

WATER CANADA

WILDFIRES IN OUR WATERSHEDS

“Code Red” for Source Water Supply

**Fostering
Innovation**

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Planning**



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Wildfires in our Watersheds

“Code red” for source water supply. BY FRANÇOIS-NICOLAS ROBINNE AND KEVIN D. BLADON

“A CODE RED FOR HUMANITY!” That is how the recently released, landmark report from the Intergovernmental Panel on Climate Change (IPCC) was described. The report, which is the first major review of the science since 2013, clearly indicates that climate change has impacted the Earth’s support systems in ways that are irreversible for centuries to millennia. The consequences of this warming could be catastrophic to humans and society if we don’t act now. The IPCC report strongly echoes the 2019 Canada’s Changing Climate Report and the following 2021 National Issues Report, which detailed what a warmer planet means for the life of Canadians.

In each of these reports, a primary concern is the implications of climate change on the hydrologic cycle and water supply. In brief, the water cycle is accelerating, leading to more water-related climate and weather extremes—droughts, floods, storms, and wildfires. All of these disturbance events are becoming more frequent and more intense.

In particular, catastrophic wildfires have become the unfortunate icon of environmental change almost everywhere in the world where trees and people grow together. Canada is no exception. In fact, the country is a global hotspot, as illustrated by our 2021 record-breaking fire season. Even though wildfires are natural and necessary for Canadian forest ecosystems and, by extension, watershed functioning, the growing scale and intensity of wildfires increasingly poses substantial risks.

It is estimated that Canadian forests provide up to 90 per cent of our surface water supply—as such, the health of our forests is critical for maintaining national water security. Healthy forests filter precipitation, store and release water, hold soils together, and influence local and regional weather through tree water use. Together, these processes provide us with numerous ecosystem services, including river flow mediation, increased water quality, provision of aquatic habitat, and climate regulation.

As such, those living downstream of forests ultimately benefit from access to electricity from hydropower generation, recreational opportunities, and provision of drinking water supplies.

Sustainable and healthy water supplies may actually benefit from the occurrence of smaller, low intensity fires in our forests. Indeed, wildfires can keep vegetation from become overstocked, reducing water demand while providing a mosaic of habitats that keep our watersheds healthy. Historically, in many parts of Canada, smaller, more frequent fires were common. However, we have seen a shift in recent years to larger and more intense blazes that can produce many negative impacts on watershed hydrology and outweigh the positive ones.

Extreme fires can dramatically alter the natural processes of forested watersheds in storing and transmitting water and other constituents. For example, fires can lead to more flood events, shifts in the timing of availability of water, elevated occurrence of mass

movements or landslides, increases in sediment, nutrients, carbon, and metals in streams, and decreases in dissolved oxygen. All of these impacts can persist for many years, even decades, after fires, resulting in cascading challenges for recreation, aquatic ecosystems, hydropower generation, and safe drinking water production. In the worst-case scenario these effects become cumulative or compound within a basin, resulting in competition for limited resources—money or water—creating water disruption or shortages.

But the true impacts and costs to water supply across Canada remain largely unknown and understudied. Although it is generally accepted that direct risks to public health from fire-polluted water at the tap are low, they can't be dismissed because the costs to ensure safe drinking water can be substantial. For example, after a fire in a source watershed, costly challenges to water production and distribution can include: failure of the power grid, damages to water intakes and pipes from excess erosion and debris flows, reduced reservoir capacity, taste and odour issues with water, increased landfill costs from treatment

uncontrolled wildfires. These practices have the added benefit of supporting carbon sequestration and reducing the vulnerability of our forests, which can protect the health and integrity of Canadian water supplies. Additionally, we must identify those communities whose infrastructure is vulnerable to the effects of wildfire. In those cases, we can then invest in active forest management practices in source watersheds, as well as infrastructure upgrades and operator training to further safeguard the provision of safe drinking water.

To support all of these actions we must fill in the critical gaps that remain in our knowledge. Although the current research allows us to agree on generalities, experts in the field also agree that wildfire-watershed risks are local, maybe regional, in nature and require greater attention. Canada can be divided into 60 different fire regimes, which describes the way fires have burned historically, accounting for seasonality, size, severity, and frequency, among other things. Additionally, across each of those fire regimes may be variable and complex hydrological processes and systems that have not been adequately mapped or understood. Canadian research on wildfire and water can be traced back to the 1980's, but we only started to integrate risks to water supply approximately a decade ago, and most studies have been

limited in spatial and temporal scopes. As such, the identification of local risks from wildfires to water supply has been hampered by the difficulties in accessing nation-wide data. It is our hope that continued acknowledgement of the risks combined to stakeholder collaboration and investments in applied research in this area will improve data availability to facilitate a more proactive, rather than reactive, approach to wildfire-watershed risks in Canada.

But the reality is that effective risk management and water resources management requires good governance (read: people), to help support and address the social, technological, engineering, and knowledge gaps and

issues. Water crises on Indigenous land, in North Battleford, Saskatchewan, Walkerton, Ontario, and Flint, Michigan—even though not linked to fire—illustrate the critical importance of effective water governance. As the number of risk factors increase—climate change being a threat multiplier—and the system becomes increasingly complex, the odds for an incident to occur increase as hidden vulnerabilities emerge, and so the risk of water supply disruption. Planning for this reality, no matter how performant the staff is, is paramount, for the very simple reason that we are now navigating in uncharted territories, and we need to prepare for the emergence of 'unknown unknowns' by preparing people to these eventualities. Work done in Australia with staff members from numerous water treatment plants shows that communication, mutual help, and emergency drills are the best ways to manage a crisis when it happens.

So, are we alarmist? Yes, I guess we can say we are, and we stand by it. What happened this year in Canada (B.C., Alberta, and Ontario) and elsewhere around the planet, is nothing normal, but it is a new reality the water supply sector will have to face and dynamically adapt to. We can't only rely on our water distribution (infra)structures to hold the pressure and trust that they will always save the day because these are engineering beauties. But we are not catastrophists. Besides the hope that we will act on climate change and watershed degradation, documented stories from around the world, including in Fort McMurray, Alberta, strongly point at an integrated watershed approach in which wildfires are made a central part of source water protection efforts. We also suggest that "what-if" scenarios, in which a range of issues are simulated, almost anticipated, and a portfolio of risk mitigation options are studied, to become common practice. WC

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byproducts, and boil water advisories due to insufficient infrastructure. These issues, even though not life-threatening, can be costly and create substantial stress and social unrest, especially when seen as part of a large system where risks accumulate and compound.

The good news is that the future doesn't have to be bleak, and we do have means to mitigate and adapt to increasing wildfire risks to water security. Active forest management practices in source watersheds can reduce the available fuels and potential for high severity fires. Similarly, allowing natural fires to burn during times of low hazard or using prescribed fires can reduce the biomass available to burn in subsequent