Primary Indicators

1. Canada also has standards for hydrogen fluoride and is proposing standards for hydrogen sulphide.
2. Air monitoring stations operate in most Canadian cities with populations over 50,000; they are located in residential, industrial and commercial areas.
3. Standards are more stringent for longer time periods. For example, the 1-hour desirable level for sulphur dioxide is 172 ppb, whereas the annual desirable level is 11 ppb.
4. The three stations that have reported annual means above the maximum acceptable level in the past two years are located in Windsor, Hamilton, and Calgary.
5. The one exception is a station located in Quebec, which is situated near a lead mine. When the mine reopened in 1997, the station’s annual mean was 1.51 µg/m³, though it declined to .77 µg/m³ in 1999.
6. The four stations that have continued to record lead levels have been selected because of specific regional concerns over lead levels. For instance, one station is located near a lead mine.
7. Eutrophication, or nutrient enrichment, is the over-supply of inorganic nutrients that cause algae and plants to multiply rapidly; when they die and decompose, the water’s dissolved oxygen content is depleted. Dissolved oxygen, which is derived from photosynthesis by aquatic plants and atmospheric exchange, is essential to ensure the maintenance of aquatic life and self-purification processes in natural water systems.
8. Bioaccumulation in aquatic organisms occurs when a persistent, fat-soluble, contaminant enters the organism’s body through the skin or by ingestion. If consumption exceeds the organism’s ability to metabolize or eliminate the contaminant, over time it accumulates in the tissues.
9. Contaminant levels in herring-gull eggs are a good water quality indicator since these pollutants are bio-accumulative; as fish-eaters, herring gulls will have the highest concentration of these pollutants in their systems.
10. The harbour is not used for recreational purposes, such as swimming, so the comparison to this standard is somewhat tenuous.
11. Long-term monitoring has been carried out by DIAND, Environment Canada and the territorial governments. DIAND operated 21 stations in the Yukon up to 1996 and about 50 stations are operating in the NWT. Data from these stations is presently collected into a database, though not analyzed.
12. Nunavut is looking to update its guidelines with more current objectives though no time frame has been set for this.
13. The data for Lake Michigan is available only since 1976 and the data for Lake Ontario is available only up to 1996. The changes reported in percentage for Lake Superior for DDE and PCBs are from their peak levels in 1975.
14. DDT (dichloro-diphenyl-trichloro-ethane) is a persistent, bioaccumulative, synthetic insecticide. Its use was heavily restricted in the 1970s and prohibited after 1990. The breakdown product, DDE, is most easily measured in the fat of animals or in the eggs of birds. Most other pesticides in use today are not as persistent and hence are not transported to the same degree as DDT.
15. PCBs were once used extensively in many parts of the electrical and transmission industry, in flame retardants, water-proofing agents, printing inks, and adhesives. They were also spread on roads to prevent airborne dust. In the 1980s, tight restrictions al-
Lowed PCBs to be used only in closed electrical equipment. Safe incineration technologies now are used to destroy those currently in storage. They have been associated with declining fish populations in some locations.

16 HCBs are used in fungicides, dye manufacturing, and wood preservatives. They are also produced as a waste by-product of chemical manufacturing. The region of the Great Lakes is at risk from HCB contamination since numerous chlorine plants are located near the Lakes on both sides of the border.

17 These declines have not been without cost. In 1982, for example, more than 450,000 kg of PCB contaminated sediment was dredged from the Weukegan harbour at a cost of 24 million dollars (Environment Canada & USEPA 1997a).

18 While summarizing research into the toxic effects of pollution in the Great Lakes in 1997, the United States Agency for Toxic Substances and Disease Registry concluded that both wildlife and human populations are being affected by exposure to toxic substances (IJC 1997). The background paper on toxic contaminants from the State of the Lakes Ecosystem Conferences (SOLEC) reports that water-quality objectives for the protection of human health are exceeded at current levels. It also recommends further reductions in pollutant concentrations (Environment Canada & USEPA 1995b: 1).

19 Target loads for phosphorus are defined in the 1978 Great Lakes Water Quality Agreements (in metric tones per year) as: Lake Superior 3,400, Lake Michigan 5,600, Lake Huron 4,300, Lake Erie 11,000, and Lake Ontario 7,000.

20 During the Toronto city council meeting debating the proposal, one opponent of the plan, Grand Chief Carol McBride, said protests against the decision will “make Oka look like a Sunday picnic” (Lindgren 2000).

21 While this illustrates the area needed to house Canada’s garbage, it oversimplifies the situation somewhat because not all land is equal when it comes to landfills. Even given modern engineering techniques like landfill liners and leachate-capture systems, some types of land are clearly more economical or practical for use as landfills: one would want a site with clay sub-soil, distant from major water supplies, and located away from major population centers but still close enough for cost-efficient transportation of waste.

22 In Canada, municipal waste is all waste that is not construction and demolition debris. See OECD 1999: 165.

23 There are some prominent examples of situations where recycling is clearly the most cost-effective and environmentally friendly direction to follow, notably with aluminum and steel. However, it is unnecessary to have a government program for recycling these materials since companies are willing to pay for the return of them.

24 Estimates for urban space range from 0.2 percent to 1 percent depending on the definition.

25 Cropland is the amount of land used to grow field crops, fruit, vegetables, nursery products, and sod.

26 Since lands left in summerfallow are more likely to sustain erosion and to promote salinization, this decrease is a positive one. The decline in erosion rates is partly attributed to this trend in summerfallow.

27 Soil quality has been defined by Agriculture and Agri-Food Canada as the “soil’s fitness to support crop growth without becoming degraded or otherwise harming the environment” (Acton & Gregorich 1995: xi).

28 Risk is calculated by Agriculture and Agri-food Canada as an indirect measure of changes in soil quality. They assess soil, climate, management factors, prevailing land use, and tillage practices when calculating the indicator.

29 These practices were initially promoted by the National Soil Conservation Program (NSCP) in 1989. From this program came other programs addressing erosion such as the Permanent Cover Program in the Prairies, the Soil and Water Environmental Enhancement Program in Ontario, and the programs of the Eastern Canada Soil and Water Conservation Centre in Atlantic Canada (Acton & Gregorich 1995: 75).

30 Data on the risk of erosion is used instead of the actual amount of soil erosion since erosion levels vary between years largely due to natural conditions. There is also more data available on the risk of erosion.

31 To view the declaration and the names of those who signed, visit http://www.agbioworld.org.

32 Bulk water removal is the removal or transfer of water out of its point of origin by man-made diversions (e.g., canals), tanker ships or trucks, and pipelines. Small-scale removal (e.g., water in small portable containers) is not considered bulk.

33 Roundwood refers to round sections of tree stems such as logs or bolts.
34 For this inventory, old-growth was defined as the following: for coastal British Columbia, 251+ years for all forest types; for interior British Columbia, 141+ years for most forest types, and 121+ years for stands dominated by lodgepole pine or deciduous species. This inventory examined 94 percent of British Columbia’s land base. The remaining land is largely privately owned.

35 The amount of old-growth forest that is protected ranges by biogeoclimatic zones. For example, 16 percent of old growth in the Coastal Western Hemlock and Engelmann Spruce-Subalpine Fir zones is protected. In the Ponderosa Pine and Sub-boreal Spruce biogeoclimatic zones only 5 percent is protected.

36 Primary energy is the total energy available for all uses. It includes energy used by final consumers as well as energy needed to make other forms of energy.

37 Total domestic energy is defined here as the sum of total residential, commercial, industrial, transportation, and non-energy uses as well as the energy needed to produce electricity and producer consumption and loses. This calculation is a good approximation of total primary energy.

38 Non-energy uses includes petrochemical feedstock, asphalt, lubricants, etc.

39 These estimates vary depending on assumption for price and advancements on technology.

40 The oil and natural-gas industry is divided into the “upstream” sector—production—and the “downstream” sector—refining and marketing. The upstream sector includes exploration and production companies as well as seismic and drilling contractors, and technical, service, and supply companies. The downstream sector includes pipeline systems, refineries, gas-distribution utilities, wholesalers of oil products, service stations, and petrochemical companies.

Secondary Indicators

1 The atmosphere contains 750 billion tonnes of carbon dioxide; living plants contain 560 billion tonnes, soils 1,400 billion tonnes, ocean sediments 11,000 billion tonnes and the oceans themselves 38,000 billion tonnes. See Environment Canada 1991c: (22) 7.

2 Scientists do not dispute that the increase in equivalent CO₂ has occurred. Since the Industrial Revolution, equivalent CO₂ levels have risen from approximately 290 ppm to nearly 440 ppm in 1994 (Bailey 1995: 87). Humans do not, however, contribute to the main absorbers of infrared light in the atmosphere. Water vapour and clouds are responsible for over 98 percent of the current greenhouse effect (Lindzen 1992: 2).

3 Pesticides contain both “inert” and “active” ingredients. Inert ingredients are not intended to affect the targeted pest. Active ingredients prevent, destroy, repel, or mitigate the actions of, pests. Law requires that active ingredients be identified and the amount, by weight, of active ingredients sold and used be noted.

Index

1 For a comprehensive discussion of the wide variety of beliefs about nature in this century alone, see Bramwell 1989.

2 This two-stage averaging process is necessary to avoid giving exaggerated weight to categories that include a larger number of sub-categories.
Acknowledgments

References


Allen, Mark, New Brunswick Department of Health and Wellness (2001). Personal communication with Tracy Wates (July 11).


Armstrong, Louis, Department of Fisheries and Oceans (2002). Personal communication with Liv Fredricksen (January 10).


Briggins, NS Dept. of Environment and Labour (2001). Personal communication with Tracy Wates (June 7).


Brooks, Pat, Environmental Health Services, Government of the Yukon (2001). Personal communication with Tracy Wates (July 20).

Byrtus, Gary, Pesticide Monitoring Specialist, Alberta Environment (2000). Personal communication with Tracy Wates (June 4).


Center for Disease Control, Division of Vector-Borne Infectious Diseases (2000).


——— (2001). Personal communication with Tracy Wates (June 6).

——— (2002). Personal communication with Laura Jones (February 20).


Cicierski, Lauralou, National Media Relations Coordinator, Ducks Unlimited Canada (2001). Personal communication with Tracy Wates (May).


Cooper, Kim, Ontario Soybean Grower’s Association (2001). Personal communication with Tracy Wates (April).


Dolan, Dave, Professor of Natural and Applied Sciences, University of Wisconsin-Green Bay (2001). Personal communication with Tracy Wates (July 17).


Fleischer, Fred, Manager, Water Monitoring Section, Ontario Ministry of Environment (2001). Personal communication with Tracy Wates (June 5).

Fleming, Duane, Health Protection Unit, Northwest Territories Ministry of Health and Social Services (2001). Personal communication with Tracy Wates (July 24).


Gillingham, Simon, United Kingdom, Department of Environment, Transportation and Regions, Forestry Commission (1998). Personal communication with Kevin Lacey (May 23).


——— (2001). Personal communication with Tracy Wates (June 19, July 23).

——— (2002). Personal communication with Laura Jones (February 14).


Haddon, Brian D., Manager, National Forestry Database Program, Canadian Forest Service (1999). Personal communication with Laura Griggs (July).


——— (2001). Personal communication with Tracy Wates (June 13).


Hough, Ken, Ontario Corn Producers’ Association (2001). Personal communication with Tracy Wates (May).


Jain, Pritam, SERM-Environmental Protection Branch, Saskatchewan (1999). Personal communication with Laura Griggs (June 1).


Lang, Pat, Branch Head, Municipal Program Development Branch, Alberta Environment (2001). Personal communication with Tracy Wates (July 12).


Mackinnon, Andy, Ministry of Sustainable Resource Management, Gov’t of British Columbia (2002). Personal communication with Liv Fredricksen (January 24).


Martin, Hugh, Weed Management Specialist (Field Crops), Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph (2001). Personal communication with Tracy Wates (June).


Mosher, Christina L., Nova Scotia Department of Environment and Labour (2002). Personal communication with Liv Fredricksen (February 3).

Murphy, Claire, Prince Edward Island Dep’t of Environmental Resources, Water Resources Branch, Marine Environment Section (1996). Personal communication with M. Danielle Smith (May).


Raymond, Bruce, Head, Rivers and Estuaries Section, Prince Edward Island Department of Environmental Resources (1997). Personal communication with Rosemary Herbut (May 29).
———, Head, Rivers and Estuaries Section, Division of Water Resources, PEI Department of Fisheries, Aquaculture, and Environment (2001). Personal communication with Tracy Wates (June 7).
Rehman, Sami, Property Information Coordinator, the Nature Conservancy Canada (2001). Personal communication with Tracy Wates (May).
Richardson, Violeta. (1999). *Environmental Conservation*. Environment Canada. Data provided by personal communication with Laura Griggs (June 9); all trend calculations are by authors.
Rocan, Don, Environmental Engineer, Environmental Approvals Branch, Manitoba Conservation (2001). Personal communication with Tracy Wates (June).
Rodrigues, Stephen, Manager Research, Canadian Association of Petroleum Producers (CAPP) (2002). Personal communication with Liv Fredricksen (February 21).
——— (1999). Personal communication with Laura Griggs (June 30).
———, Science and Standards Division, Alberta Environment (2001). Personal communication with Tracy Wates (July 19).
Samuel, Gerald, Program Manager, Approval, Support and Certification, Alberta Environment (2001). Personal communication with Tracy Wates (July 11).
Shelton, John, Analysis and Air Quality Division, Environment Canada (1999). Data from National Air Pollution Surveillance (NAPS) Network. Personal communication with Laura Griggs.
Skinner, Brad, District Manager, Amherst, Nova Scotia Department of Environment and Labour (2001). Personal communication with Tracy Wates (June).
Somers, George, Head, Groundwater Section, Division of Water Resources, PEI Department of Fisheries, Aquaculture, and Environment (2001). Personal communication with Tracy Wates (June 6).
Swain, Les, Head, Standards and Protocols Unit, British Columbia Ministry of Sustainable Resource Management (2001). Personal communication with Tracy Wates (July 12).
Trotter, Bruce, Environmental Health Specialist, Government of Nunavut (2001). Personal communication with Tracy Wates (July 24).


Webb, Marnie, Food Biotechnology Communication Network (2001). Personal communication with Tracy Wates (July 26).


Whitley, Gerry, Water Quality Manager, Department of Indian and Northern Affairs Canada, Water Resources, Northern Affairs Program (Yukon) (1997). Personal communication with Rosemary Herbut (May 26).


——— (1997). Personal communication with R. Herbut (July 14).


Willis, Paul, United Kingdom, Department of Environment, Transportation and Regions, Air Quality Information Archive (1998). Personal communication with K. Lacey (May 15).

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