Hazard Risk Analysis

Contamination and Pollution

Contamination and Pollution

This section discusses air pollution and soil and water contamination. The difference between "contamination" and "pollution" is very subtle. Both processes are linked to each other, and the words are often used to describe either process.

Air pollution and soil and water contamination have harmed the natural environment with chemical, biological, metallic or other substances harmful to humans, animals and plants.

Resources are available to assist you in completing this analysis in the Risk Analysis Resources section.

Air Pollution - Natural and Human-caused

Definition

Typically, air pollution is considered a by-product of large cities due to traffic and industrial activities. Small, rural and remote communities are not usually affected, but sometimes pollution, or smog, is carried by winds outside of larger cities. Air pollution in rural and remote communities can also occur as a result of smoke from forest fires.

Discussion

Air quality in a number of remote, rural sites across Canada is checked through the Canadian Air and Precipitation Monitoring Network. However, most of rural and remote Canada is not well monitored.

Air pollution can have a negative effect on your heart and lungs, and depends on:

- the length of time you are exposed to bad air;
- your health status;
- your genetic background;
- and the amount of pollutants in the air…

Polluted air can make it harder to breathe, irritate your lungs and airways, and worsen chronic diseases such as heart disease and several lung diseases. Negative health effects increase as air pollution worsens. Studies have shown that even small increases in air pollution can lead to more emergency room visits, hospital admissions and deaths. Small increases in air pollution over a short period of time can make existing illnesses worse.

The Canadian Air Quality Health Index gives the following risk levels:

- levels 1 to 3 are low health risk;
- 4 to 6 present a moderate health risk;
- 7 to 10 a high health risk; and
- over 10 a very high health risk. Even healthy people should limit outdoor activities.

It Happened Here…

In 2020 Victoria was the most affected since smoke from Washington State and Oregon drifted north. Visibility has been affected over a week.

The B.C. wildfire season in 2018 eclipsed the previous year's as the worst recorded in provincial history. Smoke choked the province again that summer, compounded by additional plumes drifting north from similar fires in Washington state. The Lower Mainland was stuck under health advisories for 22 days in a row. Flights at several airports in the Interior and West Kootenay regions were cancelled because pilots couldn't see. As was largely the case in 2017, only B.C.'s north and part of the western coast were spared.

The thick smoke also created air-quality problems for much of Alberta, Saskatchewan and southwestern Manitoba, as winds drove the haze eastward. The smoke even reached Atlantic Canada and as far as Ireland.

In 2017, the destructive wildfires displaced thousands of British Columbians and burned more than 1.2 million hectares. More than 1,300 fires engulfed the province between April and November, costing B.C. more than $564 million. Multiple air quality advisories were also issued as a blanket of smoke covered parts of B.C. and people were urged to avoid strenuous outdoor activities. By the start of August, Metro Vancouver had already seen the longest air quality advisory in its history at 10 days. Kamloops set a new record for the most hours spent with low visibility in 2017, with 18 smoky days and the air quality reached an extreme 18 out of 10 rating on the Air Quality Health Index. Williams Lake and Penticton weren't far behind with 14 days, while Abbotsford had 10 days.

On August 6, 2010 the Members of the Tl'etinqox-t'in First Nation near Alexis Creek in central British Columbia rushed to move people out of the area as heavy smoke from forest fires blanketed their community. About 130 people — mostly elders, children and people with health issues — were moved to Williams Lake.

In May 2010, over 50 fires burned in north Quebec and acrid smoke drifted over much of central Canada and the northeastern United States. About 100,000 acres of forest had burned since a May 25 thunderstorm ignited a series of fires. Over 1,300 people from the Wemotaci First Nation community were evacuated. In some cases, the evacuees were taken by bus to locations as many as four hours away.

Air Pollution

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not	FACTORS
☐	☐	☐	☐	Has your community experienced air pollution in the past?
☐	☐	☐	☐	Industries such as factories or coal-fired power plants can cause air pollution. Are there any smokestacks near your community and does wind blow in your direction?
☐	☐	☐	☐	In Canada smoke from wildfires can cause significant air pollution and can cause breathing difficulty. Temperature inversions (warm air overlaying cooler air) can increase the smoke. Is your community affected by wildfire in the summer? Do you have summertime temperature inversions?

Soil Contamination Human Induced

Definition

Soil contamination can be classified as biological, chemical, radioactive, or metallic in nature. The soil is considered contaminated when it is harmful to humans, animals or plants.

Discussion

Soil contamination can result from industrial activities such as oil and gas exploration and production. It can also arise from mining and mineral processing, saw mills and paper mills, and power generation. There is also increasing concern regarding the use of pesticides and fertilizers, and the effect on the soil and plants.

The Government of Alberta, Ministry of Environment, states the following regarding soil contamination:

> Negative environmental impacts caused by chemical substances can be very difficult or even impossible to remedy. Below follow some examples of how soil contamination can be dealt with:
>
> - hydrocarbons (fuels like gas and diesel) can be removed thermally or through bioremediation;
> - effects of sulfur can be remediated by neutralization;
> - salts (for example, road/ de-icing salts) can be removed by washing;
> - and pesticides can be removed by deactivation or bioremediation.
>
> In most cases, substances are only partially removed, unless extreme and expensive removal efforts are used.
>
> Some substances have a direct toxic effect on essential life processes of plants and soil organisms. For example, chlorides found in road salt or salt water produced during oil and gas production are toxic to plants and organisms. Salt

and hydrocarbons can also create water deficits by limiting water movement through soil, and uptake by plants and organisms.

It Happened Here…

In 2019, the Nova Scotia government announced it will spend $48 million to clean up two of the province's most toxic former gold mines: Goldenville, near Sherbrooke on the Eastern Shore, and Montague Gold Mines, in Dartmouth. The sites were extensively mined from the 1860s to the early 1940s. Miners used liquid mercury to extract gold from crushed rock, and the leftover material, called tailings, was simply dumped in the closest body of water. Arsenic, which occurs naturally in rock, was released as part of the mining process.

In 2009, the Department of National Defence will begin to clean up the contamination that has forced residents in 11 low-income rental homes on a former radar base in Sydney, N.S., to find another place to live due to soil contamination caused by buried oil tanks. The tenants were offered $1,500 to help with moving costs, a reimbursement of their final rent payment and assistance in finding another place to live.

In 2006, soils at eight sites in northwestern Quebec were found to be contaminated with lead within the area surrounding the Horne Copper smelter in Rouyn-Noranda.

In the 1980s, diesel fuel was discovered in the crawl space of a school, and the area was contaminated with polychlorinated biphenyls (PCBs). The buildings and infrastructure were affected—many had to be demolished, and the people in the community of the Mathias Colomb Cree Nation in Manitoba had many health issues.

Soil Contamination

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not	FACTORS
☐	☐	☐	☐	Irrigation for agriculture can contaminate soil by increasing salt content. Has there been a long history of irrigation in/near your community?
☐	☐	☐	☐	The application of pesticides in agriculture can cause soil pollution. Do farms use pesticides in or near to your community?
☐	☐	☐	☐	Are there old industrial sites in or near your community that have not been not been properly remediated?
☐	☐	☐	☐	Resource extraction industries (such as gold, copper, oil or gas mining) can cause soil pollution. Are there, or have there been, mining activities near your community?
☐	☐	☐	☐	Old underground (fuel) storage tanks can break and release contaminants into the soil. Are there old buried storage tanks in your community?
☐	☐	☐	☐	Old live firing and military training sites can lead to the contamination of soils by explosives and metals. Is your community near an existing or previous established military training site?

Water Contamination - Human Induced

Definition

Water contamination is a result of biological or chemical contamination of water systems. Waterborne disease outbreaks in Canada have been caused by bacteria (such as Salmonella, Shigella and Campylobacter), protozoa, or Enteric viruses (such as Norwalk and Hepatitis A, which are virusses that affect our bowel-system). Waterborne outbreaks create human health hazards as drinking water and recreational water suplies may be affected. Outbreaks also pose threats to agriculture, aquaculture, aquatic ecosystems and biodiversity.

Discussion

It is estimated by Environment Canada that 90,000 people become ill and 90 die from acute waterborne infections in Canada each year. Waterborne disease outbreaks can lead to beach closings.This negatively impacts local communities that rely on the recreation and tourism sectors.

It Happened Here…

In 2014, the Mount Polley mine tailings spill sent more than 24 million cubic metres of mine waste into nearby waterways and continues to impact lakes, rivers and aquatic ecosystems, according to a new study. Researchers have been monitoring Quesnel Lake since the spill, which is considered one of the largest environmental mining disasters in Canadian history. Though samples taken one year after the spill showed the lake waters had potentially returned to their pre-spill state, new information from a 2020 study revealed that is not the case; elevated levels of copper and fine sediment have been found in the lake in both the spring and fall.

In 2012, leachate from Teck Coal Limited's Fording River Operations and Greenhills Operations coal mines deposited selenium and calcite into the upper Fording River. On March 26, 2021, Teck Coal Limited was ordered to pay a total of $60 million in fines and monetary court orders after a guilty plea was entered on two counts of unlawfully depositing a deleterious substance into water frequented by fish, contrary to s. 36(3) of the *Fisheries Act*.

In August 2003 the community of Anglemount, British Columbia's (population 300) water supply was contaminated with fecal coliform levels above acceptable provincial standards. The contamination lasted three weeks. There were no injuries reported.

Problems with drinking water wells in the First Nations community of Little Salmon Carmacks, Yukon (population 426) date back to 1991. The community lacks proper wells that can serve the entire community. Many of the small, private wells were contaminated with E. coli and fecal bacteria. The drinking water conditions were so severe that Elder Johnny Sam had to be airlifted to a hospital in Vancouver. He suffered from a bacterial infection and had to remain in the hospital for 4.5 months. The doctors linked his illness to his water consumption.For five years the community remained under a boil water advisory. The contaminated wells were slowly repaired.

Eight hundred members of the First Nation community Kashechewan, in Northern Ontario were evacuated in October/ November 2005. The community had lived on a boiling-water advisory for the past 2 years, as the E. coli bacteria was found in the water supply system. The contaminated water had led to many skin conditions in the community.

Between 1962 and 1970, the Dryden Chemical Paper Mill dumped ten tonnes of waste mercury into the Wabigoon-English River, approximately 320km upstream from the Asubpeeschoseewagong Nitam-Anishinaabeg (Grassy Narrows First Nation) community. Fifty years on, the First Nation is still feeling the effects, and awaiting appropriate government action. A study published on April 27th 2020 by the Université du Québec à Montréal (UQAM) and TÉLUQ University found a correlation between the early mortality of Grassy Narrows First Nation

People, and exposure to higher levels of mercury as a result of freshwater fish consumption from the river. Mercury exposure was almost five times higher for those who died before the age of 60, in comparison to their counterparts who lived beyond the age of 60.

Water Contamination

Hazard Rating	High Risk ☐	Low Risk ☐	Need More Info ☐	Not Applicable ☐

Yes	No	Need More	Not	FACTORS
☐	☐	☐	☐	Is there a current “Do Not Consume” or “Boil Water” Advisory in place in your community? (Check Risk Analysis Resources – “Do Not Consume” and “Boil Water” Advisories)
☐	☐	☐	☐	Agricultural runoff, such as pesticides or fertilizers, can cause water pollution. Is your community located in or near an agricultural area?
☐	☐	☐	☐	Improperly treated sewage (domestic and industrial) can contaminate water supply. Does your community lack sewage treatment capability?
☐	☐	☐	☐	Landfill sites can leak dangerous compounds into the water table. Do landfill sites in and near your community have adequate bottom-lining?
☐	☐	☐	☐	Resource extraction industry such as mining can lead to water pollution. Are there, or have there been, mining activities near your community?
☐	☐	☐	☐	Industrial waste water can contaminate water. Do polluting industries such as pulp and paper mills operate in or near your community without adequate environmental controls?
☐	☐	☐	☐	Without proper water treatment, drinking water can become contaminated. Does your community lack a water treatment facility?
☐	☐	☐	☐	Animal fecal matter can cause contamination if it gets into water. Does your community have livestock located near water sources?
☐	☐	☐	☐	Abandoned and/or improperly sealed wells can contaminate ground water. Does your community have any abandoned and/or old wells?

Risk Analysis Resources

Environment and Climate Change Canada lists short term and long term drinking water advisories that are in place on First Nation communities on reserve located south of the 60 degree parallel in Canada (all provinces, except British Columbia):

Key Words: Environment and Climate Change Canada, drinking water advisory, First Nations

First Nation communities in **British Columbia** should consult with their local Chief about **drinking water advisories**. They can also talk to their local Environmental Health Officer (EHO). A list of EHO's (including telephone numbers and email), as well as general information, can be found on the website of the First Nation Health Authority (FNHA):

Key Words: British Columbia, First Nation, drinking water advisory, environmental health officer

The *Journal of Pollution Effects & Control* is an open-source journal that includes hundreds of articles dealing with pollution, the introduction of contaminants into the natural environment that causes adverse changes in the form of toxicity of environment, damage to ecosystem and aesthetics of our surrounding. This journal covers areas like Environmental toxicology, Bioremediation, Public health and Toxicogenomics.

References

Alberta Institute of Agrologists. (2017). *Contaminated lands – Assessment, remediation and management practice standard.*

Canadian Institute for Climate Choices. (2020). 11 ways to measure clean growth.

Contamination from Mount Polley spill continues to affect waterways, study finds. (2020, August 3). CBC News.

Davies-Colley, R. J., Nagels, J. W., Smith, R. A., Young, R. G., & Phillips, C. J. (2004). Water quality impact of a dairy cow herd crossing a stream. New Zealand Journal of Marine and Freshwater Research, 38(4), 569-576. https://doi.org/10.1080/00288330.2004.9517262

Defence Research and Development Canada. (2009). *Evaluation of soil contamination by explosives and metals at the Land Force Central Area Training Centre (LFCA TC) Meaford, Ontario (Phase I)*.

Duran, E. (2017, December 25). *B.C. year in review 2017: Wildfires devastate the province like never before*. Global News.

Dyck, A. (2011). *Why First Nations struggle with some of the country's dirtiest water*.

Environment and Climate Change Canada. (2021, March 26). *Teck Coal Limited to pay $60 million under the Fisheries Act and must comply with a Direction requiring pollution reduction measures*. [News Release].

Environment Canada. (2019). *The air quality health index*.

Environmental Protection Agency. (2011). *Pollution prevention*.

Everest, K. (2020, May 11). *Breaking the norm of contaminated water for First Nations in Canada*. The Organization for World Peace.

Forest fire smoke blankets B.C. Community. (2010, August 6). CBC News.

Forest fire smoke blankets Montreal, Ottawa. (2010, May 31). CBC News.

Gangbazo, G., Pesant, A. R., Barnett, G. M., Charuest, J. P., & Cluis, D. (1995). Water contamination by ammonium nitrogen following the spreading of hog manure and mineral fertilizers. Journal of Environmental Quality, 24(3), 420-425. https://doi.org/10.2134/jeq1995.00472425002400030004x

Heron, L. (2001). *Threats to sources of drinking water and aquatic ecosystem health in Canada, by Environment Canada*.

Hou, X., Parent, M., Savard, M.M., Tasse, N., Bégin, C. & Marion, J. (2006) Lead concentrations and isotope ratios in the exchangeable fraction: tracing soil contamination near a copper smelter. *Geochemistry: Exploration, Environment, Analysis, 6*(2-3); 229-236; doi: 10.1144/1467-7873/05-092. https://doi.org/10.1144/1467-7873/05-092

Kashechewan: Water crisis in Northern Ontario. (2006, November 9). CBC News.

Kookana, R. S., Baskaran, S., & Naidu, R. (1998). Pesticide fate and behavior in Australian soils in relation to contamination and management of soil and water: A review. Australian *Journal of Soil Research, 36*(5), 715-764. doi: 10.1071/S97109

Office of the Auditor General of Manitoba. (2007). *Audit of the province's management of contaminated sites and landfills*.

Pariona, A. (2017). *What is the environmental impact of irrigation?* World Atlas.

Ritter L, Solomon, K., Sibley, P. & Hall, K. (2002). Sources, pathways, and relative risks of contaminants in surface water and groundwaters. *Journal of Toxicology and Environmental Health, 65*(1), 1-142. doi: 10.1080/152873902753338572

Schmunk, R. (2020, September 19). *Smoked in: A look back at B.C.'s haziest wildfire seasons over the past 20 years*. CBC News.

Tobin, G. A., & Rajagopal, R. (1993). Groundwater contamination and protection problems in a small rural community. *The Social Science Journal, 30*(1), 113-128. https://doi.org/10.1016/0362-3319(93)90009-K

Tomesco, F. (2010, May 31). *Quebec Forest Fires Send Smoke, Haze South to Boston*. Bloomberg News.

Troian, M. (2015). The toxic contamination of Manitoba's First Nations communities. Briarpatch.

Willick, F. (2019, October 12). *How do you clean up a contaminated 150-year-old gold mine?* CBC News.

Woods Hole Oceanographic Institute (2020). *Pollution*.

World Air Quality Project. (2021, March). *Air pollution in Canada: Real-time air quality index visual map.*