------|---|------------------|-------------------|-------------|---|
| 36 | Water Shortages | Water shortages limit community growth | 2 | 4 | 8 | 2.2, , 3.3, 3.4, 3.9, 4.1, 9.10 |
| 37 | Extreme Wind | Extreme wind blows down power lines / trees, leading to closures of roads that are critical to the transportation network | 4 | 2 | 8 | 1.3, 3.13, 5.1, 5.5, 9.2 |
| 38 | Extreme Cold | Extreme cold could impair water system | 3 | 2 | 6 | 4.5 |
| 39 | Extreme Wind | Extreme wind events cause power outages and disruptions to business continuity | 3 | 2 | 6 | 1.3, 4.4, 5.1, 5.5, 9.7, 10.3 |
| 40 | Flooding | Major flooding stresses MNC finances during response and recovery | 3 | 2 | 6 | 2.2, 2.8, 2.10, 3.6, 9.6 |
| 41 | Invasive Species | Increase in invasive species in forested areas impacts plantation survival | 2 | 3 | 6 | 5.3, 6.1, 8.5, 9.2 |
| 42 | Heatwaves | Extreme heat events impact tree growth in younger tree plantations | 3 | 2 | 6 | 6.1, 7.3, 7.4 |
| 43 | Invasive Species | Increased invasive species presence slows down development and increases costs for removal | 3 | 2 | 6 | 2.5, 5.3, 6.3, 8.5, 9.2 |
| 44 | Water Shortages | Water shortages impact local businesses/ industry that rely on water. | 3 | 2 | 6 | 2.2, , 3.3, 3.4, 3.9, 4.1, 4.4, 8.4, 9.10, 10.3 |
| 45 | Extreme Wind | Extreme wind events cause power outages and downed powerpoles/trees prevent access to critical infrastructure | 3 | 2 | 6 | 1.3, 5.1, 5.5, 9.7 |
| 46 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that damage critical water system assets | 2 | 3 | 6 | 3.14, 4.5, 7.3 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|------------------|--|------------------|-------------------|-------------|--------------------------------------|
| 47 | Extreme Wind | Extreme wind events lead to powerline failure and downed powerlines/trees block transportation network preventing refuelling of back up generators. Large trees fall and damage dykes. | 2 | 3 | 6 | 1.3, 3.13, 5.1, 5.5, 9.7 |
| 48 | Heatwaves | Extreme heat events negatively impact functionality of low impact development and runoff treatment infrastructure | 3 | 2 | 6 | 7.1 |
| 49 | Severe Wildfire | Severe wildfire leads to increased tree mortality and decreased slope stability resulting in deadfall and sediment impairing drainage capacity | 2 | 3 | 6 | 2.1, 3.14, 7.2, 7.3 |
| 50 | Severe Wildfire | Severe wildfires cause damage to roads that are critical to the transportation network | 3 | 2 | 6 | 2.6, 3.8, 3.13, 7.2 |
| 51 | General | Changes to freeze-thaw cycles, shifting precipitation patterns, more frequent flooding events, and increased summer temperatures impact transportation annual operations and maintenance plans | 3 | 2 | 6 | 1.3, 3.13 |
| 52 | Invasive Species | Increased invasive species presence requires parks staff time and resources to remove and maintain | 5 | 1 | 5 | 5.3, 6.1, 6.3, 8.5, 8.6, 9.2 |
| 53 | Heatwaves | Extreme heat events cause work interruptions for health and safety considerations. | 4 | 1 | 4 | 1.1, 1.2, 1.5, 3.12, 5.4, 8.7 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|-----------------|--|------------------|-------------------|-------------|--------------------------------------|
| 54 | Heatwaves | Extreme heat events lead to increased demand for cooling centres (recreation facilities and spaces) | 4 | 1 | 4 | 1.1, 1.4, 1.5, 2.3, 4.6, 5.4, 8.3 |
| 55 | Water Shortages | Water shortages and resultant usage restrictions causes accelerated deterioration or loss of recreation infrastructure assets | 4 | 1 | 4 | 2.2, 4.2, 4.3 |
| 56 | Heatwaves | Extreme heat events cause disruption to regularly scheduled waste collection pick-up due to staff health and safety considerations. | 4 | 1 | 4 | 1.2 |
| 57 | Flooding | Extreme rainfall events impact transportation routes resulting in delays in garbage pick up | 4 | 1 | 4 | 3.13, 9.6 |
| 58 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that block storm/flood infrastructure resulting in flooding | 2 | 2 | 4 | 3.1, 7.3, 9.3 |
| 59 | Flooding | Developable area is limited due to changing flood protection requirements, capital costs and insurance issues | 2 | 2 | 4 | 1.5, 2.2, 2.4, 2.6, 3.6, 9.6 |
| 60 | Heatwaves | Extreme heat events exceed the cooling capacity of municipal buildings | 3 | 1 | 3 | 4.6, 5.4 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|------------------------------------|--|------------------|-------------------|-------------|--------------------------------------|
| 61 | Landslides | Wildfires, heatwaves, drought and extreme rainfall impact slope stability, increasing the risk of landslides that restrict access to recreation sites (trails) in MFR | 3 | 1 | 3 | 7.3 |
| 62 | Coastal Storm Surge/Sea Level Rise | Coastal storm surge events damage/destroy coastal recreation infrastructure | 1 | 3 | 3 | 2.6, 6.4, 10.2 |
| 63 | Coastal Storm Surge/Sea Level Rise | Coastal flooding closes coastal roads, prevent access for goods, staff, and customers for local businesses | 1 | 3 | 3 | 4.4, 6.4, 10.2, 10.3 |
| 64 | Flooding | Flooding events impact business continuity of North Cowichan business impacting tax base, employment and food security | 1 | 3 | 3 | 2.2, 3.6, 4.4, 10.3 |
| 65 | Coastal Storm Surge/Sea Level Rise | Coastal storm surge events damage wastewater system infrastructure | 1 | 3 | 3 | 6.4, 10.2 |
| 66 | Coastal Storm Surge/Sea Level Rise | Coastal storm surge events combined with sea level rise cause increased backflow into the storm system, leading to flooding and saltwater intrusion and damage coastal drainage infrastructure | 1 | 3 | 3 | 6.4 |
| 67 | Flooding | Flooding in developed areas results in the high risk areas becoming uninhabitable | 1 | 3 | 3 | 2.2, 2.4, 2.6, 3.6, 6.4, 9.3, 9.6 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|------------------------------------|--|------------------|-------------------|-------------|--------------------------------------|
| 68 | Severe Wildfire | Closure of forestry/wood products business erodes tax base and increases unemployment in area | 1 | 3 | 3 | 4.4, 7.2, 10.3 |
| 69 | Extreme cold | Heavy snowfall events require road/sidewalk clearing that exceeds the current level of service | 2 | 1 | 2 | |
| 70 | Extreme Cold | Extreme cold results in increased demand for recreational centres to be used for warming | 2 | 1 | 2 | |
| 71 | Extreme Wind | Extreme wind events lead to loss of power for critical water system components | 1 | 2 | 2 | 4.5, 5.1, 5.5, 9.7 |
| 72 | Invasive Species | Increased occurrence and abundance of invasive species within drainage systems could cause root penetration into stormwater pipes, causing localized flooding. | 1 | 2 | 2 | 5.3, 6.1, 8.5, 9.2 |
| 73 | Flooding | Extreme rainfall events leading to sediment buildup in stormwater ponds | 2 | 1 | 2 | 2.5, 3.6, 3.10, 3.14 |
| 74 | Coastal Storm Surge/Sea Level Rise | Long term sea level rise causes settlements near the ocean to become uninhabitable | 1 | 2 | 2 | 2.6, 10.2 |
| 75 | Heatwaves | Heatwaves cause thermal expansion of road and sidewalks resulting in heaving. | 2 | 1 | 2 | 1.1, 5.4 |
| 76 | Extreme Cold | Extreme cold could impair sewer system | 1 | 1 | 1 | |
| 77 | Coastal Storm Surge/Sea Level Rise | Coastal storm surge closes coastal transportation routes resulting in delays to waste pickup | 1 | 1 | 1 | 3.13, 10.2 |

| ID | Climate Hazard | Risk Statement | Likelihood Score | Consequence Score | Risk Rating | Related Climate Adaptation Action(s) |
|----|-----------------|---|------------------|-------------------|-------------|--------------------------------------|
| 78 | Heatwaves | Heatwaves can result in increased odours. | 1 | 1 | 1 | |
| 79 | Severe Wildfire | Severe wildfires damage/destroy cemeteries and interrupt burial services | 1 | 1 | 1 | 2.6, 7.2 |
| 80 | Water Shortages | Water restrictions during water shortages lead to the death of memorial trees due to lack of watering. | 1 | 1 | 1 | 2.5, 3.2, 4.3 |
| 81 | Heatwaves | Heatwaves lead to delays in transportation repair/construction projects due to health and safety considerations for workers | 1 | 1 | 1 | 1.2, 3.13, 5.4, 8.7 |