



Managing Water in Response to a Changing Climate in Southwest Nova Scotia: Climate Change and Climate Change Impacts in Nova Scotia

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Climate Change

What is climate change?

Climate change is the result of long-term weather patterns being altered. These changes can be the result of natural processes such as modulations in solar cycles or volcanic eruptions, or the result of human activities that release carbon dioxide and other greenhouse gasses. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: *“a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”*.

There is consensus among the scientific community that the earth is currently experiencing human-caused or “anthropogenic” climate change. The Intergovernmental Panel on Climate Change (2015) has stated that... *“human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.”*



Image source:

<https://climatechange.novascotia.ca/climate-impacts>

*Nova Scotia’s climate is warming. It is possible that precipitation, temperature, and wind patterns will continue to change for decades, affecting the way communities throughout Southwest Nova Scotia manage their natural resources and infrastructure, and also changing the lives of people who depend on these resources and assets to survive. Currently Nova Scotians are responding to known and potential impacts of climate change in two ways: mitigation – reducing greenhouse gas emissions, and **adaptation**. (Nova Scotia Environment, 2014)*



Climate change and water

Climate change is expected to have significant impacts on both water quality and quantity which will be felt globally and locally in southwest Nova Scotia. Understanding how water flows through systems on Earth is important for understanding how we will be impacted by climate change.

Water cycle

The water cycle describes the continuous movement of water on, above, and below the surface of the earth. The processes that comprise the water cycle include:

Evaporation: As water is heated by the sun, surface molecules become sufficiently energized to break free of the attractive force binding them together, and then evaporate and rise as invisible vapour in the atmosphere.

Transpiration: Water vapour is also emitted from plant leaves by a process called transpiration. Every day an actively growing plant **transpires** 5 to 10 times as much water as it can hold at once.

Condensation: As water vapour rises, it cools and eventually **condenses**, usually on tiny particles of dust in the air. When it condenses it becomes a liquid again or turns directly into a solid (ice, hail or snow). These water particles then collect and form clouds.

Precipitation: Precipitation in the form of rain, snow and hail comes from clouds. Clouds move around the world, propelled by air currents. For instance, when they rise over mountain ranges, they cool, becoming so saturated with water that water begins to fall as rain, snow or hail, depending on the temperature of the surrounding air.

Runoff: Excessive rain or snowmelt can produce overland flow to creeks and ditches. Runoff is visible flow of water in rivers, creeks and lakes as the water stored in the basin drains out.

Percolation: Some of the precipitation and snow melt moves downwards - **percolating** or **infiltrating** through cracks, joints and pores in soil and rocks until it reaches the water table where it becomes groundwater.

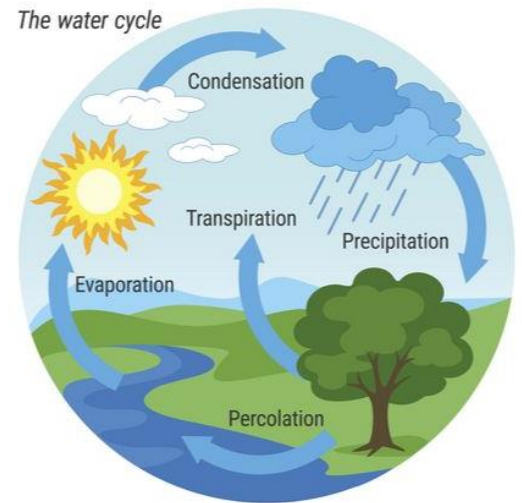


Image source:

<https://www.worldatlas.com/articles/what-is-the-water-hydrologic-cycle.html>



How will climate change impact the water cycle? (NASA, 2010)

- Higher average temperatures will cause more evaporation resulting in lower surface and ground water ground water levels and more water in the atmosphere
- As air gets warmer, it can hold more water vapor. This can lead to more frequent intense rainstorms
- More intense storms increase the risk of flooding
- An earlier arrival of spring conditions will lead to earlier peaks in snow melt and high river flows. As a result of this, less water will be available during summer and fall months
- Increased temperatures increase the risk of seasonal drought conditions



Southwest Nova Scotia’s Changing Climate

The province of Nova Scotia is almost completely surrounded by water, making the sea a major influence on our climate. About 70% of the population in Nova Scotia lives along our 7600km of coastline (Nova Scotia Environment, 2009), making populations particularly vulnerable to impacts such as sea-level rise, severe storm events and storm surge. This will result in damage to homes and businesses and other infrastructure through flooding and erosion occurring.

Photo location: Storm surge in Cow Bay, NS

Image source:

<https://www.thestar.com/news/canada/2011/01/06/nova-scotia-storm-damage-totals-13-million-and-counting.html>

In Nova Scotia, it is anticipated that climate change impacts will result in more frequent and severe storm events, resulting in increased rates of surface water runoff. Alternate warm and cold periods during the winter are also projected to occur, which will decrease the ability of rain to be absorbed into the ground due to snow and ice acting as impermeable surfaces, resulting in flooding. Runoff from stormwater can collect pollutants such as waste, gas, oil, sediment, fertilizers, etc. on its way to the storm drain, polluting nearby water bodies. A loss of forest canopy cover and human development also contribute to higher rates of surface water runoff due to a lack of infiltration.

According to Charles Bourque, Professor of Hydrology and Meteorology at the University of New Brunswick, southwest Nova Scotia could see a 24 percent rise in mean temperature by 2040 (CBC, 2016). Although we expect to see more precipitation as a result of climate change, higher rates of evaporation due to warmer temperatures may result in an overall decline in water levels. We will see lower surface water levels and water tables due to higher rates of evaporation, making water availability an anticipated



issue for the region. Nova Scotia Environment anticipates a higher demand for freshwater resources, making the conservation of freshwater resources an important step in climate change adaptation.

Nova Scotia’s freshwater supplies could potentially be at a greater risk from pollution due to runoff that is caused by heavy rain and snow events, bacteria outbreaks (parasites in warmer water conditions), and contamination of drinking water in wells (salt water intrusion – *sea level rising above water table*) (Nova Scotia Environment, 2014).

Declines in surface water can lead to increased issues with water quality as contaminants become more concentrated - increasing water temperatures creating conditions suitable for algal blooms and other pathogens. This will affect the water resources that are available for tourism and recreation, municipal water supplies, agriculture, freshwater fisheries, etc. (Nova Scotia Environment, 2014).

Summary of anticipated water-related climate change impacts in Nova Scotia

- ✓ Changes in precipitation and extreme precipitation events
- ✓ More frequent storm events
- ✓ Increasing storm intensity
- ✓ Sea level rise
- ✓ Storm surges and coastal flooding
- ✓ Accelerated coastal erosion
- ✓ Inland flooding and flash-floods
- ✓ Wetter winters
- ✓ Loss of sea ice
- ✓ Drier summers with droughts and more forest fires
- ✓ Water availability constraints
- ✓ Increased rates of evaporation
- ✓ Lower surface water and ground water levels in the summer

Municipalities in Nova Scotia are concerned about the above impacts of climate change on water resources and are working to implement their Municipal Climate Change Action Plans. Examples of the issues highlighted in these documents include:

- **Coastal and inland flooding** causing damage to infrastructure, washout of dyke systems, etc.
- **Erosion** – affecting infrastructure and wildlife habitat and degrading water quality
- **Less potable water** – less drinking water available and increased issues with water quality
- **Summer drought conditions** and **reduced water recharged** (*groundwater*) resulting in a lack of water for well users, agriculture and other users



Photo location: Highway 101
Source: http://www.novaweather.net/Flood_2003/FloodHwy101b.ipa



- **Sewers backing up** into homes and businesses causing sanitary issues
- **Washout of wastewater treatment plants** during heavy precipitation and runoff events, polluting water bodies and increasing E.coli levels

Climate change adaptation and mitigation

Climate change **adaptation** refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects (Government of Nova Scotia). Some degree of climate change will be unavoidable, and will have various impacts on Nova Scotian communities. Adaptation is needed to reduce the threats of climate change and make necessary adjustments in our day-to-day lives.

Climate change **mitigation** refers to human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs) (Intergovernmental Panel on Climate Change, 2015). The difference between climate change adaptation and mitigation is that *adaptation* focuses on responding to current climate impacts, where *mitigation* looks to reduce the potential future impacts it may have.

Action

What is the federal government doing?

- **The Pan-Canadian Framework on Clean Growth and Climate Change** – this plan was developed with the provinces and territories and in consultation with indigenous peoples to grow the economy while reducing emissions and adapting to the impacts of a changing climate. Read more: <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework/climate-change-plan.html>

Adaptation Approaches

(Elemental Sustainability Consulting Ltd., 2012)

Preserve and enhance lands for natural resource and habitat values (e.g., the preservation of land surrounding wetlands and beaches to allow for their inland migration as the seas rise).

Avoid developing in areas considered at moderate to high risk to a hazard. Avoidance measures are typically limited in application to future development or redevelopment (e.g., setbacks, zoning that aligns land use with flood risk).

Protect areas considered at moderate to high risk to a hazard from development. Avoidance measures are typically limited in application to future development or redevelopment.

Accommodate climate change effects by adapting land-based structures and activities to tolerate an impact (e.g. warning and evacuation protocols, rolling easements).

Managed Retreat is defined as any strategic decision to withdraw, relocate or abandon private or public assets that are at risk of being impacted by coastal hazards.

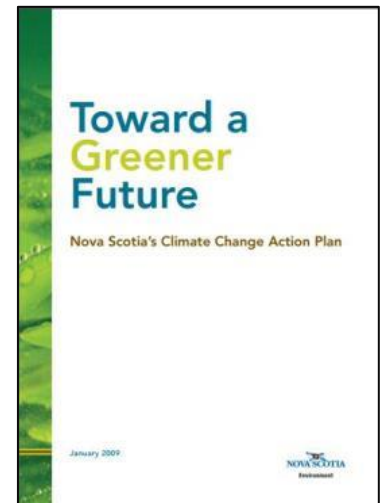


- **Expert Panel on Climate Change Adaptation and Resilience Results** – was launched to help define how to measure progress building Canada’s resilience to climate change.
- **Federal Adaptation Policy Framework** – helps the Government of Canada take account of climate risks as decisions are made on a wide range of programs and activities that support the well-being of Canadians. It brings climate change issues into the mainstream of federal decision-making, and guides federal priorities to address climate risks in the future.
- **Canadian Centre for Climate Services.** The Canadian Centre for Climate Services (CCCS) is a dedicated multi-disciplinary team with expertise across a broad range of climate-related disciplines. CCCS works with partners and stakeholders to support the implementation of the Pan-Canadian Framework on Clean Growth and Climate Change.

Learn more: <https://www.canada.ca/en/environment-climate-change/services/climate-change/adapting.html>

What is the provincial government doing?

- The **Environmental Goals & Sustainable Prosperity Act (EGSPA)** became law in 2007. Under this act are, the long-term environmental and economic objectives of the province is to achieve sustainable prosperity and to this end to: 1. Establish clear goals that foster an integrated approach to environmental sustainability and economic well-being; and 2. Work towards continuous improvement in measures of social, environmental and economic indicators of prosperity. Read more: <https://novascotia.ca/nse/egspa/>
- **Nova Scotia’s Climate Change Action Plan**- outlines what Nova Scotia is doing to be leaders in climate change, including reducing greenhouse gas emissions and preparing for changes to our climate that are already happening. Read more: <https://climatechange.novascotia.ca/sites/default/files/uploads/ccap.pdf>



Nova Scotia’s Climate Change Action Plan

Source: <https://cumberland-energy-authority.ca/sidewalks.html>



- **Atlantic Climate Adaptation Solutions (ACAS)** – is a partnership among provincial governments, not-for profit groups, tribal governments, and industry to provide access to ACAS's projects, publications, and other research outputs that help Atlantic Canadians better prepare for, and adapt to, climate change. Learn more about their projects at <https://atlanticadaptation.ca>
- In response to climate change and its effects, the Province of Nova Scotia has mandated that all municipalities prepare **Municipal Climate Change Action Plans (MCCAP's)**

Municipal Level:

- **Municipal Climate Change Action Plans**- All municipalities in Nova Scotia were required to complete a Municipal Climate Change Action Plan (MCCAP) as an amendment to the Integrated Community Sustainability Plans adopted in 2010 by the end of 2013. Climate Change Action Plan's help to establish a long-term framework for action in relation to climate change, while also identifying threats, and recommending and implementing solutions to help adapt and mitigate to these arising concerns.
- **Integrated Community Sustainability Plans (ICSP)** - are plans that have been developed by all of Nova Scotia's fifty-four municipalities. They are a reporting requirement of the Municipal Funding Agreement (MFA) between the province and municipalities. These long term plans were developed in consultation with members of the community to help individuals better understand objectives that are sustainable within environmental, cultural, social, and economic aspects in relation to climate change and encouraging action and adaptation.

Municipal Climate Change Action Plans

Each of the municipalities in Nova Scotia has developed a Climate Change Action Plan. The content of these plans is specific to each municipality, and identifies climate change issues and hazards, affected locations, facilities and infrastructure and local socio-economic and environmental factors. These plans can typically be accessed online if you are interested in learning more about the MCCAP for your community.



The following list shows examples of types of actions identified in MCCAP's within southwest Nova Scotia:

Land use planning

- Considering land use planning in coastal areas
- Development of flood plain mapping to assess setbacks in vulnerable areas
- Liaising with NS Power and NS Department of Agriculture about best management practices and maintenance of dykelands where present in NS
- Ensuring that land use planning protects agricultural lands (*due to a large volume of the population relying on agriculture for their income*)
- Land use planning to limit development in ecologically sensitive areas
- Storm surge monitoring integrated into coastal flood risk mapping
- Beach planning
- Inland flood risk mapping
- Adoption of Coastal Management Strategy

Water quality and quantity

- Development of Stormwater Management Plans for select areas
- Development of Source Water Protection Plans
- Conducting infiltration reduction assessments
- Upgrading and maintenance of water and wastewater infrastructure
- Strategy development for supply and sharing of potable water sources
- Minimizing inflow and infiltration in the wastewater system through *cleaning, inspection, and repair programs*
- Development of back-up measures, re-design or upgrade of individual stations as needed

Infrastructure

- Review of road construction design standards
- Adapt land management practices to limit/restrict development in low-lying coastal areas
- Liaise with the Province to adapt maintenance program to protect vulnerable sections of road

Public safety

- Reviewing safety risks associated with climate change
- Weather safety policy – *hurricanes, storm surge and ice storm*
- Increasing public awareness of emergency preparedness
- Updating Emergency Preparedness procedures to address drought scenarios

GHG emissions reductions

- Upgrading municipal heating systems to renewable energy sources
- Implement energy efficiency improvements

Science and research

- Encouragement of citizen science projects
- Liaison with local conservation groups and government departments to identify sensitive areas

Public education

- Integration of climate change into public outreach programs
- Development of education and outreach programming for coastal landowners regarding development of best practices



The role of water conservation and stormwater management in climate change adaptation

Adaptation to climate change requires collective action, including actions taken at the household or business level. Improved **stormwater management** and **water conservation** are two areas that offer many opportunities for action at an individual or community scale.

Stormwater management

The traditional way of managing stormwater runoff is shown through grey infrastructure (ditches, pipes and culverts) which was intended to evacuate stormwater runoff as quickly as possible, reducing the risk of flooding in targeted areas. These systems are unable to handle increasing volumes of water that result from intense precipitation events in conjunction with increasing rates of surface runoff as development leads to more impermeable surfaces that do not allow infiltration of surface water.

In developed areas, surface runoff is traditionally conveyed directly into receiving water bodies, such as rivers, lakes, streams or the ocean. Water is collected from roads, roofs and other impermeable surfaces and transported through stormwater infrastructure such as drains, pipes, culverts and other water carrying systems. The stormwater carries trash, sediment, bacteria, heavy metals and other pollutants from the landscape, degrading the quality of the receiving waters. Higher flows can also cause erosion and flooding in streams, damaging habitat, property and infrastructure.



Photo description:

Rain garden in Digby Nova Scotia, constructed by the Clean Annapolis River Project

Green infrastructure refers to water management that protects, restores, or mimics the natural water cycle (American Rivers , 2017). Green infrastructure can be combined with traditional grey infrastructure to create a more resilient, financially stable, and less polluting way of managing stormwater runoff.

Low impact Development (LID) is a subset of approaches that utilize green infrastructure. LID refers to *“designing and implementing practices that can be employed at the site-level to control stormwater and strive to replicate the pre-development hydrology of the site”* (Dickinson, 2013).

See the companion document, “Managing Water in Response to a Changing Climate in Southwest Nova Scotia: Stormwater Management” to learn more about stormwater LIDs.



Green infrastructure and LID for stormwater management:

- Trenches, swales, and xeriscaping
- Tree planting
- Constructed wetlands
- French drain system/ perforate pipes
- Cisterns and rain barrels
- Removal of impervious surfaces (ex: pavement) and permeable options (ex: permeable pavers)
- Rain gardens and soil enhancement
- Redirecting your downspout
- Lot grading



Image source:
<http://www.calgary.ca/UEP/Water/Pages/Water-conservation/Lawn-and-garden/Rain-barrels/Green-Calgary-Rain-Barrel-Sales.aspx>

Water Conservation

Although we expect to see more precipitation as a result of climate change, there may be an even higher rate of evaporation due to warmer temperatures resulting in an overall decline in water levels. This may mean reduced water levels in surface waters (eg. lakes, ponds) and a lowered water table, where well water is obtained.

Water conservation includes all the policies, strategies and activities to sustainably manage the freshwater resources, to protect the hydrosphere, and to meet the current and future human demand. By conserving water we can reduce the pressure placed on this limited resources and better manage the risk of water shortages during drought conditions.

Ways to conserve water:

- Harvest rainwater from your roof
- Check for leaks (sinks, toilets, plumbing, etc.)
- Install low flow devices
- Have a water audit done
- Reuse grey water
- Take shorter showers
- Turn off tap when brushing teeth
- Do full loads of laundry and dishes
- Using mulch for plants to save from watering
- Planting native species that require little water and maintenance

See the companion document, "Managing Water in Response to a Changing Climate in Southwest Nova Scotia: Water Conservation" to learn more about residential water conservation practices.



For more information on ways to properly manage and conserve water on your property and in your home, contact us at:

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