



Community Water Supplies

Introduction

The purpose of this chapter is to provide information related to the quality of “treated” or “finished” drinking water to the users of *Canadian Environmental Quality Guidelines*. Much of the information contained in this chapter has been taken from *Guidelines for Canadian Drinking Water Quality—Supporting Documentation* (Health and Welfare Canada 1989) and *Water Treatment Principles and Applications: A Manual for the Production of Drinking Water* (Health and Welfare Canada 1993). For further details and technical information on health, please refer to Health and Welfare Canada (1989).

Water may be drawn from surface waters or groundwater for domestic use (including drinking, washing, laundry, and watering lawns and gardens) by individuals or by communities. Surface waters are almost always treated; groundwater may be used without treatment, as is generally the case with individual wells.

Provincial and territorial regulations concerning water treatment vary. For example, Saskatchewan requires treatment for all community systems. In British Columbia, on the other hand, treatment is only mandated for surface supplies. A wide variety of treatment procedures are used by individuals and different communities (Health and Welfare Canada 1993).

In 1983 (the last year for which published figures are available), about 92% of Canada’s population was served by some type of community water supply system. Of the 12.4 million cubic metres of water drawn each day by community water utilities in that year, 90% was taken from surface waters. Domestic use accounted for roughly 40% of the total, with most of the remaining water being used for commercial (16%) or industrial (18%) purposes (Tate and Lacelle 1987).

Purpose of Drinking Water Guidelines

Drinking water quality guidelines are developed by the Federal–Provincial Subcommittee on Drinking Water and

are published periodically as *Guidelines for Canadian Drinking Water Quality* (e.g., Health Canada 1996). Most provincial and territorial agencies use these guidelines as the basis for developing their own drinking water objectives and standards; some of the provinces incorporate the guidelines directly into their own regulations.

Drinking water guidelines apply to all public and private drinking water supplies and to treated or finished water as it emerges from the tap. **These guidelines are not intended to be applied directly to source waters.** In fact, since modern water treatment technologies can produce high-quality drinking water from even heavily contaminated sources, numerical limits are not usually proposed for the quality of raw water sources used for drinking water. However, since one purpose of environmental quality guidelines, i.e., site-specific ambient water quality objectives (hereafter referred to as water quality objectives), is to protect the present and potential uses of a water body, surface water quality objectives may sometimes be required, with limits below the drinking water guidelines.

Drinking water guidelines are intended to protect human health and to provide water of good aesthetic quality (taste, odour, colour, etc.). They do not imply that the quality of the drinking water may be degraded to the specified levels. Indeed, a continuous effort should be made to ensure that drinking water is of the highest possible quality. This includes the implementation of measures to protect raw water supplies from contamination, where feasible. If an activity is likely to change source water quality, steps should be taken to minimize the human health risks and to avoid causing an unacceptable increase in the cost of providing a safe and high-quality drinking water to the downstream utility.

Current Drinking Water Guidelines

The Federal–Provincial Subcommittee on Drinking Water has prepared the *Summary of Guidelines for Canadian Drinking Water Quality*, part of Health Canada’s *Supporting Documentation* (Health and Welfare Canada

1989), which is included at the end of this chapter. It contains the current Canadian guidelines for microbiological, chemical, physical, and radiological parameters in treated drinking water. The *Summary* will be updated periodically and distributed to users of both the *Supporting Documentation* and *Canadian Environmental Quality Guidelines*. It is also available on Health Canada's water quality website (see end of chapter).

The Federal-Provincial Subcommittee on Drinking Water continually evaluates the available scientific, technical, and medical literature on new drinking water parameters and on parameters whose guidelines require revision. The Subcommittee's *Drinking Water Substances Priority List* is also found at the end of this chapter.

Using the Drinking Water Guidelines

The drinking water guidelines outlined in the *Summary* must be interpreted using the *Supporting Documentation* (Health and Welfare Canada 1989). The *Supporting Documentation* contains the scientific and management information used to determine the concentrations required to adequately protect human health or the aesthetic quality of the water.

Health-Based Guidelines

Microbiological Parameters

In order to prevent the spread of waterborne disease, treated drinking water must conform to strict standards of microbiological purity. The public health goal is to provide drinking water that contains no viable infectious viruses or protozoa (e.g., *Giardia*). Coliform counts and related tests indicate disinfection efficiency in the treated water, but do not indicate the presence or absence of viruses or protozoa.

Conventional water treatment processes will remove bacteria and other contaminants contained in natural surface waters used as a source for drinking water. However, if the quality of the source water deteriorates, higher concentrations of contaminants may require changes in treatment plant operations or process in order to ensure the finished drinking water is safe. Surface water quality objectives should be set to avoid such conditions.

Chemical and Physical Parameters

The environmental quality guidelines dealing with water (except recreational water) in the other chapters of this document are derived using risk assessment. They are based on scientific information concerning the use of the water and on an evaluation of what is needed to protect the ecology in question. Other factors, such as technical feasibility, socioeconomic factors, and societal values, are taken into account during the development of site-specific objectives derived from the guidelines.

Maximum acceptable concentrations (MACs) have been established for certain substances that are known or suspected to cause adverse effects on health. Each MAC has been derived to safeguard health assuming lifelong consumption of drinking water containing the substance at that concentration. The use of drinking water for all usual domestic purposes, including personal hygiene, has been considered in the derivation of the guidelines wherever possible. However, water of higher quality may be required for some special purposes, including renal dialysis.

Drinking water that continually contains a substance at a level greater than its MAC will contribute significantly to consumers' exposure to the substance and may, in some instances, induce deleterious effects on health. However, short-term excursions above the MAC do not necessarily mean that the water constitutes an undue risk to health. The amount by which, and the period for which, the MAC can be exceeded without posing a health risk must be assessed by taking into account the toxicity of the substance involved. When the MAC for a substance is exceeded, however, the minimum action required is immediate resampling. If the MAC continues to be exceeded, the local authority responsible for drinking water supplies should be consulted concerning appropriate corrective action.

For those substances for which there are insufficient toxicological data to derive a MAC with reasonable certainty, interim values have been recommended, taking into account the available health-related data, but employing a larger safety factor to compensate for the additional uncertainties involved. **Interim maximum acceptable concentrations (IMACs)** were also established for those substances for which the estimated lifetime risks of cancer associated with the guideline (the lowest concentration in drinking water that is practically achievable using available analytical or treatment methods) are greater than those deemed to be "essentially negligible". Because of their nature, IMACs will be reviewed periodically as new toxicological data and new methods of quantitation and treatment become available.

Drinking water guidelines, on the other hand, are derived using a combination of risk assessment and risk management. In particular, since the desirable risk assessment concentration for carcinogens is zero, drinking water guidelines for carcinogens are risk management values. In most instances, dose–response data for a carcinogen are extrapolated to a concentration where the estimated lifetime risk is 10^5 to 10^6 (i.e., 1 in 100 000 to 1 in 1 000 000), a range that is judged to be “essentially negligible”. When the determination of a guideline is limited by the practical quantitation limit or the limits of the available treatment technology for reducing the concentration of the carcinogen in question, then the guideline may be set at a level corresponding to greater than “essentially negligible” lifetime risk.

This means that a number of values must be examined when considering drinking water guidelines for carcinogens during the development of water quality objectives or during similar uses of *Canadian Environmental Quality Guidelines*. For example, all the following must be taken into consideration: the desirable concentration of the carcinogen (zero); the concentration of a carcinogen corresponding to an “essentially negligible” risk, which is described in *Guidelines for Canadian Drinking Water Quality—Supporting Documentation* (Health and Welfare Canada 1989); and the published guideline value (e.g., Health Canada 1996; see also the *Summary*).

While any guideline may change in light of new information, IMACs are specifically reviewed periodically as new information on toxicity, analytical methods, or treatment technology becomes available. The susceptibility of IMACs to change should be kept in mind when using them as the basis of objectives.

Radiological Parameters

Drinking water guidelines for radiological characteristics have also been established, primarily for protection against chronic or cumulative exposure to radionuclides.

Aesthetic Objectives

An aesthetic objective may be the limiting factor, if, for example, a substance causes an off-taste at a concentration below its toxic level. Aesthetic objectives should be considered in developing source water quality objectives, bearing in mind that some parameters are changed considerably during the production of drinking water.

Aesthetic objectives (AOs) apply to certain substances or characteristics of drinking water that can affect its acceptance by consumers or interfere with practices for supplying good-quality water. For certain parameters, both AOs and health-related guidelines (e.g., MACs) have been derived. Where only AOs are specified, the values are below those considered to constitute a health hazard. However, if a concentration in drinking water is well above an AO, there is a possibility of a health hazard.

Water Treatment Principles

The protection of drinking water differs from the protection of water used for other purposes, in that it is almost always processed before use, particularly if derived from surface waters. Conventional treatment, including screening, coagulation, sedimentation, filtration, and disinfection (Health and Welfare Canada 1993), eliminates harmful bacteria and also reduces turbidity. The reduction in turbidity improves the aesthetic qualities of the water and facilitates disinfection. Detailed information on drinking water treatment technologies can be found in *Water Treatment Principles and Applications: A Manual for the Production of Drinking Water* (Health and Welfare Canada 1993).

Conventional treatment is normally adequate for surface waters that are not, or are only slightly, polluted. All supplies drawn from surface water sources should receive a minimum treatment of coagulation, filtration, and disinfection. Supplies drawn from shallow groundwater sources should also receive disinfection.

Analytical capabilities have improved over the past few decades, and new and better information on the potential health effects of many environmental contaminants is now available. At the same time, public expectations and concerns about drinking water quality have increased. In response, better protection of the quality of raw water supplies has been emphasized. In some cases, however, new and more advanced water treatment processes are being used, such as carbon and membrane filtration, air stripping, and ion exchange (Health and Welfare Canada 1993).

Advanced processes allow even severely polluted raw waters to be treated for community use. However, additional processing is expensive. It is generally not desirable from a water management point of view to allow source waters to degrade to the point that special treatment is required. Additional processing also increases the risk of exposure to harmful disinfection by-products or other unsuspected hazards.

As a basic principle, it is recommended that water quality objectives be sufficiently stringent to allow conventionally treated water to be used for community water supplies, except where contaminants are naturally present at a concentration that makes this impossible. The desirable level of protection may be influenced by such factors as the type of water treatment that may be employed by the user(s), the fact that residents may ingest contaminants from both local food (e.g., fish) and drinking water, and other technical, social, and economic factors.

The type of drinking water treatment processes used in or planned for communities may also be a consideration when setting water quality objectives. When a new plant or major upgrade to a plant is envisioned, close monitoring of all aspects of the raw water quality is required to ensure that the proper treatment processes are selected. In addition, measures to protect raw water supplies from contamination should be implemented where feasible.

The application of these water treatment principles will not guarantee the production of drinking water of adequate quality from every raw water source. For example, protection or partial treatment of the supply may be necessary to reduce turbidity even when coliform counts are low. In addition, satisfaction of other water quality criteria may dictate the use of special treatment processes not mentioned in the above schemes.

For Further Information

The terminology used for drinking water guidelines is explained fully in the following Health Canada publications: *Guidelines for Canadian Drinking Water Quality* (e.g., Health Canada 1996) and *Guidelines for*

Reference listing:

Canadian Council of Ministers of the Environment. 1999. Community water supplies. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

For further scientific information, contact:

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Canadian Drinking Water Quality—Supporting Documentation (Health and Welfare Canada 1989). These publications also contain further details on the various drinking water guidelines and on sampling procedures. Additional information about treatment processes can be obtained from municipalities and provincial agencies, from *Water Treatment Principles and Applications: A Manual for the Production of Drinking Water* (Health and Welfare Canada 1993) and from other sources.

More information on Health Canada's drinking water guidelines and the activities of the Federal-Provincial Subcommittee on Drinking Water can be found on Health Canada's water quality website:

English:

<http://www.hc-sc.gc.ca/waterquality>

French:

<http://www.hc-sc.gc.ca/eauqualite>

References

- Health and Welfare Canada. 1989. Guidelines for Canadian drinking water quality—Supporting documentation. Updated November 1990, December 1992, and February 1995.
- . 1993. Water treatment principles and applications: A manual for the production of drinking water. Prepared by the Department of National Health and Welfare, Environmental Health Directorate, Health Protection Branch. Printed and distributed by the Canadian Water and Wastewater Association, Ottawa.
- Health Canada. 1996. Guidelines for Canadian drinking water quality. 6th ed. Prepared by the Federal-Provincial Subcommittee on Drinking Water of the Federal-Provincial Committee on Environmental and Occupational Health.
- Tate, D.M. and D. Lacelle. 1987. Municipal water use in Canada, 1983. Soc. Sci. Ser. 20. Environment Canada, Inland Waters/Lands Directorate, Water Planning and Management Branch, Ottawa.

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