CLIMATE CHANGE IN MUSKOKA:
A WORKSHOP ON EXTREME WEATHER AND WATERFRONT PROPERTY

AUGUST 8, 2017
WATERLOO SUMMIT CENTRE FOR THE ENVIRONMENT
87 FORBES HILL DR, HUNTSVILLE, ONTARIO
Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR)

OCCIAR is a university-based resource hub for researchers and stakeholders and provides information on climate change impacts and adaptation. The Centre communicates the latest research on climate change impacts and adaptation, liaises with partners across Canada to encourage adaptation to climate change and aids in the development and application of tools to assist with municipal adaptation. The Centre is also a hub for climate change impacts and adaptation activities, events and resources.

www.climateOntario.ca

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Ministry of Natural Resources and Forestry – Parry Sound District

The purpose of the Ministry of Natural Resources and Forestry is to provide opportunities for resource development and outdoor recreation for the continuous economic and social benefit of the people of Ontario; and to administer, protect, and conserve public lands and waters. The ministry's programs are concerned with the use of the physical resources such as land, water, trees, fish, animals and certain minerals for resource utilization and recreation.

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Table of Contents

1.0 About the Workshop ................................................................. 3
  1.1 Workshop objectives and expected outcomes ........................... 3
  1.2 Who will be in attendance? .................................................... 3
2.0 Agenda .................................................................................. 4
3.0 Presenters ............................................................................. 5
  3.1 Workshop Facilitator ............................................................ 8
4.0 Climate Change: A Brief Introduction ..................................... 9
  4.1 Climate change in Canada ..................................................... 10
  4.2 Climate change in Ontario .................................................... 11
  4.3 The impacts of climate change .............................................. 14
  4.4 Response to climate change .................................................. 15
  4.5 Climate change resources ..................................................... 17
5.0 Literature Cited .................................................................... 18

Appendix: Useful Websites .......................................................... 20
Notes ......................................................................................... 23
1.0 About the Workshop

The Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR) and the Ontario Ministry of Natural Resources and Forestry (MNRF) Parry Sound District Office are pleased to present this special one-day workshop – Climate Change in Muskoka: A Workshop on Extreme Weather and Waterfront Property.

Climate change continues to bring challenges that require government and residents to face head-on and manage proactively. The effects of climate change have already been felt across Ontario, as the province is experiencing warmer temperatures, changing precipitation patterns, and is facing more extreme weather events with unparalleled damage. These changes in our weather have resulted in a variety of environmental, social and economic impacts. For example, the increasing frequency and intensity of weather extremes has especially impacted shoreline infrastructure in the Muskoka region.

Everyone will be impacted by climate change and will have a role to play in adapting to the challenges it will bring. This workshop will take you through the science of climate change, understanding the impacts of climate change on the ecology and natural amenities of the lakes and rivers we enjoy and considerations for a more resilient waterfront.

1.1 Workshop objectives and expected outcomes

The overall goal of the workshop is to increase your knowledge of climate change science, impacts and adaptations and to provide you with information and tools to help increase shoreline resilience to extreme weather events. By the end of the workshop we hope to increase your understanding of:

- The science of climate change, and what future climate models are projecting for temperature and precipitation in the area;
- The impacts that climate change will bring to the Muskoka region, including the increasing frequency of extreme rain events (resulting in high water levels/floods), drought (resulting in low water levels), wind, etc.;
- The effect that these impacts will have on the aquatic ecosystems;
- How water is managed in the Muskoka watershed; and
- The information available to help incorporate resiliency into your shoreline property, where possible.

1.2 Who will be in attendance?

This workshop is geared towards representatives from each of the 20 cottage associations for lakes with water control structures managed under the Muskoka River Water Management Plan, who are interested in the unique issues that climate change will bring to the Muskoka area.
## 2.0 Agenda

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>9:30am – 10:00am</td>
<td>Registration and Light Refreshments</td>
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| 10:00am - 10:15am| Welcome and Opening Remarks  
Al Douglas (Ontario Centre for Climate Impacts and Adaptation Resources) |
| 10:15am - 11:00am| Morning Keynote: The Changing Climate  
Heather Auld (Risk Sciences International) |
| 11:00am - 11:30am| Extreme Weather and Emergency Preparedness  
Geoff Coulson (Environment and Climate Change Canada) |
| 11:30am - 12:00pm| Extreme Weather and Risks to Shoreline Infrastructure  
Dan Sandink (Institute for Catastrophic Loss Reduction) |
| 12:00pm - 12:40pm| Lunch                                                                |
| 12:40pm - 1:20pm| The Muskoka River Watershed and Water Management in Muskoka  
Ministry of Natural Resources and Forestry (Parry Sound District Office) |
| 1:20pm - 1:50pm| Effects of Climate Change on Ontario’s Aquatic Ecosystems  
Cindy Chu (Ministry of Natural Resources and Forestry) |
| 1:50pm - 2:00pm| Short Break                                                          |
| 2:00pm - 2:30pm| Improving Resiliency for your Shoreline Property  
Rebecca Willison (Muskoka Watershed Council) |
| 2:30pm - 3:00pm| Cottage Country Hazards: getting your family and your community prepared for the unavoidable  
Terry Rees (Federation of Ontario Cottagers’ Associations) |
| 3:00pm - 3:15pm| Workshop wrap up and farewell                                        |
3.0 Presenters

HEATHER AULD – Principal Climate Scientist, Risk Sciences International

Heather Auld joined Risk Sciences International in 2011 as Principal Climate Scientist after 32 years with Canada’s Federal Government. She has worked both with Environment Canada and the Department of National Defence across Canada in climate science, climate services and climate change adaptation, weather forecasting and operations, training, and stakeholder consultations.

As one of Canada’s foremost engineering climatologists, Heather brings nationally- and internationally-recognized expertise in climate change impacts and adaptation research, engineering climatology for national codes and standards, energy-climate research, extreme event and forensic analyses, disaster risk reduction planning, and science-policy linkages. She has served on both World Meteorological Organization and International Panel on Climate Change expert groups.

In Canada, Ms. Auld is a main climate science advisor to Canada’s National Codes Commission, is routinely called upon by industry groups and built infrastructure design standards committees for expert advice, and has provided climate risk-related training to a range of industrial players as well as public sector agencies. She has developed weather hazards information for disaster risk reduction and provided expert testimony to many disaster-related inquiries including the Walkerton Inquiry into water contamination.

Ms. Auld has been central to the development of decision-support applications for the interpretation and use of historical climate information, forensic data, and climate model outputs for the purpose of “on-the-ground” decision-making. Ms. Auld has worked with practitioners and decision makers across a range of sectors, including but not limited to: municipal planning, engineering design, emergency response; airport management and operations; forest management; and, electricity systems, water resources and other infrastructure.
GEOFF COULSON – Warning Preparedness Meteorologist, Environment and Climate Change Canada

Geoff Coulson has been a meteorologist with Environment and Climate Change Canada for over 33 years. During his career he has been involved in weather forecasting, training, software development and outreach activities. For the last 13 years, Geoff has been a Warning Preparedness Meteorologist providing weather information to all levels of government, the media and the private sector. He also sits on the Provincial Flood Forecast and Warning Committee and manages the CANWARN storm spotter program in Ontario.

DAN SANDINK – Director of Research, Institute for Catastrophic Loss Reduction

Dan Sandink has led a significant portion of the Institute for Catastrophic Loss Reduction’s (ICLR’s) urban flood risk reduction work, and has authored or co-authored dozens of reports and articles on topics related to urban flooding and natural hazards. Dan’s work has focused on public risk perceptions, adoption of lot-level disaster mitigation practices, insurance, climate change adaptation, lot-level flood protection technologies, inflow/infiltration, construction codes, wildland-urban interface fire risk reduction, among other topics. Dan is a graduate of the geography and planning programs at the universities of Guelph, Western Ontario and Toronto.

MARA KERRY – a/Resource Management Supervisor, Ministry of Natural Resources and Forestry (Parry Sound District)

Mara Kerry is a first generation Canadian of Welsh descent. Born and raised in Toronto, she obtained an undergraduate degree in International Development and a graduate degree in Forest Ecology, both from the University of Toronto. Mara has a keen interest in the intersection of conservation and sustainable development objectives. A seasoned conservation professional, Mara has experience in biodiversity conservation, sustainable development and climate change impacts on natural systems. Her specialized expertise in integrated conservation and development led to work with BirdLife International in the Americas. For 11 years, Mara worked in Latin America to advance migratory bird conservation with southern partner organizations. She spent 3 years at the David Suzuki Foundation and is currently advancing partnerships on behalf of the Ontario government.
AMANDA VINCENT – a/Partnership Specialist, Ministry of Natural Resources and Forestry (Parry Sound District)

Amanda Vincent has been a resource technician with the Ministry of Natural Resources and Forestry (MNRF) since 2001. Over the past 16 years she has been involved with fisheries monitoring and assessment, rabies research and abatement as well as lands and waters management. Amanda is extremely familiar with the Muskoka River watershed spending the past nine years focused on dam operations and water management for the Parry Sound District.

CINDY CHU – Research Scientist, Ministry of Natural Resources and Forestry

Cindy Chu is a Research Scientist with the Aquatic Research and Monitoring Section of the Ontario Ministry of Natural Resources and Forestry. She is also an Adjunct Professor at the University of Toronto in the Ecology and Evolutionary Biology Department. Cindy studies the impacts of human activities (e.g., urbanization, exploitation, climate change) on aquatic habitats, freshwater fish biodiversity, and fisheries resources. She also researches the regulations, actions, and protected area network designs that can aid in the conservation and management of fisheries resources.

REBECCA WILLISON – Watershed Planning Technician, Muskoka Watershed Council

Rebecca Willison has been the Watershed Planning Technician for the Muskoka Watershed Council since 2002 and the District of Muskoka since 2003, where she coordinates the Lake System Health Recreational Water Quality Monitoring Program. She has a degree in Zoology and a certificate in Environmental Conservation from the University of Guelph, as well as a certificate in Restoration Ecology from Niagara College. Since moving to Muskoka in 2001, she has enjoyed hiking the many excellent trails found in the area and recently began volunteering with the Muskoka Trails Council. Through her work with the District and the Muskoka Watershed Council, Rebecca is active in promoting good stewardship practices across the district, with an emphasis on maintaining good water quality.
TERRY REES – Executive Director, Federation of Ontario Cottagers’ Associations

Terry Rees has worked across Canada and North America for small community groups and large multi-nationals and has a history of progressive resource management experience within Canada’s petroleum and mining sectors, including roles related to hazardous materials recycling, forest fire fighting, and environmental risk management and policy. Throughout his 20-year affiliation with the Federation of Ontario Cottagers’ Associations (13 as Executive Director) Terry has been an outspoken champion for rural communities and the protection of freshwater environments. Terry has been an advocate for proactive community action and emergency preparedness for many years. Terry spends his most precious “shore time” at his island property northeast of Peterborough that his family has enjoyed since the 1950’s.

3.1 Workshop Facilitator

AL DOUGLAS – Director, Ontario Centre for Climate Impacts and Adaptation Resources

Al Douglas is the Director of the Ontario Centre for Climate Impacts and Adaptation Resources (OCCIAR), located at Laurentian University in Sudbury, Ontario. He has been working in the field of climate change impacts and adaptation for over 15 years and has partnered with many different organizations in Ontario and Canada to develop and deliver adaptation resources and strategies.
4.0 Climate Change: A Brief Introduction

Over the course of the past few decades the science behind climate change has become increasingly clear – our climate is changing in a way that is unlike any other time in Earth’s history. The Intergovernmental Panel on Climate Change (IPCC), the leading international body for the assessment of climate change, states that the degree of warming that the Earth has experienced since the 1950s is unequivocal, and many of the changes are unprecedented over decades to millennia. The evidence of this warming as all around us: the atmosphere and oceans have warmed, snow and ice cover have diminished, sea levels have risen, and the concentration of greenhouse gas emissions (GHGs) has increased (IPCC, 2013).

![Figure 1: Observed change in global surface temperature 1901-2012 (source: IPCC, 2013).](image)

The globally averaged combined land and ocean surface temperature shows a warming of 0.85°C over the period of 1880 to 2012. Each of the last three decades has been successively warmer at the Earth’s surface than any preceding decade since 1850 and in the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1,400 years (IPCC, 2013). The IPCC states that it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century, particularly through carbon dioxide (CO₂) emissions. If we continue along the path that we are currently on (i.e. no significant effort is made to reduce our consumption of fossil fuels), global surface temperature could rise by another 4.8°C by 2100 (IPCC, 2013).

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**CO₂ LEVELS ARE AT THEIR HIGHEST IN 650,000 YEARS.**

- NASA
4.1 Climate change in Canada

Over the last six decades, Canada has become warmer, with average temperatures over land increasing by 1.5°C between 1950 and 2010 (see Figure 2). This rate of warming is about double the global average reported over the same time period. Warming has been occurring even faster in many areas of northern Canada, and has been observed in all seasons, although the greatest warming has occurred in winter and spring. The annual number of extreme warm days has also risen, which the number of cold nights has declined (Warren and Lemmen, 2014). Over the same time period (1950-2010), Canada as a whole has become wetter, with increasing annual average precipitation trends in many parts of the country and for the nation as a whole. Trends in annual precipitation have been less uniform across the Canadian landmass than those of annual air temperature (see Figure 3).

Figure 2: The average annual surface temperature in Canada has increased by 1.5°C between 1950 and 2010, with the greatest warming in the winter and spring (the triangle size is proportional to the magnitude of the trend) (Warren and Lemmen, 2014).
4.2 Climate change in Ontario

Relative to a 1961-1990 baseline, almost every region in Ontario has experienced an increasing temperature trend (see Figure 4). Across the province, mean annual temperature has increased by 1.5°C since 1948 – nearly double the global average. This seemingly small number may look insignificant, but relatively small changes in average temperatures can result in significant impacts.

As you can see from Figure 5, precipitation patterns in Ontario are already changing. The annual precipitation difference between two normals periods (1951-1980 and 1971-2000) shows that some areas of the province, including the Muskoka region, have seen increases in precipitation of between 150mm and 250mm per year.
Figure 4: Relative to a 1961-1990 baseline, average annual temperatures across Canada have increased by 1.7°C, and Ontario by 1.5°C (source: ECCC, 2017).

Figure 5: Annual precipitation difference between two normals periods (1951-1980 and 1971-2000) (Comer, 2011).

Figure 6 provides an example of temperature and precipitation changes at a local scale. Between 1979 and 2008, Barrie experienced an average annual mean temperature increase of 1.5°C, right in line with the provincial average. One of the many impacts of a warming climate is changes to precipitation patterns; Barrie saw a total annual precipitation increase of 42mm between 1979 and 2008.
Figure 6: Barrie has seen a 1.5°C increase in average annual mean temperature and a total annual precipitation increase of 42mm between 1979 and 2008.

With help of global climate change models, scientists are able to simulate changes in climate based on a set of scenarios of anthropogenic forcings. Figure 7 represents projections in surface air temperature and relative precipitation changes for the winter season in Ontario for the middle of the century relative to the reference period (1986-2005) (ECCC, 2015). In northern countries such as Canada, the largest temperature change is likely to occur during the winter season.

Figure 7: Temperature change and precipitation change for RCP8.5 in 2046-2065 for the winter season (December – February), 50th percentile (source: Adapted from ECCC, 2015).
4.3 The impacts of climate change

In Ontario, warming temperatures and changing precipitation patterns are expected to result in a variety of environmental, social and economic impacts. Some of these impacts include: reduced ice cover on the great lakes; increased snowfall; increased ice storms; increased freeze-thaw cycles; increased viability of pests and diseases; increased flooding; increased soil erosion; degraded water quality; earlier peak flow in streams and rivers; decreased total flow in streams and rivers; potential for drought conditions and forest fires.

Since warmer air holds more moisture, climate change will result in more frequent and intense extreme weather events (Warren and Lemmen, 2014). The increasing frequency and intensity of weather extremes poses risks to infrastructure, buildings, drinking water, communication, energy and shorelines. The effects of climate change have already been felt in Ontario, as the province has faced more frequent and intense weather events over the past decade with unparalleled damage (ECO, 2014):

- On July 14-15, 2004 a state of emergency was declared in Peterborough after 175mm of rain fell in the city, resulting in $95M in insured losses.
- On August 19, 2005 150mm of rain fell in Toronto, causing $647M in damages, washing out part of Finch Avenue and causing flash flooding across the city.
- On August 20, 2009 19 tornadoes touched down in southern Ontario, causing extensive damage to homes and one death.
- On April 28, 2011 a severe wind storm with 150km/hr winds hit southern Ontario, resulting in sweeping power outages and one death.
- On October 25, 2012 Wawa declared a state of emergency as 133mm of rain fell in 9 hours, causing the washout of five major roads and the destruction of one business.
- In April, 2013 the Muskoka region experienced extreme flooding due to a combination of partially frozen ground, later-than-usual snowmelt, persistent lake ice, and largely heavy, warm rains. Eight regions across the area declared a state of emergency.
- On July 8, 2013 126mm of rain fell in Toronto in only two hours, resulting in close to $1B in insured property damage and $60M in uninsured costs to the City (to date, it is the most expensive natural disaster in Ontario’s history).
- From December 20-22, 2013 waves of freezing rain hit southern Ontario, resulting in up to 3cm of ice accumulation and over 600,000 power outage due to fallen trees, branches and utility poles.
- On May 11, 2014 rising flood waters forced the evacuation of 2,000 residents in the northern Ontario First Nation communities of Kashechewan and Attawapiskat, where 40 homes and
buildings were damaged by sewage and flood waters. It marked the third straight year an evacuation was required because of flooding concerns.

- On August 4, 2014 over 150mm of rain fell in Burlington, Ontario which led to flooded basements and intersections and forced the closure of many roads.
- On November 19-20, 2014 strong cold winds and relatively warm waters off the Great Lakes combined to produce intense snow squalls. The strongest affected regions near Georgian Bay, dumping snow amounts of 90cm near Parry Sound, 40cm in Huntsville, and 20cm in Bracebridge and Barrie.
- During the last week of March and the first week of April 2016, Muskoka received three significant rain events, depositing 171.5mm of rain into the watershed. These rain events were preceded by an unusually early spring freshet that began in early March, about a month earlier than normal, causing flooding in the area.
- On September 28, 2016 between 135mm and 195mm of rain fell in the Windsor and Tecumseh regions respectively. The mayors of Windsor and Tecumseh declared states of emergency due to flooding of streets and upwards of 2,500 flooded basements.
- Spring 2017 saw abnormally wet weather across the province resulting in high water and flooding across central Ontario. Communities along the Ottawa and St. Lawrence Rivers declared states of emergencies while Lake Ontario water levels reached the highest recorded in 100 years.

These events appear to be on an upwards trend, not only in Ontario but around the world (see Figure 8).

![Figure 8: Natural catastrophes worldwide from 1980-2016 (source: Munich RE, 2017).](image)

### 4.4 Response to climate change

Taking action at the federal, provincial and municipal government levels is important. Most levels of government are taking steps to respond to climate change through mitigation (i.e. reducing GHG emissions) (CAP, 2011). However, adaptation is gaining momentum in many communities and local governments across Canada as an essential response to climate change that complements mitigation
efforts (Warren and Lemmen, 2014). Businesses and residents can also incorporate climate change adaptation into their planning and activities.

![Figure 9: Communities can respond to climate change in two ways: mitigation and adaptation (source: Vaughan, 2012).](image)

Adaptation involves making adjustments in our decisions, activities and ways of thinking in response to observed or expected changes in climate, with the goals of reducing harm and taking advantage of potential opportunities (see Figure 9) (IPCC, 2013). This can include behavioural changes, operational modifications, technological interventions, planning changes and revised investment practices, regulations and legislation. All levels of government, researchers, the private sector and non-governmental organizations now view adaptation as an essential complement to mitigation (Warren and Lemmen, 2014).

The provincial government is also taking action on climate change. In 2016, the Government of Ontario released its Climate Change Action Plan, a 5-year plan that will help Ontario fight climate change over the long-term by reducing GHG emissions and helping to move us to a prosperous low-carbon economy. Building on Ontario’s new Climate Change Mitigation and Low-Carbon Economy Act, the plan will ensure that proceeds from the province’s recently finalized cap and trade program are invested in a transparent and accountable way back into green projects that will help households and businesses reduce GHG emissions and save on energy costs (MOECC, 2016).

While the primary focus is on mitigation of GHGs, Ontario’s plan for adapting to climate change and becoming more resilient will be released in 2017. The upcoming climate change adaptation plan will build on Climate Ready: Ontario’s Adaptation Strategy and Action Plan, which was released in 2011, and was Ontario’s first public commitment to address climate impacts across government (MOECC, 2016). The new adaptation plan will provide details of a new climate modelling collaborative which will help decision-makers understand potential climate impacts so they can make effective, climate-resilient decisions. The collaborative will be useful for provincial and municipal governments, Crown agencies, utilities, conservation authorities, the private sector, First Nations and Métis communities, and others (MOECC, 2016).
4.5 Climate change resources

In 2016, the Muskoka Watershed Council released a report (Sale et al., 2016) which provides an in-depth look at how climate change will impact the Muskoka area by mid-century. The report, ‘Planning for Climate Change in Muskoka’, is a follow-up to the Council’s first report on climate change published in 2010 (Muskoka Watershed Council, 2010). It suggests that a typical year by mid-century will be characterized by approximately half the number of extremely cold winter nights (<-20°C), four times the number of winter nights that remain above freezing, half the number of winter days in which maximum temperatures breaks through 0°C (from 36 days to 56 days), and seven times as many days in which the maximum temperature exceeds 30°C (from 4 days to 27 days). The Muskoka region is also likely to see a 10% - 20% increase in the total amount of precipitation, most of which is likely to occur in late fall/early spring. This increase in precipitation during November to April will largely be driven by the Muskoka’s proximity to Georgian Bay, as warmer winter temperatures will result in less ice coverage and more evaporation, which can bring rain or snow squalls to the Muskoka region (Sale et al., 2016).

The report also suggests that what is needed is long-term adaptation planning by individuals, businesses, community groups and local governments in order to prepare Muskoka communities for climate change. It outlines 15 recommendations around four types of action:

1. Actions to improve understanding of ecological functioning of the Muskoka environment
2. Actions to address anticipated impacts of climate change on the Muskoka environment
3. Actions to prepare our built infrastructure and its management for the climate of mid-century
4. Actions to facilitate the effective implementation of these recommendations

Also published in 2016 is a resource from the Federation of Ontario Cottagers’ Associations on ‘Managing Your Waterfront Property in a Changing Climate’ (FOCA, 2016). The document provides information on climate change impacts and adaptation options for waterfront properties owners to help them increase the resiliency of their shoreline. This particular topic is important to the Muskoka region as the large lakes in particular are very developed with cottages, commercial tourism, and marinas. In some cases (Lake Muskoka, Lake Joseph and Lake Rosseau), virtually all the shoreline is privately owned with extensive shoreline development including docks and boathouses. The amount of shoreline development within Muskoka makes the area unique when compared with other regions. The FOCA resource offers 5 top actions shoreline owners can take:

1) Keep your shoreline natural and enhance it if possible;
2) Keep aquatic plant populations intact;
3) Maintain and improve your waterfront property’s health and biodiversity;
4) Manage pests and diseases; and
5) Stay informed.

There is a large number of resource to help waterfront property owners understand climate change impacts and how to reduce their vulnerability. See the Appendix for a list of useful resources.
5.0 Literature Cited


Appendix: Useful Websites

Climate Change Adaptation Organizations

**Great Lakes Adaptation Assessment for Cities** brings together researchers and practitioners to develop actionable climate adaptation programs for cities in the Great Lakes region: [www.graham.umich.edu/glaac](http://www.graham.umich.edu/glaac)

**Great Lakes Integrated Sciences and Assessments** contributes to the long-term sustainability of the region in the face of a changing climate and facilitates smart decision-making backed by scientific knowledge: [www.glisa.umich.edu](http://www.glisa.umich.edu)

**ICLEI – Local Governments for Sustainability** provides technical consulting, training, networking opportunities, and information services to build capacity, share knowledge, and support local governments in becoming more sustainable and resilient: [www.icleicanada.org](http://www.icleicanada.org)

**Institute for Catastrophic Loss Reduction** is a world-class centre for multi-disciplinary disaster prevention research and communications: [www.iclr.org](http://www.iclr.org)

**Ontario Centre for Climate Impacts and Adaptation Resources** is a university-based resource hub for researchers and stakeholders searching for information on climate change impacts and adaptation: [www.climateOntario.ca](http://www.climateOntario.ca)

**Ontario Climate Consortium** works collaboratively with university researchers and partners from the public, private and NGO sectors on projects aimed at answering specific questions related to climate change and creating the intelligence necessary to address climate risk: [www.climateconnections.ca](http://www.climateconnections.ca)

**Ouranos** acquires and develops knowledge on climate change, its impact and related socioeconomic and environmental vulnerabilities, in order to inform decision makers about probable climate trends and advise them on identifying, assessing, promoting and implementing local and regional adaptation strategies: [www.ouranos.ca/en](http://www.ouranos.ca/en)

General Adaptation Resources

**Adaptation Library** is a publicly accessible and searchable collection of community, forestry, and energy related adaptation products: [www.adaptationlibrary.ca](http://www.adaptationlibrary.ca)

**Adaptation Wizard** is a 5-step process that provides a framework and resources to help you generate information to inform your own adaptation strategy: [www.ukcip.org.uk/wizard](http://www.ukcip.org.uk/wizard)

**Building Adaptive & Resilient Communities**, offered through ICLEI, is a program that offers a comprehensive way to respond to the impacts of climate change, develop and implement an adaptation
plan, and protect the people, property, and prosperity of your community:
www.icleicand.org/programs/adaptation/barc

**Canadian Institute of Planners** climate change resource library provides access to a variety of tools and resources that have been produced to date from CIP climate change initiatives: www.cip-icu.ca/ClimateChangePolicy#

**Climate Adaptation Knowledge Exchange** aims to build a shared knowledge base for managing natural and built systems in the face of rapid climate change and is intended to help build an innovative community of practice: www.cakex.org

**Canadian Climate Change Adaptation Community of Practice** is an interactive online community dedicated to advancing knowledge and action in the area of climate change adaptation, and serves as a location where members can come together to ask questions, generate ideas, share knowledge, and communicate with others on the topic of climate change adaptation: www.ccadaptation.ca

**Climate Resilience Framework** helps clarify factors that need to be included in the diagnosis of climate vulnerability, structures the systematic analysis of vulnerability in ways that clearly identify the entry points for responding, and supports strategic planning to build resilience to climate change: http://i-s-e-t.org/resources/training/climate-resilience-framework.html

**Federation of Canadian Municipalities** offers a variety of climate change adaptation resources for municipalities: https://fcm.ca/home/issues/climate-change-and-resiliency/climate-change-adaptation.htm

**Georgetown Climate Center** seeks to advance effective climate, energy, and transportation policies in order to help communities adapt to climate change: www.georgetownclimate.org

**Great Lakes Coastal Resilience Planning Guide** aims to connect planners and coastal, floodplain and stormwater managers with the tools and data they need to account for natural hazards and climate change in the Great Lakes: www.greatlakesresilience.org

### Flood/water resources

**FloodSmart Canada** is a hub of information related to floods, flood risks, and emergency preparedness: www.floodsmartcanada.ca

**Muskoka Watershed Council** provides information to decision-makers, managers and the general public on ways to protect and restore the resources of our watersheds: www.muskokawatershed.org

**Muskoka Water Web** was developed by The District Municipality of Muskoka to provide a portal to information about Muskoka’s most cherished resource – water: www.muskokawaterweb.ca

**Partners for Action** is an applied research network advancing flood resiliency in Canada in the face of a changing climate and extreme weather: www.uwaterloo.ca/partners-for-action
WaterBudget.ca is an invaluable resource for anyone interested in water quantity within Ontario and beyond, and is designed to communicate advancements in water quantity assessment: www.waterbudget.ca

Real-Time Hydrometric Data Map Search provides public access to real-time hydrometric data collected at over 1800 locations and access to historical data collected at over 7600 stations (active and discontinued) in Canada: https://wateroffice.ec.gc.ca/google_map/google_map_e.html?searchBy=p&province=ON&doSearch=Go

The Umbrella is an online tool to share knowledge about green stormwater infrastructure. All members have free access to resources and discussions: www.theumbrella.ca

Climate data resources

Canadian Climate Data and Scenarios supports climate change impact and adaptation research in Canada through the provision of climate model and observational data: www.cccsn.ec.gc.ca

Climate Change Hazards Information Portal is a web-based tool that helps empower organizations of all sizes and capacities to integrate climate change impacts into their planning and design decisions to help protect private and public infrastructure, resources and public health: www.cchip.ca

National Climate Data and Information Archive provides practitioners with historical climate data that can be used to determine a baseline and be used in planning, design and implementation activities: www.climate.weather.gc.ca

Ontario Climate Change Data Portal was launched to ensure technical or non-technical end-users (e.g. municipalities, private sector) have easy and intuitive access to the latest climate data over the Province of Ontario: www.ontarioccdp.ca

Government of Ontario

Emergency Management Ontario provides tools to support emergency planning efforts, information about current emergency-related events, training opportunities, resources for teachers and educators, and more: www.emergencymanagementontario.ca

Flood Forecasting and Warning Program prepares provincial and local authorities in the event of a flood: www.ontario.ca/law-and-safety/flood-forecasting-and-warning-program

The Flood page includes hazard information, safety tips, and frequently asked questions in the event of a flood: www.ontario.ca/page/floods

The Climate Change page provides an overview of how Ontario is fighting climate change and helping to build a cleaner, more sustainable future for generations to come: www.ontario.ca/page/climate-change
"Adaptation is the only means to reduce the now-unavoidable costs of climate change over the next few decades"

- Sir Nicholas Stern