COSTS OF POLLUTION IN CANADA

Measuring the impacts on families, businesses and governments

HIGHLIGHTS REPORT

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WHY THIS REPORT?

Canadians realize that clean water, air and land contribute to better health, greater enjoyment of life, more productive communities and a stronger economy. Likewise, they understand that contamination of the environment by pollution leads to a wide variety of costs. Pollution harms human health, damages forests and crops and degrades the quality of land and water—to name just some of its impacts. The result is higher costs for many things: medical care, raw materials, food and public services. In these and numerous other ways, pollution threatens not only Canadians' current well-being but also the prospects for sustaining that well-being into the future.

Despite pollution's widespread costs, Canadians are not adequately informed about them. Various studies have assessed the costs of specific pollutants (for example, additional hospital stays due to urban smog), but no single study covers them all. For many pollutants, no cost information is available at all. The result is an incomplete and complicated array of information that an average citizen would be hard-pressed to sort through.

With financial support from the Ivey Foundation, the International Institute for Sustainable Development reviewed and synthesized existing studies on the costs of pollution in an effort to improve the data available to Canadians. Our findings, which represent the most comprehensive assessment of pollution and its costs undertaken in Canada, are summarized in this document (the full report is available at: http://www.iisd.org/library/cost-pollution-canada. The methods used in compiling the report were scrutinized and approved by the Conference Board of Canada.

Our hope is that the report better equips Canadians, policy-makers and industry leaders to understand and make decisions about pollution. The challenge is to balance the trade-off between pollution's costs on the one hand and the benefits of the activities that lead to its creation on the other. The report shows that the costs involved are significant—allowing them to be obscured by poor data serves no one well.

OVERALL FINDINGS

Pollution costs Canadian families, businesses and governments a startling amount every year.

We know from our review that these costs add up to **tens of billions of dollars *at least***.

We can't say what the full costs are because the data that are needed to measure the costs of many pollutants simply don't exist. We can say, though, that it is very likely that the pollutants that couldn't be measured would **add tens of billions of dollars more** to the annual cost.

The costs of pollution arise in three ways:

- First, pollution harms Canadians' health and well-being by lowering their enjoyment of life, making them sick and, in extreme cases, leading to premature death. These are the best studied and understood of pollution's costs. We estimate that they amounted to ***at least* $39 billion in 2015, or about $4,300 for a family of four. They were very likely much higher than this—perhaps twice as high—**because we weren't able to measure the health and well-being impacts of many pollutants. In particular, we couldn't put a value on the costs of persistent organic pollutants. These include a number of chemicals that people are exposed to in everyday life such as pesticides, plastic additives and flame retardants. Scientists believe these chemicals play a role in diseases like diabetes and obesity that affect thousands of Canadians, so the associated costs could be enormous.
- Pollution also costs families, businesses and governments money straight out of their pockets. When people get sick from pollution—perhaps with an asthma attack caused by smog—they need treatment. This can be costly. Medications, visits to the hospital, lost time at work—all these are a burden on households' incomes. Businesses and governments face costs too. Farmers lose money when their crops are damaged by air pollution. Extra money is needed to treat polluted water before it can be used to brew beer. Pollution dirties buildings and erodes infrastructure, adding to their maintenance costs. Governments spend billions of dollars cleaning up sites contaminated by industrial pollutants from days past. These costs are not as well studied as those related to health and well-being, so we know less about them. **Those that could be measured amounted to $3.3 billion in 2015**. Many important costs could not be measured, however, and **full impacts on income were likely in the tens of billions of dollars**. Put another way, **income costs likely reached upwards of 3 per cent of the combined net income of households, businesses and governments in 2015**.

> "We simply don't know how much pollution costs us in terms of lost wealth"

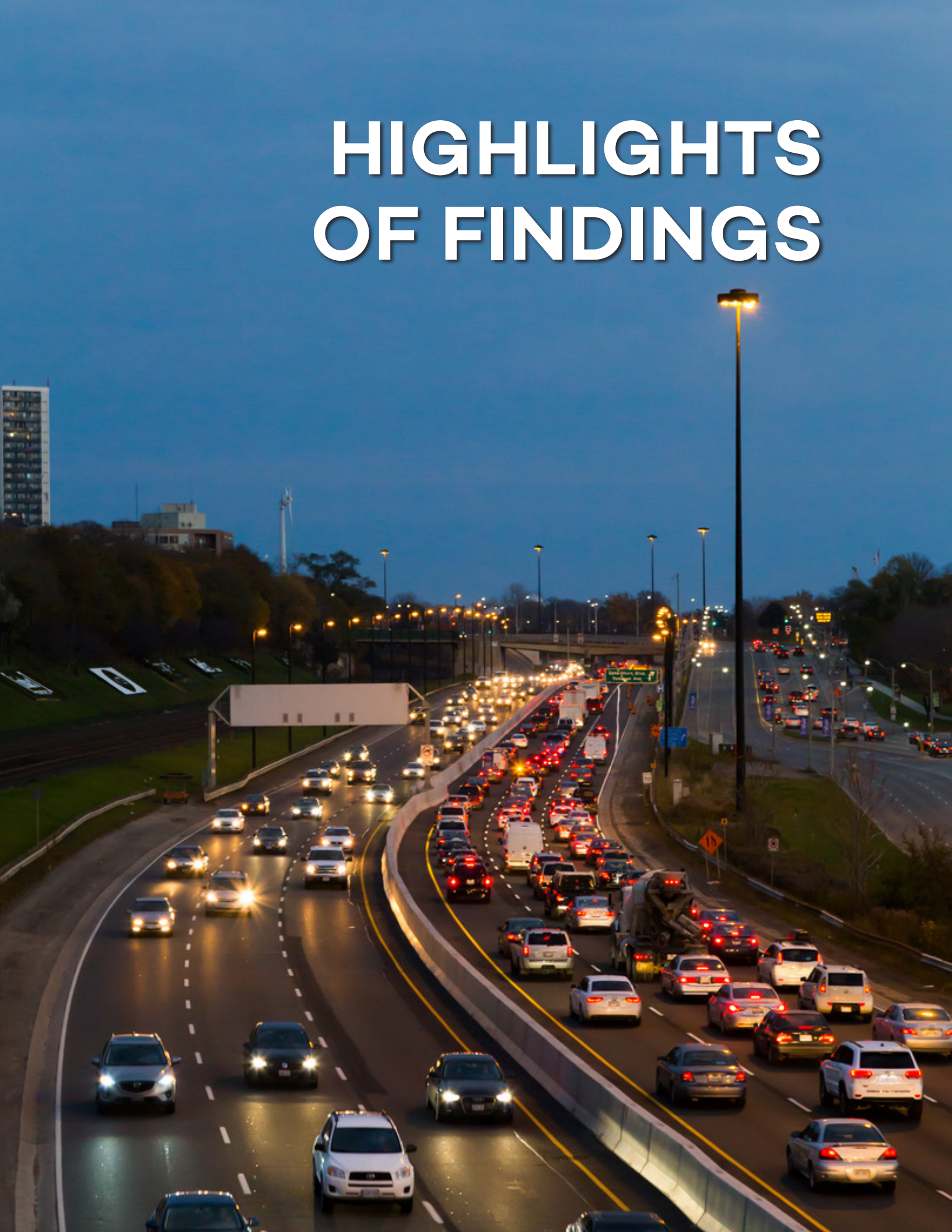
- Finally, pollution reduces the value of the assets that make up Canadians' wealth. Cottage properties are less valuable when they sit on lakes that are thick with algae. Penthouse condos with views clouded by smog are worth less than those with clear vistas. Farmland falls in value when crops are harder to grow because of air pollution. Forests are less productive when damaged by acid rain. These wealth impacts are the least understood of pollution's costs. **We simply don't know how much pollution costs us in terms of lost wealth** (though a few illustrative examples are laid out below). We do know that **there are trillions of dollars of assets at risk from pollution**, and it is very likely that these assets are significantly impacted by pollution today.

We Don't Know Enough About the Costs of Pollution

More research is needed to fill the gaps in our understanding of pollutions' costs. The amounts of money involved are too big—and the impacts on Canadians' lives too important—to be left to guesswork. The only pollutant that is really well understood today is urban smog. Beyond that, we know far too little about the costs of pollution. In addition to persistent organic pollutants (noted above), we were unable to come up with costs for many other important pollutants. Though by no means the only missing pieces, filling the gaps below would be a good start to better understanding pollution and its costs in Canada.

- The costs of **greenhouse gas emissions** in terms of climate change and its impacts the economy and the environment.
- The costs of **heavy metals** in terms of human health.
- The costs of **fertilizers and other nutrient runoff** in terms of freshwater "eutrophication" (or excessive growth of aquatic plants and algae).

HIGHLIGHTS OF FINDINGS



Though we were not able to fully answer the question "What is the cost of pollution in Canada?" we nonetheless found solid evidence that pollution imposes significant costs on Canadians. Some of our more important findings are outlined below.

Urban Smog—The Best Understood Pollutant

Urban smog and its health impacts have been widely studied over many years, and scientists are confident in saying that its costs are significant. It is not surprising, then, that smog was found to be the pollutant with the largest health and well-being costs in Canada *based on available data*. **Smog's cost is estimated to have been $36 billion in 2015**.

Smog is made up of several different pollutants, the most damaging of which is fine particulate matter, or $PM_{2.5}$. $PM_{2.5}$ is made up of particles about one-thirtieth the width of a human hair. Because of their small size, these particles are capable of penetrating deep into the respiratory tract. There they can cause a number of health effects, including cardiovascular and respiratory illnesses. In extreme cases, smog exposure can lead to premature death. The latest figures indicate that 7,712 deaths were attributable to $PM_{2.5}$ and the other components of smog in Canada in 2015.

Though smog is the costliest pollutant in Canada based on available data, others—particularly persistent organic pollutants (or POPs)—are likely to have costs of a similar size. The costs of pollutants beyond smog have not been nearly as well studied, however, so the data needed to confirm this are not available (see below).

Persistent Organic Pollutants—Their Costs Are Big… But *How* Big?

Most people think of pollution as smoke billowing from factories or the tailpipes of cars, but this is not always the case. Exposure to some pollutants comes from the use of everyday products. This is true for a group of chemicals known as persistent organic pollutants—or POPs—which include pesticides, plastic additives and flame retardants. People are exposed to POPs in daily life through food, cosmetics, furniture and clothing.

Scientists believe the health effects of POPs include cancer, allergies and hypersensitivity, damage to the nervous system, reproductive disorders, birth defects, obesity, diabetes, heart disease, behavioural and learning dysfunctions and disruption of the hormone (endocrine) system (Text Box 1). Though the extent to which these diseases are caused by exposure to POPs it is not yet fully clear, scientists increasingly believe POPs are responsible for a considerable share of them.

Since these diseases are widespread and their health consequences are significant, the costs associated with them are very large. Even if a relatively small fraction of the burden of these diseases is attributable to exposure to POPs, POPs might cost Canadians tens of billions of dollars annually.

The truth is, we simply don't know how much POPs cost Canadians in terms of health impacts. Given the potential magnitude of the costs, though, more research in this area should be considered a high priority.

Text Box 1. POPs and hormone disruption

The endocrine system produces the hormones that coordinate and regulate growth and development, behaviour, reproduction and weight, among other things. Certain substances, both naturally occurring and artificial (including POPs), can disrupt the endocrine system. The number of substances believed to act as endocrine disruptors is wide and varied. They may be present in the environment at very low levels but still have the potential to impact health.

Endocrine disruptors are found in industrial chemicals, plastic additives, pesticides and artificial hormones. Some metals such as cadmium, mercury, arsenic, lead, manganese and zinc also disrupt endocrine systems.

Many consumer products (cosmetics, personal care products and cleaners, especially those that are fragranced), contain chemicals with endocrine-disrupting properties.

Contaminated Sites—A Costly Legacy

A large number of sites are contaminated with pollutants from earlier periods in Canada's history. These include former mines, industrial facilities, gas stations and military installations.

More than 22,000 contaminated sites fall under federal jurisdiction. The provinces/territories also track the number of sites under their jurisdiction, though this information is harder to obtain. The number of sites falling under municipal and private responsibility is largely unknown. Many contaminated sites have been abandoned by those originally responsible for their contamination (Text Box 2).

The average annual cost of managing contaminated sites under federal jurisdiction was $283 million between 2005/06 and 2014/15. This represents a ***lower bound*** on the total cost of managing contaminated sites, as it **does not include sites under provincial, municipal or private responsibility**.

This cost is likely to rise in coming years as a number of very large and complex sites move from the relatively inexpensive assessment stage into the much more costly remediation stage.

In addition to the costs incurred for managing contaminated sites today, estimates are available of the future financial liability of the federal and provincial/territorial governments. **The total future liability for contaminated site cleanup recognized by the federal government was $5.8 billion in 2015, a figure that has been rising in recent years as the assessment of sites continues. An additional $6.4 billion in liabilities was recognized by provincial governments**. An unknown additional amount of liabilities are represented by sites under municipal and private responsibility.

Text Box 2. Abandoned mines – The "giants" of Canada's contaminated sites

Most contaminated sites in Canada are small in size and impacted by pollutants that are relatively easily dealt with. A few sites are very large and complex however. Of these, the majority are abandoned mines. The story of how Canadian taxpayers ended up bearing the extraordinary remediation costs associated with the most infamous of these sites—Yellowknife's Giant gold mine—is worth recounting.

The Giant mine is located a few kilometres from downtown Yellowknife on the shores of Great Slave Lake. It produced its first gold in 1948 and operated until 2005 when it was finally abandoned. During its life, the mine was a major engine of economic growth for Yellowknife. At various points, it was owned by Falconbridge, Pamour, Royal Oak Mines and Miramar Mining.

Weak economic conditions and the repercussions of a protracted and violent labour dispute led Royal Oak Mines to declare bankruptcy in 1999. Because the Giant mine was located on land that belonged at the time to the Crown, the then-federal Department of Indian Affairs and Northern Development was obliged to assume responsibility for the heavily contaminated mine site and its cleanup.

The contamination at the Giant mine is the result of smelting the arsenopyrite ore in which the gold was found. This process created highly toxic arsenic trioxide dust as a by-product. In the mine's early years, the dust was simply discharged to the atmosphere. At least one death resulted from this uncontrolled release—a Dene child who succumbed to arsenic-contaminated drinking water in 1951. An unknown number of illnesses also occurred. Pollution control equipment was installed to collect and store the dust beginning in the early 1950s. The collected dust was stored in the empty underground cavities from which the ore had been mined, as well as in purpose-built chambers. In the 1950s, scientists and government agencies believed that this was a feasible long-term solution for storage of the waste. They felt that when the mine closed permanently, the natural permafrost in that area would re-establish around the storage vaults and seal in the arsenic trioxide. For a variety of reasons, including concerns about thawing of permafrost due to climate change, this solution is no longer viable.

Over the life of the mine, some 237,000 tonnes of arsenic trioxide dust was created and stored in the underground vaults. It is the cost of dealing with this enormous toxic legacy that the Canadian public now bears.

Between 2005 and 2016, assessment, maintenance and remediation of the Giant mine site cost the federal government about $325 million. The total cost is expected to reach $1 billion by the time remediation is "complete," though the proposed solution (permanent freezing of the storage vaults) actually has no end date—it must be carried out in perpetuity.

Extreme Weather—Climate Change Making Its Costs Felt

It is widely understood today that greenhouse gas emissions are leading to changes in the climate. One of the consequences of this is an increase in the frequency and intensity of extreme weather events (heat, cold, precipitation and winds). These have the potential to cause death and sickness and severe damage to property and infrastructure.

Scientific understanding of the links between climate change and extreme weather is improving, though uncertainty remains. Today, only heat waves can be attributed with enough certainty to climate change to allow their costs to be estimated. **The cost of climate change-related heat waves in Canada is estimated to have been $1.6 billion in 2015. The costs of other extreme weather related to climate change were likely much larger, though they can't be estimated today**.

What is clear is that payouts for insured losses due to storms, floods and wildfires, including the 2016 Fort McMurray fire, have increased substantially since the 1980s. The Fort McMurray wildfire is estimated to have resulted in $3.58 billion in insured property losses. It was by far the largest single payout for a natural disaster in Canada, more than doubling the $1.74 billion figure for the Alberta floods in 2013.

Six straight years of insurance losses exceeding $1 billion were witnessed from 2009 to 2014. Insured losses averaged only $400 million a year between 1983 and 2008, and only two years saw losses exceeding $1 billion. Storms previously expected only once every 40 years are now expected every six years.

Of course, not all extreme weather is due to climate change. Some of it is simply the result of natural variability. However, as climate change progresses, its impacts and the associated costs are likely to grow. Gaining a better understanding of the links between climate change, extreme weather and its costs is therefore a high priority.

Algal Blooms—Lake Erie Under Threat Again

When water is polluted by sewage and fertilizer runoff, the nutrients available to aquatic plants can greatly exceed natural levels. The result is growth of algae and other nuisance plants that can overwhelm waterbodies with massive "algal blooms." Because algal blooms can produce toxins and impart unpleasant tastes and odours to water, higher levels of water treatment are required if it is to be used for human consumption. Recreational opportunities are also greatly reduced.

Lake Erie was infamously labelled "dead" in the 1960s and 1970s due to algal blooms. At that time, the culprit was phosphorus from sewage treatment plants discharging into the lake. Through a combination of improved technologies and policies, the lake made a remarkable recovery in the 1990s. It is under severe threat again today. This time, the concern is runoff of fertilizer from surrounding agricultural areas. The blooms in recent years have been as bad or worse than what was seen in the past, in part because both climate change (warmer waters) and zebra mussels (clearer waters) are making it easier for the blooms to grow and persist.

The estimated loss in Lake Erie's ecosystem value due to algal blooms was $3.8 billion in 2015. A further $4 billion loss was estimated in its value as a source of market goods and services. Houses along the lake's shoreline, whose values depend in part on the quality of the lake, were found to have lost more than $700 million in value.

Though Lake Erie is perhaps the best known of them, a large and increasing number of Canada's freshwater lakes are affected by algal blooms. This "rise of slime" has been most dramatic in the large lakes found along the edge of the Canadian Shield: Lake Champlain, Lake Ontario, Lake Erie, Lake of the Woods and Lake Winnipeg. In fact, Lake Winnipeg has the dubious distinction of being called "Canada's sickest lake." Smaller lakes are also affected. The number of Ontario lakes observed to have algal blooms increased steadily from nearly zero in 1994 to almost 50 in 2009. In Quebec, about 150 water bodies have been reported to have visible blooms annually since 2007, up from 21 in 2004.

Pathogens–Another Threat From Water Pollution

Pathogens are living organisms that cause disease in humans and animals. They include bacteria, viruses and other organisms that cause disease directly as well as others that cause disease indirectly by the creation of toxins.

Pollution-related pathogens are mainly related to human, animal and food wastes that enter waterbodies from sewage, farm manure and landfill sites and toxins produced by algal blooms (see above).

Modern sewage treatment plants and landfill sites are capable of preventing most pathogens associated with municipal sewage and solid wastes from being released to the environment. But not all sewage and solid wastes are treated in such facilities. Three per cent of Canadian homes connected to municipal sewer systems in 2009 saw their wastes sent directly into the environment untreated. Another 16 per cent received only primary treatment—which does not remove pathogens—before release, and a further 13 per cent of households managed their own sewage using private septic systems, where the quality of treatment is difficult to judge. So, while the risk of pathogens entering the environment from municipal sewage is low, it is not zero. Once pathogens find their way into the environment, humans are at risk of exposure through a variety of pathways. The most likely routes are recreational activities in and around contaminated waters and consumption of contaminated shellfish (Text Box 3) and/or drinking water (Text Box 4).

Good data on pollution-related pathogens and their costs are hard to come by. A tentative estimate of the cost of tap water-borne pathogens in 2015 is $895 million based on Canadians' spending on bottled water and water filtration devices. This does not include any health and well-being costs associated with exposure to other pollution-related pathogens, such as algal bloom toxins or contaminated shellfish.

Text Box 3. B.C. oyster-borne norovirus outbreak

An outbreak of the gastrointestinal pathogen norovirus began plaguing the British Columbia oyster industry in December 2016. As of March 28, 2017, 321 cases of illness had been reported.

Though not the first outbreak of oyster-borne norovirus in B.C., this was the largest such outbreak in the province's history. On top of its unusual duration and severity, scientists are uncertain about its cause. The outbreak was most likely the result of contamination of shellfish farms by human sewage, though the specific source of the contamination had not been discovered as of March 2017. Seven oyster farms had already been closed due to contamination by that point, with others closing voluntarily.

The prolonged outbreak presents a financial challenge to the province's oyster industry. The Canadian industry is worth $11.7 million a year, 60 per cent of which is based in B.C. Some oyster farms reported an almost total stop to sales, resulting in layoffs and reduced hours. Offsetting this was a short-term boom in sales for oyster farmers on the east coast. Despite this, East Coast farmers are concerned that the prolonged outbreak will damage public trust in the safety of the industry as a whole. The total economic impact of the outbreak will not be known until it has been fully controlled.

Text Box 4. Water-borne pathogens—First Nation communities in Canada

The risks associated with consumption of contaminated drinking water are managed by local governments for Canadians with municipal water supplies. Most drinking water in Canada is of high quality and the risk of exposure to pathogens is low. It is not zero, however, as the need to issue boil-water advisories from time-to-time proves.

In 2015, 10 per cent of households in Canada reported that they had been notified of a boil-water advisory. Households in Manitoba (36 per cent) were most likely to have reported one. The situation on First Nations reserves is, in general, considerably worse than that for the general population.

Two-thirds of all First Nation communities in Canada have been under at least one drinking water advisory at some time in the last decade. Data show that 400 out of 618 First Nations in the country had some kind of water problem between 2004 and 2014. The longest running water advisory is in the Neskantaga First Nation in Ontario, where residents have been required to boil their water for 20 years.

In the summer of 2015, water advisories were in place in 114 First Nations. Of the 719 INAC-funded First Nations water systems inspected in a 2011 "national assessment," 525 systems (73 per cent) were found to be at either medium or high risk for producing unsafe drinking water.

Photo courtesy of Alberta Venture

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