





Naturally Resilient

MNRF'S NATURAL RESOURCE CLIMATE ADAPTATION STRATEGY (2017–2021)





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INTRODUCTION: TAKING ACTION

The climate is changing and these changes are impacting natural resources across Ontario, including species, ecosystems and other components of the biodiversity that underpins a healthy environment. Healthy and biodiverse natural resources are important to the wellbeing of the people of Ontario. They provide important environmental, economic and social benefits including food, clean water, storm protection, products, jobs and recreational opportunities.

The Ministry of Natural Resources and Forestry (MNRF) is responsible for protecting Ontario's biodiversity and managing its natural resources in an ecologically sustainable way – its forests, fisheries, wildlife, lands, waters, aggregates and petroleum resources. This includes providing stewardship over provincial parks and protected areas, supporting outdoor recreation opportunities, promoting economic opportunities in the resource sector, and managing provincially assigned emergency types.

The ministry's role also includes promoting knowledge, strengthening management through innovation, supporting partnerships, and increasing First Nation and Métis participation in natural resource management.

MNRF is already beginning to observe the impacts of climate change during everyday work. Climate change is creating an increasingly complex operating environment and introducing additional uncertainty for the ministry in fulfillment of its responsibilities. Further impacts of climate change have the potential to present significant challenges for delivery of the ministry's mandate. *Naturally Resilient* will ensure the ministry is well positioned to reduce its vulnerabilities, fulfill its mandate, and address the impacts of climate change – thereby safeguarding valuable resources and the services they provide, as well as the communities and economies that depend on them.

1.1. NATURAL RESOURCES IN ONTARIO ARE VULNERABLE TO CLIMATE CHANGE

Ontario's climate has experienced significant changes over the last 40 years. Since 1970, the province has observed an increase in minimum temperatures, with a 2.6°C rise in Northern Ontario and a 1.4°C warming in Southern Ontario. Parts of the province have become slightly wetter and more winter precipitation is falling as rain. Drier summer conditions are being felt in some regions as a result of reduced snow accumulation, soil moisture and spring runoff. Warming temperatures, increased frequency of weather anomalies, changing precipitation patterns and other climatic changes are putting stresses on the environment and the communities and economies that depend on the natural world.



Research suggests that climate change will very likely impact natural resources in Ontario under a range of possible future scenarios. For example, <u>Figure 1</u> depicts potential impacts to natural resources in the 2050's, under a businessas-usual greenhouse gas emissions scenario. The impacts of climate change are expected to vary across the province, with differing implications for Northern and Southern Ontario, and for communities located in rural or urban areas.

As part of its commitment to a healthy and naturally diverse environment, MNRF has taken significant steps to respond to climate change. For more than 20 years, the ministry has advanced research, monitoring, partnership and natural resource management initiatives to support climate change mitigation and adaptation. Due to the uncertainty associated with predicting future climate conditions and the adaptive capacity of natural systems, MNRF's work is guided by a precautionary approach, including the need for adaptive management. This approach can be effective across multiple potential scenarios.

Naturally Resilient builds on this foundation and renews MNRF's commitment to addressing the impacts of climate change. It sets out forward-thinking goals and actions that complement the ministry's current adaptation initiatives and provide a framework for introducing new initiatives.

OBSERVED ENVIRONMENTAL IMPACTS OF CLIMATE CHANGE IN ONTARIO

- Trees and other plants such as wild blueberries are experiencing earlier leaf production, longer growing seasons, and bud, flower, and fruit damage, due to more spring freezes and expanded ranges of insect pests and pathogens.
- Native species known to live in certain parts of the province are expanding into new areas, resulting in new species interactions, such as cross-breeding and the introduction of hybrid species.
- Reduced ice seasons are affecting biodiversity in coastal wetlands and nearshore habitat, reducing ice fishing opportunities, making food less available for polar bears, and rendering shorelines more susceptible to damage from extreme storm events in winter.
- Lyme disease, a bacteria spread by some species of tick which once had limited range in Ontario due to temperature, is emerging as a serious health risk in new areas.
- ► Fire seasons have ended later in the year over recent decades, resulting in overall longer fire seasons, and lightning-caused fires in the northwest have increased.
- Increased frequency of extreme weather and changing precipitation patterns are creating more frequent low and high water level situations in Ontario, resulting in increased requests for provincial disaster assistance and associated costs.



LOOKING AHEAD: 2050s UNDER A BUSINESS-AS-USUAL EMISSIONS SCENARIO

Climate modeling is an evolving science but projections remain relatively consistent, even as models and the ability to interpret them improve. The three impact models in <u>Figure 1</u> show examples of changes in the 2050s under a business-as-usual greenhouse gas emissions scenario, based on Ontario climate research efforts.

- Increasing temperatures, changing precipitation: Southern Ontario is projected to experience a 4 – 4.5 °C increase in annual temperature, with greater increases in winter months compared to summer months. Northern Ontario would experience a more significant increase of 4.5 – 6 °C. Precipitation could increase minimally in some parts of the province, with more lakeeffect precipitation and more frequent extreme weather events including heavy rains, wind and ice storms.
- Shifting climatic conditions affecting biodiversity: Climatic conditions, such as temperature and precipitation, drive how ecosystems are formed and function. As the climate changes, the climate conditions that support plants, animals and other organisms in Ontario are expected to shift northward, influencing the amount of suitable habitat for these species and affecting biodiversity in unique and novel ways. For example, in the middle map, climate conditions suitable to support the species of Ecoregion 6E in South-central Ontario are projected to shift northward and fragment (full climate envelope), with the best representation of suitable conditions centered near the Sault Ste. Marie area (core climate envelope).
- Impacts to commercial and recreational fish species: Shifting climate conditions such as those presented in the middle map could have particularly significant impacts for fish species in Ontario. Fish habitats would be altered as water warms, stream flows change and oxygen levels decrease. Coldwater species such as brook trout and lake trout, may see a 50-60% decline in habitat, while cool and warmwater species, such as walleye and smallmouth bass, may see a 50-80% increase.
- Impacts to tree species and forest ecosystems: As climate conditions shift, the types of trees that will do best in a given location are expected to gradually change over time. Some southern populations of eastern white pine, Ontario's provincial tree, may no longer experience the climate they regenerated in. In these locations, it is expected that white pine will gradually be replaced by faster growing southern species moving north.



CHANGE IN AVERAGE ANNUAL TEMPERATURE – 2050s RCP 8.5 scenario, applied to downscaled ensemble of 4 Earth Systems Models



MOVEMENT OF ECOREGION 6E CLIMATIC CONDITIONS BY 2050 A2 scenario, applied to downscaled CGCM2



AN EXAMPLE OF CLIMATE NICHE MODELLING FOR WHITE PINE BY 2060 A2 scenario, applied to 3 General Circulation Models

THE STRATEGY

NATURALLY RESILIENT:

Provides a strategic framework that will enable MNRF to fulfill its sustainable natural resource management mandate in a changing climate. This includes taking actions to maintain, enhance and restore the resilience of natural resources and ecosystems in Ontario.

This strategic, coordinated five-year framework ensures that MNRF can adapt ministry business to address the key climate change vulnerabilities to its natural resource management mandate. It outlines the specific types of actions the ministry is advancing to respond to a changing climate, focuses science and research efforts, and supports the implementation of policy and program initiatives across the ministry.

The actions outlined in Naturally Resilient build on MNRF's existing climate change adaptation efforts and will support Ontario in moving towards a new provincial adaptation approach that builds on the Climate Ready (2011–2014) adaptation plan.

The strategy also complements Ontario's Climate Change Strategy and Action Plan, which outline the province's climate change mitigation efforts actions that reduce, sequester or prevent emissions of greenhouse gases into the atmosphere and build a low-carbon economy (Figure 2).





THE ROLE OF NATURAL RESOURCES IN CLIMATE CHANGE MITIGATION

Forests, lands and healthy diverse ecosystems play a unique role in climate change mitigation. Trees, plants and soils all naturally store and release carbon over time. The process of storing carbon is called "carbon sequestration". As trees and plants grow, they absorb carbon dioxide from the atmosphere through photosynthesis and store the carbon in their leaves, stems and roots. Carbon is also stored in soil when trees and plants decompose.

Areas of forests and lands that sequester more carbon than they release are known as carbon sinks. Wetlands and peatlands are particularly important in reducing greenhouse gas concentrations because they have the potential to sequester and store significant amounts of carbon.

Long-lived harvested wood products such as furniture and wood used in construction can also store carbon and act as carbon sinks; keeping the carbon out of the atmosphere for the lifetime of the structure or longer if the wood is reclaimed and re-used or remanufactured into other products. The way forests are managed can influence the amount of carbon that is released into the atmosphere and that is stored in trees and harvested wood products.

Forests and lands can also be carbon sources, meaning they emit more carbon than they sequester. This can occur through natural disturbances such as forest fires, disease, insect infestations and mortality of trees in older forests, or through human disturbances such as conversion of wetlands to other land uses.

MNRF is contributing to climate change mitigation efforts in Ontario's Climate Change Strategy and Action Plan by:

- Working with partner ministries to develop a land use carbon inventory to assess the potential of agriculture, forestry and other land uses to emit, remove and store carbon;
- Assessing the role managed Crown forests can play in mitigating the effects of climate change and reducing greenhouse gases;
- Supporting programs to guide and enhance wetland and grassland conservation, restoration and management;
- Advancing a mass timber buildings research program to advance building science, technologies, materials, and designs needed to meet emission reduction goals for the buildings sector, and supporting development of a wood stove exchange program to retrofit existing, inefficient wood stoves, furnaces and boilers with more efficient wood heating appliances in northern communities;
- Continuing to plant trees across the province through Ontario's 50 Million Tree Program to restore forest cover on suitable lands, including a doubling of the number of trees planted within the boundaries of urban municipalities;
- Supporting development of offset programs and protocols to promote participation in both the compliance and voluntary offset markets; and
- Releasing a draft Far North Land Use Strategy to provide guidance to support preparation of community based land use plans in the Far North of Ontario and integration of matters beyond the scale of individual plans, such as climate change.

2.1. ASSESSMENT OF THE VULNERABILITY OF MNRF'S MANDATE TO CLIMATE CHANGE

Taking into consideration the latest science and research, MNRF conducted a ministry-wide assessment in 2016 to determine its vulnerability to the impacts of climate change and ability to effectively meet its mandate and organizational goals in the future.

The results indicated that climate change could have far-reaching, numerous and diverse impacts on the ministry's ability to do so. The assessment also revealed that a suite of adaptation actions by the ministry and its partners is needed to reduce its vulnerability.

The assessment explored the potential impacts on ministry business from a series of climate stressors, including warmer air and water, sea level rise, extreme events and changing precipitation (Figure 3)¹. It reflected the broad range and diversity of potential impacts, including those with slow onset, sudden onset and variability regarding intensity and timing (short [2020] and long [2050] terms), as well as whether impacts would be felt more severely in specific parts of the province.

Types of vulnerabilities varied from those associated with MNRF's mandate for maintaining infrastructure and ensuring public safety, to conserving biodiversity, delivering services, sustainably developing resources and providing opportunities for recreation.

In order to focus the ministry's adaptation efforts over the coming five years, the areas of MNRF's mandate with the greatest vulnerability to climate change were identified, assessed, and prioritized.

Key MNRF Mandate Areas Vulnerable to Climate Change

FROM THE MANDATE AREAS POTENTIALLY VULNERABLE TO CLIMATE CHANGE, 11 KEY AREAS WERE IDENTIFIED:

Conserving biodiversity

Conserving wetlands, including Far North peatlands

Maintaining the ecological integrity and ecotype representation of protected areas

Managing Crown forests sustainably

Managing fish and wildlife sustainably

Managing water resources sustainably

Operating and maintaining Crown-owned dams and other public infrastructure

Preventing, detecting and responding to invasive species

Protecting and recovering species at risk

Providing socioeconomic benefits of natural resource use and development

Responding to provincially assigned emergency types and natural hazard management

1 Stressors derived from general climate change projections presented in the fifth assessment report of the Intergovernmental Panel on Climate Change for the three main drainage basins in Ontario.

Figure 3: Areas of MNRF's Mandate Vulnerable to Climate Change – Grouped by Primary Stressor



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2.2. INDIGENOUS COMMUNITIES AND CLIMATE CHANGE

Climate change has the potential to impact many First Nation and Métis communities. For example, communities in Northern Ontario rely on ice roads for access and provision of essential products and services. Warmer winters disrupt travel on winter roads, impacting the ability of communities to bring in materials, including building supplies and the diesel fuel some communities continue to rely on for electricity generation.

MNRF is committed to working collaboratively with Indigenous peoples to exchange knowledge and experiences, and find potential solutions for adapting to climate change. For example, in the Far North of Ontario, traditional knowledge is a foundation for land use plans that are being jointly prepared by First Nations and MNRF. Appropriate sharing and use of traditional knowledge about peoples' relationship to and use of the land can also inform climate change adaptation approaches. Engagement with Indigenous peoples will continue to be a focus for the ministry. First Nation and Métis observations and understanding of changes in land, ecosystems and species add critical information to the climate change knowledge base. In working toward the goals and actions in this strategy, MNRF will seek to explore opportunities to learn from Indigenous communities and incorporate traditional knowledge in the understanding of climate change and potential adaptation actions. MNRF is also committed to respecting Aboriginal and treaty rights, and meeting any constitutional or other obligations including the duty to consult that may arise due to government action on climate change.

As MNRF carries out the actions identified in *Naturally Resilient*, the ministry intends to consider opportunities to improve Indigenous peoples' quality of life, support capacity building within communities, expand sharing of information and data between government and Indigenous peoples, and identify collaborative endeavours for adaptation.



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STRATEGY GOALS AND ACTIONS: 2017–2021

Naturally Resilient is organized around five goals that advance a series of actions needed to address MNRF's key areas of vulnerability and deliver on its mandate.

THE GOALS ARE:

- Mainstream Adaptation
- Build Resilience and Biodiversity
- ▶ Increase Science, Research and Knowledge
- Increase Awareness and Motivation
- Optimize Services and Response

The adaptation actions outlined in the strategy commit MNRF to undertaking initiatives over the next five years that will ensure progress towards the goals, including activities in the areas of policy, information, operations and service delivery.

Many of the actions are already underway and involve a wide range of the ministry's core business areas, from sustainable natural resource development, emergency response, natural hazard management and recreational opportunities, to enhancing nature's ability to withstand climate change through stewardship of biodiversity and resilient environments and communities.

Implementation may be carried out on a provincial, regional or local basis depending upon the scale of the vulnerability to MNRF's mandate, the distinct qualities of the potential impacts and the type of actions required to address those impacts. MNRF will continue to work toward the goals throughout the five-year period of the strategy, as ongoing adaptation initiatives are extended and new initiatives are introduced.

Some actions will require a straightforward approach, while others may take longer to complete and involve sequential steps and a number of partners. MNRF is committed to working collaboratively with all levels of government and identifying opportunities to continue collaboration with the public and partners to pursue the goals of *Naturally Resilient*.

Taking action to accomplish the goals of the strategy will benefit MNRF in delivering its mandate and will also provide benefits to the people of Ontario, including those who rely on natural resources for traditional, recreational and economic purposes. For example, First Nation and Métis communities' access and use of natural resources for traditional medicines, food supplies, cultural purposes and economic opportunities could be affected by climate change. Planning for resilience, improving emergency services, enhancing outreach and collaboration, and increasing the potential benefits to these communities.



GOAL 1: MAINSTREAM ADAPTATION

CLIMATE CHANGE ADAPTATION IS INTEGRATED INTO POLICY, PLANNING, PROGRAMS AND PRACTICES.

ACTIONS:

1.1: Work Within Government – Encourage consideration of natural resource climate change adaptation as part of provincial initiatives

1.2: Planning and Strategy – Take into account climate impacts and adaptation options in the development and implementation of broad scale strategies and land-use plans

1.3: Policy Framework – Incorporate climate change considerations and adaptation options when evaluating existing and developing new natural resource management policies, guides, and management plans

1.4: Technical Guidance – Develop technical guidance, products and tools that provide direction for considering and adapting to the impacts of climate change

1.5: Work with Partners – Work with organizations, communities, and Indigenous peoples to integrate climate change adaptation into local plans and projects

Climate change adaptation should be considered when making sustainable natural resource management decisions.

By considering best available science and integrating climate change adaptation into daily business and participation in provincial initiatives, MNRF will be able to continue to sustainably manage natural resources while addressing the current and future implications of changes in fish and wildlife abundance and behaviour; increased prevalence of invasive species; increased forest fire, natural disturbances and emergencies; threats to biodiversity; species at risk; and difficulties in providing the benefits of natural resource use and access.

TOOLS FOR MAINSTREAMING CLIMATE CHANGE ADAPTATION

MNRF is currently taking action to put in place the right tools to ensure climate change adaptation is a key consideration when developing or updating policies and programs. This includes:

- a climate lens that provides MNRF policymakers and natural resource managers with guidance on how to consider and integrate climate change adaptation into natural resource management planning, policy development, programs and practices
- specific tools and technical guidance to support the integration of climate change adaptation considerations into management planning for provincial parks and conservation reserves

TECHNICAL GUIDANCE FOR FLOODING HAZARDS

MNRF is exploring potential options to expand the climate change considerations in its technical guide – *River & Stream Systems: Flooding Hazard Limit*, which is used for managing flood susceptible lands across the province. The guide provides standardized approaches to support municipal implementation of the natural hazard policies in the Provincial Policy Statement of the *Planning Act*, and development of management plans to limit public health and safety risks related to exposure to flooding hazards.

MNRF relies on the technical guide to assist in the municipal land use planning approval process and to explain, or if necessary defend, methods for flood plain delineation. As science and technology have evolved since the guide's 2002 release, the ministry is investigating opportunities to expand the guide to include information that supports floodplain management and mapping in a changing climate.

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PLANTING THE RIGHT TREES IN THE RIGHT PLACES

The potential for rapid changes in climate may mean that some ecosystems and species could have difficulty adjusting to the changing conditions.

If climate change significantly alters local growing conditions for populations of native tree species, these trees may not be able to keep pace by adapting or migrating naturally to more suitable regions.

As climate conditions shift and the types of trees that will do best in a given location change, Ontario's forest managers will be challenged to ensure they are planting trees that suit local growing conditions and continue to deliver the social, economic and ecological benefits of sustainable forest management. Traditionally, planting the right trees has meant using seed from local sources, however as climate change progresses it may become necessary to consider using seed from further away to match the new growing conditions.

To address this challenge, MNRF is reviewing the province's tree seed and nursery stock transfer policies. By ensuring these policies are based on the best available forestry and climate science, MNRF can provide forest managers with the flexibility necessary to adapt to climate change.

GOAL 2: BUILD RESILIENCE AND BIODIVERSITY

MANAGING FOR RESILIENCE IS SUPPORTED ACROSS A VARIETY OF GEOGRAPHIES, TO MAINTAIN AND ENHANCE BIODIVERSITY AND HELP LANDSCAPES, ECOSYSTEMS AND SPECIES WITHSTAND CHANGES IN CLIMATE.

ACTIONS:

2.1: Ecosystem Resilience – Maintain and improve ecosystem resilience by conserving biodiversity, identifying and reducing pressures, restoring degraded ecosystems and mitigating the impacts of land uses

2.2: Landscape Resilience – Enhance landscape integrity and connectivity through land use planning, sustainable natural resource management and conservation activities to enable landscape-level resilience to withstand climate change

2.3: Species Resilience – Reduce the impacts of climate change on vulnerable species by undertaking and supporting activities that enhance and rehabilitate habitat, encourage genetic diversity and facilitate natural movement

Climate change and biodiversity are interconnected. While climate change presents a serious threat to Ontario's biodiversity, the conservation of biodiversity can play an important role in adapting to a changing climate. *Naturally Resilient* supports the vision, goals and objectives set out in Ontario's Biodiversity Strategy, 2011 and the commitments in Biodiversity: It's In Our Nature, Ontario Government Plan to Conserve Biodiversity 2012–2020.

By planning and managing for resilience of landscapes, ecosystems and species, MNRF can improve the ability of Ontario's natural environment to withstand climate change impacts and continue providing ecosystem services that communities rely on for social, economic and health benefits.

Efforts to reduce existing pressures and follow resource management practices that maintain species diversity, support healthy terrestrial and aquatic ecosystem function and provide for connectivity of natural features are important objectives for achieving biodiversity conservation goals. These management practices can reduce impacts (e.g. changes in land cover, shifts in wetlands extent and composition, increased beach erosion and storm surges, melting permafrost and loss of protective ice), facilitate the movement of species, maintain ecological integrity and help support the resilience of natural systems.

BUILDING RESILIENCE AND BIODIVERSITY THROUGH NATURAL COVER

Taking steps to increase the overall amount of natural cover in Ontario is essential if we are to assist native species and ecosystems in adapting to climate change. MNRF is currently identifying opportunities and undertaking initiatives to improve ecosystems and biodiversity through conservation, restoration and enhancement programs. This includes the:

- 50 Million Tree Program: In partnership with Forests Ontario, MNRF is continuing to support a commitment to plant 50 million trees across the province by 2025, including 2 million trees within the boundaries of urban municipalities
- Ontario Grasslands Stewardship Initiative: MNRF is working to develop and implement a program to create, maintain, and enhance 30,000 hectares of grassland in Ontario by 2036, with a target of creating 22,500 hectares in the first 10 years
- Wetland Conservation Strategy: A Wetland Conservation Strategy for Ontario 2017–2030 includes a vision, goals and outcomes, and a

comprehensive list of actions that the Ontario government will take to advance wetland conservation across the province. Priority actions include improving Ontario's wetland inventory and mapping, developing conservation approaches and policy tools to prevent net loss of wetlands, and improving guidance for evaluating the significance of wetlands. Continuing to work with partners to restore wetlands is recognized as vital to supporting healthy, resilient ecosystems and communities. The strategy further supports climate change adaptation through actions that expand programs to assess the response and vulnerability of wetlands and wetland species to climate change, support research into the role of wetlands in adaptation and climate resiliency, and ensure that wetland conservation integrates adaptation considerations. Taken together, these actions will advance efforts to increase wetland area and function by 2030.

COMBATTING INVASIVE SPECIES

MNRF recognizes that climate change is expected to increase the number of species that will be able to survive in Ontario, as well as the potential for native species to be displaced in some circumstances. Taking steps to prevent the introduction of new invasive species into Ontario and where possible reduce the impacts of those that are already here, will allow species and ecosystems to better withstand and recover from climate change related stresses. In response to this challenge, MNRF released the Ontario Invasive Species Strategic Plan in 2012 and passed the *Invasive Species Act* in 2015 to provide a policy and legislative framework for combatting invasive species in Ontario. The ministry is also assessing the likelihood that non-native species may survive in Ontario and potentially become invasive under predicted climate conditions, and is incorporating this information into regulatory decisions under the *Invasive Species Act*.

BUILDING RESILIENCE IN THE FAR NORTH OF ONTARIO

An objective of Ontario's *Far North Act* is to protect at least 225,000 square kilometres of the Far North in an interconnected network of protected areas.

Through the Far North Land Use Planning Initiative, MNRF is engaged in a planning process with local First Nations to jointly prepare and approve community based land use plans that will designate the areas for protection, as well as areas that will be open for sustainable economic development.

By working with First Nations to designate protected areas in the Far North, MNRF is conserving ecological systems and improving ecosystem, landscape and species resilience to climate change.



GOAL 3: INCREASE SCIENCE, RESEARCH AND KNOWLEDGE

SCIENCE, RESEARCH AND KNOWLEDGE ABOUT THE ECOLOGICAL IMPACTS OF CLIMATE CHANGE, THE RESPONSE OF THE NATURAL WORLD AND POTENTIAL ADAPTATION MEASURES, IS CONTINUALLY EXPANDED TO BETTER INFORM AND IMPROVE THE CONSIDERATION OF CLIMATE CHANGE ADAPTATION IN DECISION-MAKING.

ACTIONS:

3.1: Economics and Valuation – Improve knowledge of the economic implications of climate change for natural resource management and ecosystem resilience

3.2: Modelling – Undertake new modelling and build on existing modelling studies to improve data on the predicted impacts of climate change

3.3: Monitoring – Advance monitoring and reporting programs to collect data on climate change impacts and review existing indicators to identify opportunities for enhancement

3.4: Partnerships – Support partnerships and collaborations that advance the collective understanding of climate change impacts and opportunities for adaptation

3.5: Vulnerability Assessment – Conduct studies to better understand and estimate climate change vulnerabilities, assess risk and inform adaptation efforts

3.6: Study Vulnerable Species and Habitat -

Improve knowledge and information about the impacts of climate change on vulnerable species and habitats, their capacity to adapt to climate change and the potential for increasing resilience and coping mechanisms **3.7: Local, Community and Traditional Ecological Knowledge** – Develop processes to increase understanding about climate change from local, community and traditional knowledge sources

It is essential for MNRF to continue building organizational understanding of the potential environmental changes, associated impacts and increased demands on ministry capacity as a result of climate change.

Adaptation of natural resource management and decision making needs to be underpinned by the best available knowledge and information about the changing climate and predictions about the response of natural resources to those conditions.

MNRF will be able to inform increasingly effective adaptation actions across the ministry's mandate by more closely examining existing information, addressing information gaps, assessing vulnerability and response to climate shifts, and seeking local, community and traditional sources of knowledge. The ministry will also explore opportunities to improve provincial monitoring programs (e.g. fisheries, forests, wildlife) to take stock of climate change impacts.

Increasing science, research and knowledge will underpin and support the advancement of all five goals of *Naturally Resilient*.

ECONOMICS OF CLIMATE CHANGE AND NATURAL RESOURCE MANAGEMENT

Ecological systems and natural resources are essential for human wealth and well-being. Climate change has the potential to have a negative impact on natural systems, the benefits these systems provide to humans (ecosystem services) and the wealth they generate.

To provide a better understanding of the economics of climate change from a natural resources perspective, MNRF is exploring applications of natural capital accounting and the value of ecosystem services.

The ministry is also conducting research projects, including working with partners to determine the potential for wetlands to reduce costs associated with flooding. Initial findings from a pilot study found that costs associated with damage to buildings could be reduced by maintaining wetland functions in their natural state.

MULTIPLE STRESSORS ON AQUATIC ECOSYSTEMS

Evidence of the negative impact of climate change on aquatic ecosystems in Ontario is increasing, with significant consequences for Ontario's commercial and recreational fisheries. While it is well known that climate change can exacerbate the effects of other stressors, the interactions among these multiple stressors and their cumulative effects of is not well understood.

To support effective conservation and management of aquatic ecosystems in a changing climate, MNRF is researching the interactions among multiple stressors such as invasive species, resource exploitation and habitat degradation, and their potential cumulative effects.

This research will provide a framework for adaptation, conservation and management decisions for inland fisheries. The framework will be based on an understanding of how stressors interact with each other.

UNDERSTANDING PERMAFROST

Permafrost is defined as a state of the ground, whether soil or rock, that remains at or below a temperature of 0 °C for at least two consecutive years. Permafrost is estimated to occupy 1-10% of Ontario's Far North, in a discontinuous distribution which varies with latitude, topography, geology, vegetation, and climate.

Model predictions show that this discontinuous permafrost zone is sensitive to thawing as a result of climate change. A warming climate could lead to the thawing and disappearance of permafrost in some areas, resulting in the potential for increased landslide activity and erosion of river banks and coastlines. Permafrost thaw also has the potential to increase greenhouse gas emissions, further contributing to climate change.

MNRF scientists are working in Ontario's Far North to delineate and map permafrost; assess changes in it since the 1950's, monitor ongoing dynamics; and develop the first detailed inventory and accounting of the permafrost zone. The ministry is also developing climate change vulnerability assessments related to permafrost and peatlands thawing, including links to water resources connectivity.

This research will result in new tools, datasets and products to support land use planning in Ontario's Far North as the climate continues to warm.

Figure 4 illustrates the four permafrost zones of Ontario's Far North. Most of the permafrost occurs in the Hudson Bay Lowlands, with isolated patches in the southernmost areas and increasing abundance through the discontinuous and continuous zones. Figure 4: Current permafrost zones of Ontario



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PREDICTING NATURAL HAZARD RISKS

As the climate changes, efficient and effective adaptation interventions will rely on the ability to predict and prioritize areas at high risk for climate impacts. To improve understanding of the potential impacts of climate change on emergencies driven by natural hazards, MNRF is undertaking an assessment to produce a Natural Hazard Vulnerability Map and database which will help to visualize these risks across Ontario.

The tool will enable MNRF to identify which areas are at the highest risk from natural hazards both now and in the future, as hazard risks evolve with climate change. Communities across Ontario will be able to make use of this tool for land use planning, public safety planning and targeting areas for more detailed assessment, hazard mapping and adaptation measures.

CONSIDERING TRADITIONAL ECOLOGICAL KNOWLEDGE

MNRF recognizes that Indigenous peoples have a long history centred on their relationship with the land. First Nation and Métis perspectives, including Traditional Ecological Knowledge (TEK), are a valuable resource in understanding climate change and the potential impacts of changes to land, ecosystems and species. MNRF will work with First Nation and Métis communities to continue to deepen our understanding of climate change and potential adaptation actions.

To enable appropriate consideration of information from TEK sources, MNRF is developing guidance for the ministry to include TEK in natural resource management, including climate change adaptation approaches.

FOCUSING ON VULNERABLE SPECIES AND HABITATS

MNRF is taking action to improve knowledge and information about specific species and habitats known to be vulnerable to the effects of climate change. These focused studies provide detailed information on potential climate impacts, coping mechanisms, the ability to naturally adapt and implications for management decisions to enhance resilience. Studies currently underway include:

- Expanding understanding of genetic diversity among major tree species (white and black spruce, jack and eastern white pine, eastern larch and red oak) and the relationship to environmental factors, to determine vulnerability and enhance productivity in a changing climate
- Examining climate effects on site productivity of jack pine, black spruce, red pine, white spruce, and white pine plantations to predict growth and yield changes in a changing climate

- Researching the effects of climate change on the long-term decline of the Algonquin Provincial Park gray jay population
- Surveying the southern Hudson Bay polar bear subpopulation and assessing whether abundance has decreased as a result of climate change
- Developing tools to support the creation of a landscape scale furbearer management framework to ensure sustainable fur harvesting in a changing climate
- Reviewing the state of knowledge on climate change impacts to white-tailed deer to better understand ecosystem impacts, inform potential adaptation opportunities and enhance the sustainability of deer populations

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GOAL 4: INCREASE AWARENESS AND MOTIVATION

EDUCATION, OUTREACH AND INFORMATION SHARING EFFORTS ARE DEVELOPED AND ADVANCED, TO COMMUNICATE INFORMATION ABOUT ADAPTING TO THE IMPACTS OF CLIMATE CHANGE ON NATURAL RESOURCES

ACTIONS:

4.1: Communication Through Existing

Programs – Use existing ministry programs and reports to share climate change adaptation information with partners, stakeholders and the public

4.2: Education and Participation Opportunities –

Facilitate opportunities for communities to become involved with adaptation planning, actions and projects

4.3: Industry Liaison – Work with industry partners to communicate best management practices for adapting natural resource development to a changing climate

4.4: MNRF Understanding – Build awareness and understanding within MNRF, through climate adaptation information and training

4.5: Public Awareness – Promote public awareness of climate impacts and adaptation options through broad communications products

Climate change has the potential to significantly impact the ecological services provided by natural resources (e.g. clean air and water, pollintation, wildlife and plant habitat), as well as opportunities for the people of Ontario to use and enjoy natural resources for recreational and economic purposes.

It also has the potential to impact Indigenous communities' access and use of natural resources for food and cultural purposes. Changes to the extent and thickness of lake ice, shifts in hunting, fishing and forestry seasons, species abundance and distribution, and more difficulty controlling water pathogens and insectborne diseases, will require a greater public understanding of changing environmental conditions and participation in efforts to adapt.

MNRF can support the people of Ontario by increasing motivation, communicating opportunities to participate, and ensuring awareness of management rules and regulations.

COMMUNICATING WHY BIODIVERSITY MATTERS IN A CHANGING CLIMATE

Biodiversity and climate change are strongly connected. Climate change has the potential to impact biodiversity and associated ecosystem services, while biodiversity has the ability to help in both mitigating and adapting to climate change.

To support increased public awareness of these connections, MNRF together with key partners has developed a guide that highlights best practices for communicating messages about biodiversity conservation and climate change adaptation. It will also include key messages to assist in understanding the connection. The guide is accompanied by the *BiodiversityMakesUs* outreach campaign, which includes tools and resources that organizations can use to develop biodiversity and climate messaging and engage the public in actions that support biodiversity conservation.



GOAL 5: OPTIMIZE SERVICES AND RESPONSE

PREPAREDNESS FOR NATURAL HAZARD MANAGEMENT, EMERGENCY RESPONSE AND SERVICE DELIVERY IS OPTIMIZED TO ENSURE EFFECTIVENESS IN A CHANGING CLIMATE

ACTIONS:

5.1: Ensure Sufficient Capacity – Develop strategies and contingency plans to maintain sufficient ministry capacity to respond to predicted increases in severe and variable natural events

5.2: Interjurisdictional Cooperation – Support resource sharing between jurisdictions and development of multi-jurisdictional response plans to address escalating emergencies

5.3: Work Proactively – Work proactively to assess increased risks to service delivery posed by climate change, identify response priorities, and ensure preparedness

Climate change is likely to result in more intense and frequent extreme events, including forest fires, ice and winter storms, flooding, wind damage, drought and coastal erosion or inundation.

Such events present challenges for MNRF where the ministry is responsible for the safe operation and maintenance of parks, public infrastructure, buildings and roads. Variability in water quantity, reduced spring and summer river flows, and changes in timing and magnitude of spring melt can also create risks for the ministry in managing water resources, protecting the Great Lakes, and preventing or reducing the impacts of natural hazards to ensure resilient communities.

By optimizing approaches to natural hazard management, emergency response and service delivery, MNRF can ensure these programs remain effective in the future.

ENHANCING EMERGENCY RESPONSE CAPACITY

As the climate changes, natural hazard events have the potential to become increasingly severe and variable. MNRF is taking action to increase the ministry's ability to respond to emergencies by enhancing the amount of trained and capable staff available to respond during extreme natural hazard events.

The MNRF Emergency Response Staffing Strategy will provide a long-term and sustainable approach for training, activating and deploying staff to respond to emergencies. By building stronger partnerships and common standards across the ministry, this strategy will help MNRF become more connected in adapting to climate change.

IMPLEMENTING THE STRATEGY

The complex and uncertain nature of climate change impacts on the natural environment demands continued evaluation, learning and adjustments to courses of action. To ensure effective implementation, coordination and reporting, MNRF will align *Naturally Resilient* with broader provincial adaptation efforts and monitor the progress of the strategy over time.

MNRF will assess and report on its progress in meeting the goals of the strategy and will integrate this learning into identification of future actions. Table 1 provides an outline of the outcomes against which success will be measured.

MNRF also recognizes that *Naturally Resilient* represents one piece of an expanding focus on climate change adaptation across various levels of government, sectors and communities. As the strategy is implemented, MNRF is committed to working with partners in Ontario and other jurisdictions, as well as Indigenous communities, to foster collaboration, coordinated action and information sharing which will enhance progress towards the goals of *Naturally Resilient* and support adaptation more broadly.



Table 1: Naturally Resilient Goal Outcomes

Strategy Goal	Goal Outcome
1. Mainstream Adaptation	MNRF's natural resources management direction reflects consideration of climate change adaptation and best available science
2. Build Resilience and Biodiversity	MNRF's natural resource management actions improve ecosystem, landscape and species resilience to climate change
3. Increase Science, Research and Knowledge	MNRF has an increased knowledge of the ecological impacts of climate change and the effectiveness of potential adaptation options
4. Increase Awareness and Motivation	The people of Ontario have access to information about climate change impacts on natural resources that leads to participation in adaptation action
5. Optimize Services and Response	MNRF's preparedness for natural hazard management, emergency response and service delivery is optimized to support effectiveness in a changing climate



RELATED RESOURCES

Ontario is taking a leadership role in understanding the potential impacts of climate change and establishing policies and programs to lessen those impacts. Learn more about MNRF's current climate change efforts and recent provincial initiatives.

REFERENCES AND USEFUL LINKS:

- Climate change in Ontario: <u>https://www.ontario.ca/page/climate-change</u>
- Ontario's Climate Change Strategy: <u>https://www.ontario.ca/page/climate-change-strategy</u>
- Ontario's Climate Change Action Plan: <u>https://www.ontario.ca/page/climate-change-action-plan</u>
- Climate change and Ontario's natural resources: <u>https://www.ontario.ca/page/climate-change-and-natural-resources</u>
- Natural resource management and climate change: <u>https://www.ontario.ca/page/natural-resource-management-and-climate-change</u>
- Ontario's managed forests and climate change: <u>https://www.ontario.ca/page/managed-forests-and-climate-change</u>
- Current and future climate change impacts by ecoregion: <u>https://www.ontario.ca/environment-and-energy/climate-change-ecoregions</u>
- Current and future climate change impacts by regions and districts: <u>https://www.ontario.ca/environment-and-energy/climate-change-regions-and-districts</u>
- MNRF Climate Change Research Report series: <u>http://www.climateontario.ca/scripts/MNR_Pub/mnr_publication.php</u>
- A Practitioner's Guide to Climate Change Adaptation in Ontario's Ecosystems: <u>http://www.climateontario.ca/doc/Tools/A%20Practitioners%20Guide%20to%20ClimateChange%20</u> <u>Adaptation%20in%20Ontario's%20Ecosystems%20Ver%201%202011.pdf</u>
- A Wetland Conservation Strategy for Ontario 2016-2030: <u>http://apps.mnr.gov.on.ca/public/files/er/a-wetland-conservation-strategy-for-ontario-2017-2030.pdf</u>
- Ontario's Crown Forests: Opportunities to Enhance Carbon Storage? A Discussion Paper: <u>http://apps.mnr.gov.on.ca/public/files/er/mnrf-16-244-discussion-paper.pdf</u>

APPENDIX

GOALS & ACTIONS AT A GLANCE

GOAL 1: MAINSTREAM ADAPTATION

- 1.1: Work Within Government
- 1.2: Planning and Strategy
- 1.3: Policy Framework
- 1.4: Technical Guidance
- 1.5: Work with Partners

GOAL 2: BUILD RESILIENCE AND BIODIVERSITY

- 2.1: Ecosystem Resilience
- 2.2: Landscape Resilience
- 2.3: Species Resilience

GOAL 3: INCREASE SCIENCE, RESEARCH AND KNOWLEDGE

- 3.1: Economics and Valuation
- 3.2: Modelling
- 3.3: Monitoring
- 3.4: Partnerships
- 3.5: Vulnerability Assessment
- 3.6: Study Vulnerable Species and Habitat
- 3.7: Local, Community and Traditional Ecological Knowledge

GOAL 4: INCREASE AWARENESS AND MOTIVATION

- 4.1: Communication Through Existing Programs
- 4.2: Education and Participation Opportunities
- 4.3: Industry Liaison
- 4.4: MNRF Understanding
- 4.5: Public Awareness

GOAL 5: OPTIMIZE SERVICES AND RESPONSE

- 5.1: Ensure Sufficient Capacity
- 5.2: Interjurisdictional Cooperation
- 5.3: Work Proactively

GLOSSARY

Adaptive management: a systematic process for continually improving management policies and practices, including learning from and being responsive to the outcomes of past programs and policies, as well as building flexibility into policy through monitoring and analysis of current and changing circumstances.

Biodiversity: the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Carbon sequestration: the removal and storage of carbon from the atmosphere in carbon sinks (such as wetlands, oceans, forests or soils) through physical or biological processes, such as photosynthesis.

Climate change adaptation: an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects that moderates harm or exploits beneficial opportunities.

Climate change mitigation: an intervention intended to reduce adverse human influence on the climate system; it includes strategies to lower greenhouse gas emissions and to enhance greenhouse gas sinks.

Conservation: actions that are intended to establish, improve or maintain good relations with nature. This can include protection, restoration, rehabilitation, management, stewardship and wise use. **Ecosystem:** a dynamic complex of plant, animal and micro-organism communities and their physical environment functioning as an ecological unit.

Ecosystem services: the services that humans derive from ecological functions, such as photosynthesis, oxygen production, water purification.

Landscape: complexes of ecosystems in geographically defined areas.

Mainstreaming: the process of incorporating a concept as part of regular business in everyday actions, programs and policies.

Precautionary approach: making decisions about the environment when risks are suspected but not known with certainty. The 1992 Declaration on Environment and Development states: "In order to protect the environment, the precautionary approach shall be widely applied by States [i.e., jurisdictions] according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

Resilience: the capacity of a community, business, or natural environment to anticipate, prevent, withstand, respond to, and recover from a climate change related disruption or impact.

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