Brief to the House of Commons Standing Committee on Environment and Sustainable Development

Disaster Mitigation and Insurance: The Role of Forests in Mitigating Extreme Weather Events

Rob Keen, CEO of Forests Ontario

June 3, 2019

## Forests Ontario

Forests Ontario is a not-for-profit charity dedicated to re-greening the province through the support of forest restoration, stewardship, education and awareness. Acting as the voice of our forests, the organization promotes the ability of healthy forests to sustain healthy communities and healthy economies.

Forests Ontario was first formed in 2014 through the merging of the Ontario Forestry Association and Trees Ontario. Since then, the organization has facilitated the planting of more than 30 million trees, educated tens of thousands of students, and engaged countless people and communities through awareness efforts.

Forests Ontario has also developed a national tree-planting division, Forest Recovery Canada. Forest Recovery Canada works with planting organizations, municipalities, First Nations, ENGOs, and corporate sponsors to plant trees where they are most needed to lessen the effects of climate change, ensuring that today's trees will thrive in tomorrow's forests.

Due to the proven ability of forests to mitigate climate change and associated impacts, Forests Ontario believes that it is more imperative than ever to enhance and increase both provincial and national forest cover.

## Climate Change and Extreme Weather

Since the mid-20th century, observations of global warming and associated alterations in long-term weather patterns have been noted. This phenomenon has come to be known as climate change, and has been linked to increased levels of atmospheric carbon dioxide produced by human activities involving the use of fossil fuels. Canada's Changing Climate Report, prepared by Environment and Climate Change Canada, describes climate change as one of the defining challenges of the 21st century, requiring global action (Bush and Lemmen, 2019).

The impacts of climate change are being experienced on *all* levels by *all* people. In Canada, the effects of climate change include more extreme heat, shorter snow and ice cover seasons, earlier spring peak streamflow, thinning glaciers, thawing permafrost, and rising sea level (Bush and Lemmen, 2019). Further, a warming climate has resulted in an increase in the frequency and severity of extreme weather events, such as flooding, heatwaves, drought, and wildfires.

Ultimately, extreme weather events pose a direct threat to both human lives and engineered infrastructure such as homes, roads and bridges.

## The Role of Forests in Mitigating Climate Change

Our natural landscapes have a powerful ability to address climate change, with forests in particular playing an important and proactive role.

Trees absorb carbon dioxide, the main driver of climate change, from the atmosphere and use the carbon to build their trunks, branches, and roots, releasing oxygen as a by-product. While most climate change mitigation efforts focus on *reducing* carbon emissions, trees actually *remove* carbon from the air. To put this in perspective, the average 80-year-old Canadian tree has absorbed 200 kg of carbon during its life; in fact, 50 per cent of an 80-year-old-tree is made up of carbon.

As well, trees continue to store carbon in the form of wood products, which can lock up sequestered carbon well beyond the natural life span of a tree. For example, a wood-framed house stores the same amount of carbon emitted by a car running for five years. As new trees become established to replace those that have been removed, carbon continues to be stored and the cycle starts again, creating continual carbon benefits.

Further, the use of wood products provides a sustainable alternative to other materials which are highly dependent on fossil fuels for their production and much more energy intensive to manufacture, further contributing to the global climate crisis.

When managed sustainably, our forests become carbon sinks, meaning that they absorb more carbon than they emit. Recent studies have found that younger forests in particular are more efficient and effective carbon sinks (Pugh et al., 2019). Essentially, more trees translate to more carbon sequestration and a healthier planet.

## The Role of Forests in Reducing the Impacts of Extreme Weather Events

In addition to playing a proactive role in addressing climate change via carbon sequestration, forests also mitigate the associated impacts of climate change, such as extreme weather.

### Floods

#### *Flood Trends*

With each degree of warming, the atmosphere is thought to be able to hold 7% more water vapour (Clark, 2011). It is further predicted that average precipitation volumes will increase by 1-2% for each degree of temperature increase (Clark, 2011). As a result, climate change is expected to lead to more frequent and intense precipitation events, especially in regions of higher latitude which already experience a considerable amount of rain or snowfall (Clark, 2011; EPA, 2017; Vidal, 2017).

Precipitation events have already begun to increase in frequency and magnitude in Canada, having direct impacts on the likelihood, frequency, intensity and scale of flooding. For example, both Ottawa and Montreal had their wettest spring in history in 2017. The resulting spring flooding inundated hundreds of communities, forced 4,000 people from their homes, damaged 5,000 residences, washed away 550 roads, and led to the loss of two lives.

However, flooding in Ontario is not a new concept. In the 1920s and 1930s, flooding was a commonplace occurrence. Edmund Zavitz, Chief Forester of Ontario a century ago, traced the problem to deforestation. Settlers had cleared most of Southern and Eastern Ontario, leaving a bare-bones forest cover of about nine per cent. The Thames and Ganaraska watersheds were down to about four per cent forest cover. The indiscriminate clearing had stripped away some of the key features that absorb rainfall surges. Zavitz offered a simple solution: plant trees (Bacher, 2011).

Zavitz's recommendation has since been backed up by science. Environment Canada's 'How Much Habitat is Enough?' report states that 40% forest cover at the watershed scale is needed to support environmental resiliency and health (2013). Presently, southern Ontario has a highly fragmented landscape with forest cover averaging 26% and as low as 5% in some areas of southwestern Ontario. Increasing forest cover is critical to ensuring healthy forests for our future, especially considering the impacts of climate change.

### *Forests and Flooding*

Forests have been well recognized for their ability to effectively reduce and slow runoff during and following small-scale rainfall events (Depietri, Renaud, & Kallis, G., 2012). This is a result of several factors. First, tree canopies are able to intercept rainfall, significantly reducing the amount of rainfall reaching the ground. For example, the average canopy interception for Douglas-fir in Vancouver was calculated at 49.1% (Asadian and Weiler, 2009). Second, forests act like sponges, absorbing and storing more water than other landscapes such as farms and grasslands. Further, forests enable increased infiltration - essentially, as trees absorb water from soils, soil is able to store even more moisture.

Forests also stabilize river banks, reducing erosion and downstream blockages as a result. This in turn can reduce the occurrence of fluvial flooding events.

Finally, there is evidence that the interaction between forest cover and the water cycle can moderate floods on a broader level. According to Ellison et al. (2017), forests are able to drive air pressure patterns and recycle precipitation, thus transporting atmospheric moisture across land and dispersing water. Essentially, through transpiration and evaporation processes, forests may provide a positive impact on local-level flooding (Ellison et al., 2017).

## Heat Waves

### *Heatwave Trends*

Average temperatures are climbing around the world, with the global mean standard temperature now at 1ºC above the pre-industrial average level. In Canada, the years 2015, 2016, and 2017 have been the warmest yet (Environment and Climate Change Canada, 2019). As average global and national temperatures rise, so do the frequency and severity of short-term, excessively hot periods, or heatwaves.

To illustrate, a sweltering heatwave in Eastern Canada over the Canada Day long weekend in 2018 marked the longest and most intense heat spell in years. Across Quebec, 93 people died from heat-related complications (Environment and Climate Change Canada, 2019).

Heatwaves are also predicted to increase in length. For instance, it is estimated that the instances of 30°C and higher temperatures in the City of Toronto will climb from 20 days to 66 by 2040-2049, making the protection of vulnerable populations an incredibly pertinent and pressing issue (SENES Consultants Ltd., 2011).

### *Forests and Heatwaves*

Natural infrastructure in the form of trees and forests represent a potential solution to this problem, particularly in urban areas, as trees are able to create shade and cool air via evapotranspiration.

Shade provided by urban trees have been found to significantly reduce temperature of surfaces below them (Wang, Berardi, & Akbari, 2016). If fact, tree canopies have been identified as the most optimal solution for shading pedestrian space (Norton et al., 2015).

Evapotranspiration is the transfer of water from land to the air via evaporation and plant transpiration (the evaporation of water from plant leaves). The United States Geological Survey

estimates that a large oak tree transpires more than 150,000 liters of water every year, providing considerable relief during droughts and heatwaves (n.d.). Evapotranspiration from trees is thought to considerably cool local environments, thus providing a climate-regulating service that can help buffer the impacts of heatwaves (Depietri, Renaud, & Kallis, G., 2012; Wang, Berardi, & Akbari, 2016; Norton et al., 2015).

A study on the effects of street trees on the Urban Heat Island effect in Montreal found that tree cover could reduce day time temperatures by 4°C (Wang and Akbari, 2016). Many other studies have similar findings, and state that street trees provide the greatest cooling potential per unit area when compared to other cooling techniques such as cool pavements and cool roofs (Wang, Berardi, & Akbari, 2016; Rosenzweig, Solecki, & Slosberg, 2006).

In this way, urban trees can help mitigate heatwaves while also providing other benefits such as reducing cooling costs, improving air quality, and supporting human health.

## Wildfires

### *Forest and Wildfire Trends*

Changes in land use and vegetation composition in combination with climate change have resulted in an increase in wildfires since the second half of the 20th century, particularly in Canada's northwestern boreal regions (Natural Resources Canada, 2017). These events continue to increase in frequency and severity.

In both 2017 and 2018, British Columbia declared a province-wide state of emergency due to wildfires. In the summer of 2018, nearly 2,000 wildfires were ignited across the province, resulting in Canadians as far east as Lake Superior breathing in smoke (Environment and Climate Change Canada, 2019). Conditions in Ontario were similar, with more than 1,325 wildfires burning in Central and Northern Ontario in 2018; according to the Province, this was one of the "busiest fire seasons" on record.

### *Healthy Forests & Wildfires*

Wildfires and climate change create a positive feedback loop: with warmer temperatures comes a higher likelihood of fires, and as more forests burn more greenhouse gases are released, thus contributing further to climate change. The methods to address this problem are therefore two fold: reduce carbon emissions and reduce the number and severity of wildfires.

The wildfires Canada has been experiencing in recent years have been burning the affected area's soils so intensely that, in many cases, regeneration is not possible without external support. In turn, this can impact the occurrence of other extreme weather events. As mentioned, the presence of trees and forests are known to reduce damages associated with flood events. As a result, one can surmise that areas impacted by wildfires will also be more likely to experience flooding events following heavy precipitation.

While forests themselves may not be able to mitigate the risk of wildfire occurrence, forest management can. According to Natural Resources Canada, "Fire management is the process of planning, preventing and fighting fires to protect people, property and the forest resource. It also involves fire to attain forestry, wildlife and land-use objectives" (2016a). Managing our forests to

mitigate wildfires is not only important for reducing further carbon emissions and damage by other extreme weather events; doing so also has environmental, economic, and societal benefits.

Actively managing the composition and age of our forests is also an important consideration. In some regions of the country, including Ontario, our managed forests have become slightly skewed to older age classes (i.e. older forest stands) than normal. In addition to the reduced capacity of older trees to absorb carbon, mature forests are more prone to natural senescence and natural disturbances, such as insects and fire; this can turn our forest resources into net carbon sources rather than sinks (Natural Resources Canada, 2016b). As noted in the 'State of Ontario's Natural Resources - Forests 2016' report, "Ontario's forests are projected to be a source of carbon until 2030, reflecting their slightly older age structure" (Ontario Ministry of Natural Resources, 2016).

Sustainably managing our forests for the production of wood products represents another significant opportunity to mitigate climate change. Converting trees that might otherwise be lost to fire or other disturbance events into wood products promotes the long-term storage of carbon well beyond the natural life of the forest. To illustrate, 170.5 million tonnes of carbon are currently stored in Ontario derived wood products (Ontario Ministry of Natural Resources, 2016).

## Implications for Insurance

Insured damages for severe weather events in 2018 were the fourth-highest on record, totalling $1.9 billion as a result of floods, ice storms, tornadoes, and windstorms (Insurance Bureau of Canada, 2019). The afore mentioned 2017 spring flooding events in Ottawa and Montreal alone resulted in $223 million in property damages (Environment and Climate Change Canada, 2017). With 100-year flood events occurring more often, flood damages have become the leading cause of insurance claims in Canada (Green Communities Canada, 2017).

However, extreme weather events do not just damage property. Physical and mental human health impacts – and even loss of life – have been directly connected to floods, heatwaves, wildfires, and droughts, as well as to compounding concerns such as food security, drinking water source contamination, disease spread, and loss of land (Public Health Agency of Canada, 2017).

As the climate crisis continues to grow, so do the frequency and magnitude of extreme weather events and the costs associated with them. This has direct implications for the insurance industry.

## Summary

Afforestation combined with sustainable forest management is the most straightforward thing we can do to reduce the risks associated with climate change. As opposed to simply reducing our carbon emissions, these activities provide an opportunity to contribute to the net removal of carbon in our atmosphere.

Tree planting specifically has the potential to significantly mitigate the impacts of extreme weather events and natural disturbances associated with climate change, most notably flooding and extreme heat.

Despite these recognized benefits, we have witnessed an erosion in provincial government support for large-scale afforestation efforts. The cancellation of the Ontario 50 Million Tree Program as well

as last fall's closure of the Ontario Tree Seed Plant by our provincial government are examples of recent decisions that jeopardize the future of tree planting in areas where support is desperately needed.

Complex infrastructure is required to ensure planting success. The process of tree planting involves a suite of activities, including seed forecasting and collection, stock development, site preparation, planting, survival assessments, and other ancillary support activities. The process is also lengthy – one successful planting season is dependent upon four to five years of planning. Time is required to forecast stock demand several years out, conduct landowner outreach, and secure long-term sustainable funding to promote capacity development.

Rather than reducing the tree planting programs and supporting infrastructure currently in place, we should collectively be looking to enhance our afforestation efforts across the country in order to fulfill our climate responsibilities on a world stage.

There is growing global recognition of the valuable role forests and tree planting play in mitigating climate change. The United Nations Environmental Programme launched a 'Billion Tree Campaign' in 2006 in response to global warming, calling for the planting of a billion trees across the planet. However, the campaign's target has since been revised to a trillion trees as a result of new findings which estimate that a trillion trees could capture 25% of all human-made carbon dioxide emissions, helping to keep global temperature rise below the 2°C limit set by the Paris Climate Agreement in 2016 (Crowther et al., 2017). As a result, multiple countries have committed to planting billions of trees.

Canada has the opportunity to become a world leader in afforestation and climate action, as the necessary tree planting infrastructure already exists. However, political will and support are required to enable Canadians to contribute to broader global climate goals.

## Recommendations

In light of the information presented in this brief, two recommendations are offered:

- Support afforestation efforts and infrastructure.
- Further explore the relationship between forests and extreme weather mitigation by commissioning a study which aims to quantify the reduction in costs related to flood events facilitated by trees, forest cover, and tree planting.

## Bibliography

**Asadian, Y., & Weiler, M.** (2009). A new approach in measuring rainfall interception by urban trees in coastal British Columbia. Water quality research journal of Canada, 44(1), 16.

**Bacher, J.** (2011). Two Billion Trees and Counting: The Legacy of Edmund Zavitz. Dundurn.

**Bush, E. and Lemmen, D.S**. (2019). *Canada's Changing Climate Report*. Government of Canada, Ottawa, ON. 444 p

**Clark, D.** (December 15, 2011). How will climate change affecy rainfall? The Guardian. Retrieved from https://www.theguardian.com/environment/2011/dec/15/climate-change-rainfall

**Conservation Ontario.** (n.d.). *Flood Management - Risk to Resiliency*. Retrieved from https://conservationontario.ca/policy-priorities/flood-management/

**Crowther, T. W., Glick, H. B., Maynard, D. S., Ashley-Cantello, W., Evans, T., & Routh, D.** (2017). Predicting Global Forest Reforestation Potential. BioRxiv, 210062.

**Depietri, Y., Renaud, F. G., & Kallis, G**. (2012). Heat waves and floods in urban areas: a policy-oriented review of ecosystem services. *Sustainability science*, *7*(1), 95-107.

**Ellison, D., Morris, C. E., Locatelli, B., Sheil, D., Cohen, J., Murdiyarso, D., ... & Gaveau, D.** (2017). Trees, forests and water: Cool insights for a hot world. Global Environmental Change, 43, 51-61.

**Environment Canada.** (2013). *How Much Habitat is Enough? Third Edition*. Environment Canada, Toronto, Ontario

**Environment and Climate Change Canada**. (2017, December 20). Canada's top 10 weather stories 2017. Retrieved from https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2017.html

**Environment and Climate Change Canada**. (2019, January 10). Canada's top 10 weather stories of 2018. Retrieved May 29, 2019, from https://www.canada.ca/en/environment-climate-change/services/top-ten-weather-stories/2018.html#toc6

**Environmental Protection Agency (EPA).** (2017). Changing rain and snow patterns. A student's guide to global climate change. Retrieved from https://archive.epa.gov/climatechange/kids/impacts/signs/precip-patterns.html

**Green Communities Canada.** (2017). *Urban Flooding in Ontario: Toward Collective Impact Solutions*. Retrieved from http://www.raincommunitysolutions.ca/wp-content/uploads/2017/04/GCC-UrbanFloodingMar17.pdf

**Insurance Bureau of Canada.** (2019). Severe Weather Causes $1.9 Billion in Insured Damage in 2018. Retrieved from http://www.ibc.ca/on/resources/media-centre/media-releases/severe-weather-causes-190-million-in-insured-damage-in-2018

**Lower Thames Valley Conservation Authority. (n.d.).** *History of Flooding*. Retrieved from https://www.lowerthames-conservation.on.ca/flood-forecasting/flooding-history/

**Natural Resources Canada.** (2016a). Fire management. Retrieved from https://www.nrcan.gc.ca/forests/fire-insects-disturbances/fire/13157

**Natural Resources Canada.** (2016b). Why forests need fires, insects and diseases. Retrieved from https://www.nrcan.gc.ca/forests/fire-insects-disturbances/forest-need/13081

**Natural Resources Canada.** (2017). Climate Change and Fire. Retrieved from https://www.nrcan.gc.ca/forests/fire-insects-disturbances/fire/13155

**Norton, B. A., Coutts, A. M., Livesley, S. J., Harris, R. J., Hunter, A. M., & Williams, N. S.** (2015). Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. Landscape and Urban Planning, 134, 127-138**.**

**Ontario Ministry of Natural Resources.** (2016). *State of Ontario's Natural Resources - Forests 2016.* Queen's Printer for Ontario. Sault Ste. Marie, ON.

**Public Health Agency of Canada.** (2017). Science Narrative: Climate Change Impacts on the Health of Canadians. Retrieved from http://publications.gc.ca/collections/collection_2017/aspc-phac/HP5-122-2017-eng.pdf

**Pugh, T. A., Lindeskog, M., Smith, B., Poulter, B., Arneth, A., Haverd, V., & Calle, L.** (2019). Role of forest regrowth in global carbon sink dynamics. Proceedings of the National Academy of Sciences, 116(10), 4382-4387.

**Rosenzweig, C., Solecki, W., & Slosberg, R.** (2006). Mitigating New York City's heat island with urban forestry, living roofs, and light surfaces. A report to the New York State Energy Research and Development Authority.

**SENES Consultants Ltd**. (2011). Toronto's Future Weather and Climate Driver Study. Retrieved from https://www.toronto.ca/legdocs/mmis/2012/pe/bgrd/backgroundfile-51665.pdf

**United States Geological Survey.** (n.d.) Evapotranspiration and the Water Cycle. Retrieved from https://www.usgs.gov/special-topic/water-science-school/science/evapotranspiration-and-water-cycle?qt-science_center_objects=0#qt-science_center_objects

**Vidal, J.** (September 3, 2017). As flood waters rise, is urban sprawl as much to blame as climate change? The Observer. Retrieved from https://www.theguardian.com/world/2017/sep/02/flood-waters-rising-urban-development-climate-change

**Wang, Y., & Akbari, H.** (2016). The effects of street tree planting on Urban Heat Island mitigation in Montreal. Sustainable cities and society, 27, 122-128.

**Wang, Y., Berardi, U., & Akbari, H.** (2016). Comparing the effects of urban heat island mitigation strategies for Toronto, Canada. Energy and Buildings, 114, 2-19.