Last Update: **24 October 2005**

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Small Water Systems in BC

An Introduction to the Provision of Safe and Reliable Supplies

Part 1: Organization

2005

Prepared For: **BC Ministry of Health**
Health Protection
4th Floor 1515 Blanshard St. Victoria. BC,
Tel: 250-952-3335

Prepared By: **AquaVic Water Solutions Inc.,**
P.O. Box 3075 STN CSC.,
R-Hut McKenzie Avenue, Victoria, B.C.
250-472-4327 Phone
250-721-6497 Fax
www.AquaVic.com

Contact: Vernon Rogers M.Sc. P.Eng.
Tel: 250 472 8660 Email: vjrogers @shaw.ca

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Preface: Using this Introduction

Small Water Systems in BC: An Introduction to the Provision of Safe and Reliable Supplies. Part 1: Organization is intended for use by directors, trustees, managers and operators of small water supply systems in BC. The purpose of this introduction is two-fold. First, it is intended to help the reader develop a broad knowledge of the many issues that must be considered in planning, operating, and maintaining a small water system. Second, with this knowledge more effective communication will occur between water system directors, staff, professional advisors, regulators, and customers.

This introduction is not intended to replace experienced professional advice. It does not treat any topic in depth. Rather, references to more detailed information sources are provided.

The introduction does not address individual water systems that supply a single property or household.

Technical aspects of the operation of small water systems will be covered in the second document of this series titled *Small Water Systems in BC: An Introduction to the Provision of Safe and Reliable Supplies. Part 2: Technical Operations.*

Acknowledgements

To follow

1. Background Information

Fast Read

- *BC's Action Plan for Safe Drinking Water is a long term strategy developed to improve and safeguard the quality of drinking water throughout our province.*
- *Small water systems in BC face unique challenges including: more likelihood of contamination, aging infrastructure, lack of capacity development, and challenges in complying with regulations and standards.*
- *Approximately one in seven British Columbians obtain their drinking water from small community water supply systems, most of which are located in rural BC.*
- *A 'small water system' typically serves a population of less than 500.*
- *In rural areas, where the majority of the small water systems are found, ground water usage accounts for approximately 40% and surface water the remaining 60% of source supply.*

1.1 BC's 'Action Plan for Safe Drinking Water'

The Goal
Like many provinces throughout Canada, BC has recently developed a long-term strategy for the delivery of safe drinking water for all British Columbians.

The Challenge
This will be a challenge in British Columbia because of outdated water system infrastructure and the numerous drinking water health concerns throughout the province. For example, in 2004, over 400 communities were under a 'boil water' advisory. As well, BC for many years has had the highest rate of intestinal illness in all of Canada.

The Solution
Effective legislation, regulations, and policies provide the framework under which protection of drinking water can be attained. To this end the government has introduced the *Drinking Water Protection Act* (2003), and new Groundwater Regulations (2004) under the *Water Act*.
Eight basic principles under which to protect drinking water have been developed.

1. The safety of drinking water is a public health issue.
2. Source protection is a critical part of drinking water protection
3. Providing safe drinking water requires an integrated approach.
4. All water systems need to be thoroughly assessed to determine risks.
5. Proper treatment and water distribution system integrity are important to protect human health.
6. Tap water must meet acceptable safety standards and be monitored.
7. Small systems require a flexible system with safeguards.

8. Safe drinking water should be affordable with users paying appropriate costs.

The roles and responsibilities of those involved in the safe delivery of drinking water have been clearly outlined. The Ministry of Health is the primary body responsible for ensuring that drinking water is safe for human consumption.

1.2 Unique Challenges Facing Small Water Systems

In *Office of the Auditor General of British Columbia: Protecting Drinking-Water Sources* (1999), small water systems were identified as more vulnerable to contamination than larger systems. In addition, they are less equipped to respond to problems when they do arise. While providing **safe**, **reliable**, and **affordable** water is a challenge faced by all suppliers, there are unique challenges faced by small water suppliers. For example:

Greater likelihood of contamination – The BC Auditor General's report identified seven activities compromising BC water supplies: outdoor recreation, logging, mining, cattle grazing, and agriculture, transportation, and human settlement. These activities are more likely to occur in rural areas where small water systems are common, thus placing them at higher risk than larger systems.

Aging Infrastructure - The water systems in BC are on average the second oldest in the country, and currently have an average age beyond the expected life span.

Lack of Capacity Development - Capacity development is a term applied to the process of acquiring and maintaining adequate financial, technical, and managerial capabilities. These capabilities are necessary to enable water systems to provide safe drinking water, and to ensure sustainability. Inadequate revenues spawn a vicious circle: without sufficient funds, water systems cannot obtain appropriate technology and technical and managerial expertise. For example, they may be unable to develop long and short-term plans, purchase effective treatment technology, manage finances, monitor water quality, design and implement emergency response plans, and educate the public about water conservation and use.
Compounding small scale economics, water suppliers such as improvements districts do not qualify directly for government funding which is otherwise available to regional districts and municipalities.

Non-compliance with Regulations and Standards – As noted, small systems often lack financial and technical expertise required for adequate monitoring and maintenance. As a result many small systems do not comply with current regulations and standards. As of April 2005, there were over 400 communities throughout the province under boil water advisories (Ministry of Health, 2005).

The Good News

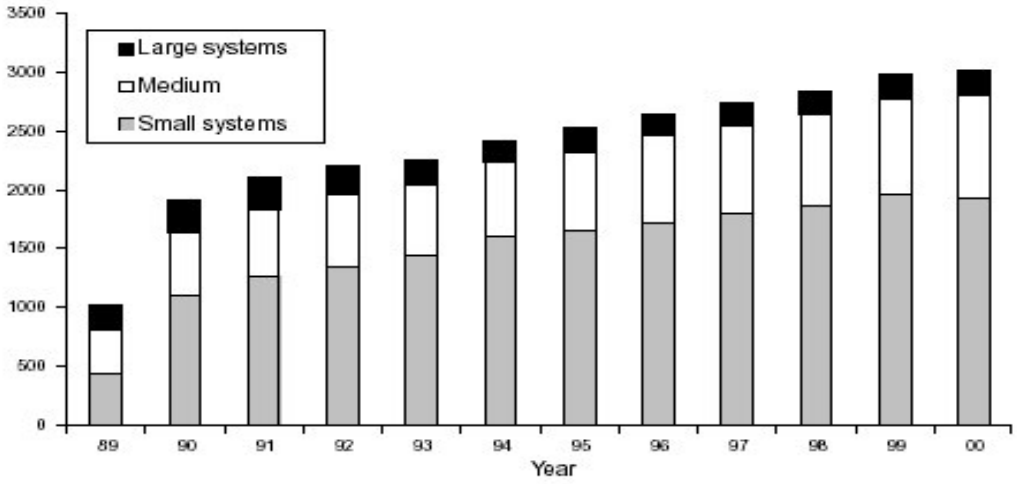
The BC provincial government and other organizations are responding to the need to build capacity in small water systems. There is a growing range of tools and resources available to small water systems to assist in meeting the challenge of providing safe and reliable drinking water. This introduction is one example, and several others are discussed in subsequent sections of this document.

1.3 An Inventory of Small Water Systems in BC

Approximately 500,000 people (one-seventh of the total British Columbia population) obtain their drinking water from small community water supply systems.
The majority of these systems are located in the rural areas of the province. The Cariboo region for example, has the most water systems under its jurisdiction with 360, followed by Kootenay Boundary (320), and the Fraser Valley (280) (Ministry of Health Services, 2002).

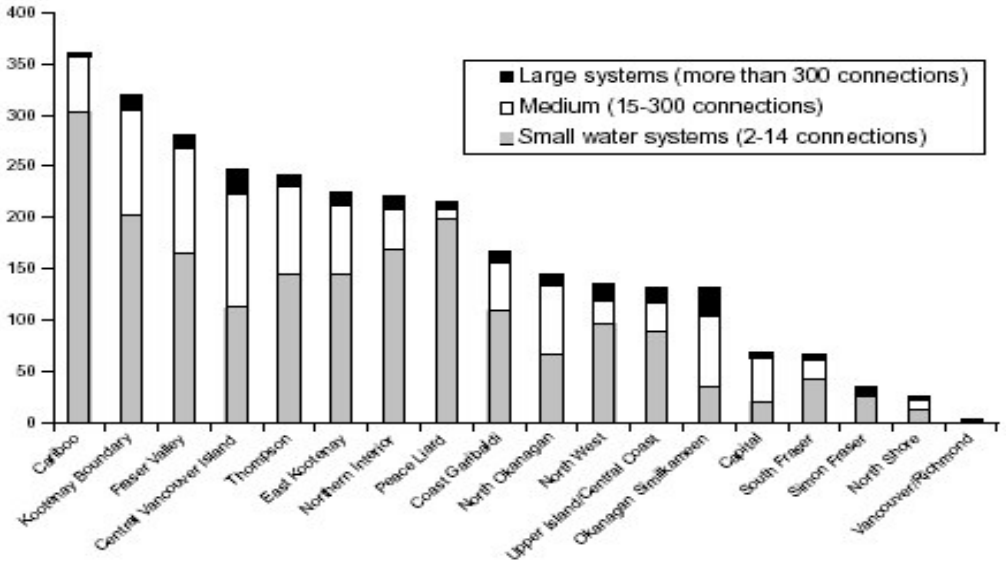
In 2000, an inventory of BC's water supply systems by the Provincial Health Officer, reported that there were 3,016 water systems under provincial jurisdiction in that year. Two-thirds of these were small systems serving two to fourteen connections. In addition, during the period 1989-1995 there was a four-fold increase in the number of small systems within BC (Figure 4 and 5). Again, the increase occurred primarily in rural BC. Partially however, the increase is attributed to efforts to identify and record these systems.

Figure 4: Number of Water Systems in B.C., 1989 - 2000



Water systems are categorized according to the number of connections: small (2 to 14 connections), medium (15 to 300), larger (more than 300 connections). Figures are as of March 31 each year and do not include First Nations water systems. Figures for 1989 to 1995 do not include former municipal health departments (Vancouver, Burnaby, North Shore, Richmond, New Westminster, Capital). Source: Public Health Protection, B.C. Ministry of Health Services.

Figure 5: Number of Water Systems by Region



Figures are as of March 31, 2000. Source: Public Health Protection, B.C. Ministry of Health Services. For additional regional data, see Appendix F.

1.4 Defining 'Small Water Systems' in BC

Definition of a Water Supply System

The definition of a water supply system in British Columbia is found in the *Drinking Water Protection Act (2003).* In the *Act* a water supply system means a domestic water system that supplies domestic water, other than those that serve only one single-family residence. Thus, a "water system" in BC is any system having two or more connections.

Definition of a Small Water System

The Ministry of Health recognizes that the provision of safe water to consumers is a public health priority, regardless of the number of connections on a system. To meet this goal, the BC Drinking Water Protection Regulation (2003) requires small system facilities and operators be classified by the Environmental Operators Certification Program (EOCP); an independent body concerned with the protection of human health and the environment.

The EOCP classifies water (and wastewater) systems based on the population served and the complexity of a system. The Small Water System (SWS) category includes both treatment (if present) and distribution, and typically serves a population of less than 500. Most Ministry of Health designated small water systems generally fall into the EOCP SWS classification.

The Health designations are as follows:

- WS2: 16-300 connections,
- WS3: 2-15 connections,
- WS4: 1 semi-private connection (examples include gas stations, campgrounds, restaurants, lodges, and motels).

1.5 Source Supply for Small Water Systems

Water systems in BC vary greatly in their size and composition, and may obtain their water supply from one or more sources. In rural areas, where the majority of the small water systems are found, ground water usage accounts for approximately 40% of the supply source. Surface water, including lakes, ponds, springs, streams, creeks and rivers, account for the remaining 60% of source supply (Auditor General of British Columbia, 1999).

Ground water

Ground water sources are found in many areas of BC. An underground formation of permeable rock or loose material, which can produce useful quantities of water when tapped by a well, is termed an *aquifer.* Two factors which are responsible for the high reliance on ground water sources in rural areas are licensing and availability. Historically,

ground water provides a better chance of uninterrupted water supply. In contrast, surface-water licensing restrictions are in place due to drought conditions in dry areas of the province such as Kamloops. In areas such as the Gulf Islands, ground water is the predominant water source available, although this area has seen an increase in the usage of rainwater catchments.

Ground water is an attractive source of drinking water for small systems because typically it has a reduced need for treatment compared to surface water. Ground water can remain relatively uncontaminated by nearby activities because of the protection provided by covering layers of material: gravel, sand, silt and rock. As surface water moves through these layers, pathogens are naturally filtered out as the water percolates towards the aquifer.

This reduced need for treatment—and the resultant savings—was a key factor in the switch by the town of Fort St. John to a ground water source. Many systems use ground water as a backup against intermittent surface-water problems. Ground water is clearly a resource of considerable value in British Columbia. Its use is expected to increase in the future, particularly in rural areas.

Although ground water is less vulnerable than surface water, it is not immune to contamination. Unconfined aquifers are sometimes relatively shallow, or separated from the surface by layers of silt, fractured rock, or permeable soils through which water and contaminants can leach from the surface. Contaminated surface run-off can reach these aquifers and introduce microbial pathogens.

The Well Protection Toolkit is a set of guidelines that outline a six-step approach to developing a well water protection plan for water purveyors, communities and local governments. Several ministries developed it jointly in BC. It also contains information about how the general public can take responsibility for well water protection. The concepts contained in the Toolkit can also be used to protect the entire aquifer, in addition to the well capture zone(s).

The Toolkit, which contains seven booklets, discusses the six steps as noted below:

1. Form a community planning team;
2. Define the capture zone (recharge area) of the community well;
3. Map potential sources of pollution in the capture zone;
4. Develop and implement protection measures to prevent pollution;
5. Develop a contingency plan against any accidents; and
6. Monitor, evaluate, and report on the plan annually.

The Well Protection Toolkit is available online at:
http://wlapwww.gov.bc.ca/wat/gws/well_protection/intro.pdf

Surface Water

Surface water accounts for approximately 60% of the supply source for small water systems in BC. In many rural areas of the Province surface water is the only available

water source, or is the easiest and least expensive source to access. Surface water sources include lakes, ponds, springs, streams, creeks and rivers.

Surface water is particularly susceptible to contamination because it is open to the atmosphere, and exposed to surface activities. Contamination can occur as a result of human or wildlife activities; or by natural events in the watershed such as landslides, wildfires, or extreme runoff from heavy rain. The Drinking Water Protection Regulation requires that drinking water in a supply system must be disinfected if the water originates from surface water.

Resources

For further information on the above topics, please consult the following resources.

- **The BC Ministry of Health, Public Health Protection** website at *http://www.healthservices.gov.bc.ca/protect/water.html* provides links to:
  - Drinking Water Protection Act and Regulation,
  - *Provincial Health Officer's report, Drinking Water Quality in British Columbia: The Public Health Perspective* (2002),
  - *British Columbia Auditor General's report, Protecting Drinking Water Sources* (1999),
  - Other related information about the Public Health Protection's Drinking Water Program.
  - The web site *www.greenbc.org*, which includes a directory of suppliers and consultants
- **The Well Protection Toolkit** is available online at: http://wlapwww.gov.bc.ca/wat/gws/well_protection/intro.pdf
- **Environmental Operators Certification Program** (EOCP) is an independent body concerned with the protection of human health and the environment has specific information about small water and wastewater systems. http://www.eocp.org/

2. Drinking Water is a Public Health Issue

Fast Read

- *Safe drinking water as one of the key reasons for reductions in deaths and illnesses from infectious diseases in the last century.*
- *Since 1980, there have been 29 confirmed waterborne disease outbreaks caused by microorganisms in BC.*
- *BC is known to have the highest rate of intestinal illness of all provinces in Canada*
- *There are elevated levels of nitrate contamination in ground water in rural areas of the province. This is a health concern when contaminated water is used to prepare infant formula.*

2.1 Water Contaminants in BC

The link between the health of the public at large and drinking water has been recognized since ancient times. The US Centre for Disease Control cites the provision of safe drinking water as one of the key reasons for reductions in deaths and illnesses from infectious diseases in the last century (National Academy of Engineering, 2000). Water contaminants are subdivided into four major classes; physical, microbiological, chemical, and radionuclides. In BC, the majority of drinking water related illnesses have been caused by a small number of microbiological pathogens. BC is known to have the highest rate of intestinal illness of all provinces in Canada (Figure 2).

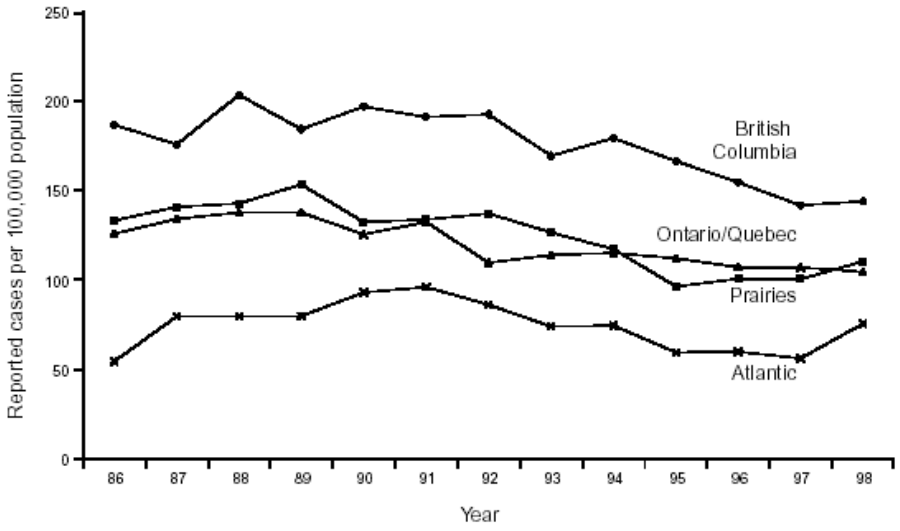
Since 1980 there have been 29 confirmed waterborne disease outbreaks caused by microorganisms. Illnesses are caused by drinking water contaminated with bacteria (Salmonella, Campylobacter), viruses, or small parasites (Cryptosporidia, Giardia, and Toxoplasma).

Most of these outbreaks were caused by the contamination of drinking water systems with the feces of infected animals or less frequently, people. Infected animals may be domestic pets, livestock, poultry, or wild animals like beaver, deer or rodents that defecate in or near surface water bodies.

There are also elevated levels of nitrate contamination in ground water in rural areas of the province (BC Auditor General, 1999). This usually occurs in areas of intense agricultural activities or where septic tanks are the main method of sewage disposal

(Ministry of Water, Land and Air, 2002). Nitrate is usually non-toxic but is a health concern because it can harm infants by reducing the ability of blood to transport oxygen. This is commonly called 'blue-baby syndrome'.

Figure 2: Enteric (Intestinal) Disease Rates, 1986 - 1998



Diseases: Total reported cases of amoebiasis, campylobacteriorsis, giardiasis, hepatitis A, listeriosis (all types), paratyphoid, salmonellosis, shigellosis, typhoid, and verotoxigenic E. coli. Reported cases from Health Canada, Disease Surveillance On-Line, http://www.hc-sc.gc.ca/hpb/lcdc/webmap/index.html. Population estimates from Statistics Canada, Demography Division; data obtained from the Health Data Warehouse, B.C. Ministry of Health Services.

2.2 Health Concerns

Waterborne contaminants can cause two types of health effects, acute and chronic. Acute health effects arise immediately, within hours or days of ingesting the contaminant in drinking water. Microbial contaminants, such as bacteria, viruses, and protozoan parasites cause acute health effects. The symptoms are usually diarrhea, nausea and vomiting, and in extreme cases death. High levels of arsenic, nitrates, or other chemicals ingested through water can also cause acute, and sometimes fatal, illness.

The use of nitrate-contaminated drinking water to prepare infant formula can cause methemoglobinemia commonly called 'blue-baby syndrome'. Affected infants develop a peculiar blue-gray skin color and may become irritable or lethargic, depending on the severity of their condition. The condition is potentially life threatening if not treated appropriately.

Long-term health effects may result from exposure to a drinking water contaminant day after day for many years at levels above the recommended guidelines. Contaminants in

the water that may cause cancer or other health effects after long-term exposure include: arsenic, lead, solvents, or disinfection by-products.

Resources

For further information on the above topics, please consult the following resources.

- **The Environment category of the BC HealthFile** includes topics on various topics including water safety. *http://www.bchealthguide.org/healthfiles/Environment.stm#Environment02*
- Appendix 2. Guidelines for Drinking Water Quality.

3. Provincial Water-related Acts and Regulations

Fast Read

- *The provincial government is the primary legal authority responsible for drinking water in BC.*
- *The Drinking Water Protection Act and the Health Act are the main legislative and regulatory tools used to ensure drinking water is safe for human consumption in BC.*
- *The intention of the Drinking Water Protection Act is to protect drinking water supplies from 'source-to-tap'.*
- *The DWPA falls primarily under the jurisdiction of the Ministry of Health. The DWPA identifies the provincial health officer as the primary authority responsible for drinking water protection in BC.*
- *The Health Act also outlines the roles and responsibilities of the provincial health officer and the medical health officers relating to source water protection.*
- *Other Acts under provincial jurisdiction that are concerned with source water protection include the Water Protection Act, the Water Act, and Forest and Range Practices Act, and the Waste Management Act.*
- *Health Canada, together with members from provincial and territorial governments, has developed "Guidelines for Canadian Drinking Water Quality" (GDWQ) for a variety of microbiological, chemical, and radiological parameters.*

The provincial government, through numerous Acts and regulations, is the primary legal authority responsible for drinking water in British Columbia. The provincial government receives expert advice from national and provincial sources and then makes decisions about the water protection programs it will implement. For example, the 'Guidelines for Canadian Drinking Water Quality' (GCDWQ) is developed by federal, provincial and territorial governments. The provincial government uses this information to set appropriate water quality standards for British Columbia.

In British Columbia, the Ministry of Health is the primary body responsible for ensuring that drinking water is safe for human consumption. The *Drinking Water Protection Act* and the *Health Act* are the main legislative and regulatory tools used to ensure the safety of drinking water in BC. These *Acts* fall primarily under the jurisdiction of the Ministry of Health in BC.

Along with the *Drinking Water Protection Act* and the *Health Act*, there are other Acts under provincial jurisdiction that are concerned with source water protection including

the *Water Protection Act*, the *Water Act*, and *Forest and Range Practices Act*, and the *Waste Management Act*. These Acts are discussed in brief in this section.

3.1 *Drinking Water Protection Act (2003)*

The intention of the *Drinking Water Protection Act* is to protect drinking water supplies from 'source-to-tap'. To support this intention, the province has adopted the Multi-Barrier Approach to the protection of drinking water. This topic is important and discussed in detail in section 6.4 The Multi-Barrier Approach.

The Drinking Water Protection Act (DWPA) is the primary regulatory means to protecting BC's drinking water. The *DWPA* came into force in 2003, replacing the Safe Drinking Water Regulations under the *Health Act*. The objective of the *Act* is to protect BC's drinking water from "source-to-tap". The *DWPA* falls primarily under the jurisdiction of the Ministry of Health.

Roles of the Provincial Health Officer and the Drinking Water Protection Officer

Key players defined under the *Act* are the provincial health officer (PHO) and the drinking water protection officers (DWO) (one in each health region). The provincial health officer is appointed under the *Health Act* and is the senior medical officer for the province. One power of the PHO is the ability to take a drinking water problem directly to cabinet. The provincial health officer must also submit an annual drinking water protection report to the legislature.

The Drinking Water Officer is responsible for drinking water issues in each health region of the province. The *Act* allows the drinking water officer to take direct action on health hazards.

The *Drinking Water Protection Act* outlines requirements for:

- Source and systems assessment,
- Source protecting protection and planning,
- Water system operator certification,
- Water monitoring requirements,
- Drinking water standards,
- Drinking water protection, and
- Reporting and notification requirements.

The Drinking Water Protection Regulations outline the standards for:

- Potable water,
- Treatment systems,
- Operator qualifications,
- Monitoring processes,
- Public notification, and
- Emergency response planning.

http://www.qp.gov.bc.ca/statreg/stat/D/01009_01.htm#section11

3.2 *Health Act*

The *Health Act* continues to contain a number of requirements and powers that may be exercised relating to water quality, despite the fact that the *Drinking Water Protection Act* has replaced its Safe Drinking Water Regulations. The *Health Act* continues to give medical health officers and the Local Board of Health powers to deal with health hazards as defined by the *Health Act*. The Act also outlines the roles and responsibilities of the provincial health officer and the medical health officers relating to source water protection. Regulations established under the *Health Act* also set out requirements to protect source water from contamination. These regulations are: the Sanitary Regulation, the Sewage Regulations, and the Sewage Disposal Regulations.

http://www.qp.gov.bc.ca/statreg/stat/H/96179_01.htm

3.3 *Water Act* and the Ground Water Protection Regulations (2004)

The *Water Act* primarily regulates activities in and around streams and defines ownership and licensing rights of water. The Act also outlines offences related to the addition of materials into streams.

The Water Regulations outlines the requirements for the acquisition of water rights, associated fees, rentals and charges. The Regulations have requirements intended to protect other water users, and to authorize the process for changes in and around streams. The Sensitive Stream Designation and Licensing Regulations are pursuant to both the *Water Act* and the *Fisheries Act.* These regulations apply to changes in licenses or application of a water license to streams identified as sensitive.

In 2004 the new Ground Water Protection Regulation (GWPR) came into force. Prior to the GWPR there was no regulation in BC that focused on ground water protection. The main goal of the GWPR is to protect both the quantity and quality of ground water in BC. It does this by outlining standards, which safeguard and maintain the integrity and efficiency of ground water. It also regulates activities relating to ground water and well water, so that they are accomplished in an environmentally safe manner.

http://www.qp.gov.bc.ca/statreg/stat/W/96483_01.htm

3.4 *Water Protection Act*

The purpose of the *Water Protection Act* is to ensure sustainable use of BC's surface and ground water supply. The Act confirms that the Crown is the primary holder of water rights (except where private rights have been established under the *Water Act*). It maintains existing bulk water removal rights, within clearly defined limits. The act prohibits bulk removal of BC water to outside the province and large-scale diversion between major watersheds of the Province.

http://www.qp.gov.bc.ca/statreg/stat/W/96484_01.htm

3.5 *Forest and Range Practices Act*

The *Forest and Range Practices Act* came into force January 31, 2004 and replaced the previous *Forest Practices Code*. The Act allows the Ministry of the Environment (formerly Water, Land and Air Protection) to designate an area of land as a 'community watershed'. The purpose of this is to protect surface water that is used for human consumption from logging activities. To be designated a community watershed the stream must be licensed under the Water Act for a waterworks or domestic purpose controlled by a water user's community. There are also other criteria to be met before designation is granted.

http://www.qp.gov.bc.ca/statreg/stat/W/96484_01.htm

3.6 *Waste Management Act*

The primary purpose of the *Waste Management Act* is to protect drinking water sources from pollution. The Act manages point-source pollutants from industry and municipal sources. It also outlines the powers of regional pollution prevention managers and allows them to approve allowable discharge and disposal of pollutants.

http://www.qp.gov.bc.ca/statreg/stat/W/96482_01.htm

3.7 Guidelines for Canadian Drinking Water Quality

Health Canada, together with members from provincial and territorial governments, has developed guidelines for a variety of microbiological, chemical, and radiological parameters. These guidelines are set out in the publication: "Guidelines for Canadian Drinking Water Quality" (GDWQ). The Guidelines provide a yardstick against which water quality can be measured by establishing maximum acceptable concentrations for substances found in drinking water.

The guidelines divide water contaminants into four categories to determine the quality of drinking water:

- Microbiological,
- Chemical/Physical (health-based),
- Radionuclides, and
- Chemical/Physical (aesthetic).

The definition of each category, together with a description of each category, is given in the appendices to this Introduction.

Quebec, Nova Scotia, and Alberta have adopted the Guidelines into law. In BC, this approach has not been used because the vast majority of drinking water related illnesses are caused by a small number of microbiological pathogens (e.g. guiardia, cryptosporidium, *E. coli* O157:H7, campylobacter, toxoplasma, and viruses) that have no

existing standards or reliable tests. As well, the cost of testing water for all the parameters in the guidelines could divert money away from true health risks.

http://www.ec.gc.ca/ceqg-rcqe/English/Html/ceqg_brochure.cfm

Resources

For further information on the above topics, please consult the following resources.

- *http://www.qp.gov.bc.ca/statreg/stat/D/01009_01.htm#section11*
- *http://www.qp.gov.bc.ca/statreg/stat/H/96179_01.htm*
- *http://www.qp.gov.bc.ca/statreg/stat/W/96483_01.htm*
- *http://www.qp.gov.bc.ca/statreg/stat/W/96484_01.htm*
- *http://www.qp.gov.bc.ca/statreg/stat/W/96484_01.htm*
- *http://www.qp.gov.bc.ca/statreg/stat/W/96482_01.htm*
- Appendix 3. Guidelines for Drinking Water Quality.

4. Roles and Responsibilities of Water Suppliers

Fast Read

- *The most important obligation of a water supplier is found in the Drinking Water Protection Act. This includes providing potable water to the users and meeting other requirements established by the Regulations and the operating permit.*
- *The Drinking Water Protection Act and Regulations also regulate construction and operating permits for water systems, water treatment, well proofing, monitoring schedules, and reporting requirements.*
- *All water suppliers must have an Emergency Response Plan in place.*
- *The Regulations also cover aspects of water quality. For example, they set out specific parameters for fecal coliform bacteria and Escherichia coli.*
- *Water suppliers are responsible for meeting requirements of other legislation. The Health Act contains a number of powers that may be exercised with respect to water quality. The medical health officer and other officials have the authority to deal with health hazards in situations when they believe the health of the public is at danger.*

4.1 Water Suppliers in BC: Ownership

Water suppliers in BC include public authorities, private companies, and property owners. The Drinking Water Protection Act defines a water supplier as any person who is the 'owner' of a water supply system. Discussed below are types of water suppliers present in BC.
Approximately ninety percent of BC's population is served by large municipalities (Greater Vancouver Regional District, Capital Regional District). The remaining ten percent is served by a variety of small or medium sized public and private authorities.

Local Government

In BC, local government organizations include municipalities and regional districts.

Municipalities: - Municipalities have a broad authority to provide services to their electorate. Typically this includes the operation of a municipal water distribution system which serves the residents of the municipality. Two primary pieces of legislation governing municipalities include: the new *Community Charter* (January 1, 2004), and the *Local Government Act*. Within the boundaries of a municipality water may also be provided by other organizations.

Regional Districts – A role of a regional district is to provide water services to consumers within a defined service area. A bylaw is required in order to provide this service, and will include definition of the boundaries of the service area. The cost of providing a service must be financed by the property owners within the defined boundaries of the service area. Regional districts are governed primarily by the *Local Government Act* and in some instances, the *Community Charter*.

Greater Board - There are a few examples of greater boards in the province, the most notable being the Greater Nanaimo Water Board, the Greater Vancouver Water District, and the Greater Vancouver Sewerage and Drainage District. A greater board is defined in the *Community Charter* as the corporate body, incorporated by an Act, with the responsibility for the provision of water or sewerage and drainage services. Greater boards are subject to inherent limitations determined by the particular wording of the statue under which they were created.

Improvement Districts - Improvement districts are autonomous local government bodies responsible for providing one or more local services for the benefit of the residents in a community. Their powers are narrower than municipalities or regional districts and they only supply direct services such as water works, fire protection, and street lighting. Most of the authority of improvement districts in found within Part 23 of the *Local Government Act*. The province is no longer creating new improvement districts.

Other Ownership Categories

Water Utilities - A water utility is a privately owned corporation that owns or operates equipment and facilities for the delivery of domestic water for compensation, to five or more persons or to a corporation. As corporations, utilities have all of the powers of a corporation, and must exercise those powers subject to the *Water Utility Act*, *Utilities Commission Act*, and the general jurisdiction of the Comptroller of Water Rights.

Water User Community - A water users community is a corporate body consisting of a group of six or more holders of water licenses who have been issued a Certificate of Incorporation under the *Water Act* by the Comptroller of Water Rights. Water users communities are required to designate a manager. Their authorities are similar to improvement districts but without an elected Board of Trustees and without the legislative power of an improvement district.

Strata Corporations - A strata corporation may be considered a "water supplier" for the purposes of the *Drinking Water Protection Act*. However, a strata corporation will not be considered a public utility where the majority of lots have been sold by the developer (owner).

Private Water Utility - A water utility under the *Water Utility Act* is a person/business who owns or operates equipment or facilities for the delivery of domestic water service to five (5) or more persons or to a corporation for compensation. Private water utilities are usually created by developers to serve rural land development where community water service is required for subdivision approval, and where there is no other water purveyor

in the area that can provide service. A Water Utility is not a local authority and therefore not eligible for government funding such as infrastructure grants.

Other Water Systems - The definition of "water supplier" within the *Drinking Water Protection Act* includes anyone who owns land and works that are used to supply water to another person. This can include a person who provides water to a neighbour as a favour, or to a tenant within a secondary suite on the property.

4.2 Responsibilities of Water Suppliers

Drinking Water Protection Act (2003)

The most important responsibilities of a water supplier are set out in the *Drinking Water Protection Act (2003)* and Regulations. The water supplier is required to:

- Provide potable water, and
- Meet additional requirements established by the Regulations or by the water system operating permit.

The Drinking Water Protection Regulations outline standards for

- Treatment,
- Operator qualifications,
- Monitoring requirements,
- Public notification, and
- Emergency response and contingency plans.

The *Drinking Water Protection Act* and Regulations also regulate construction and operating permits for water systems, water treatment, well proofing, monitoring schedules, and reporting requirements. All water suppliers must have an Emergency Response Plan in place.

The Regulations cover aspects of water quality. For example, they set out specific parameters for fecal coliform bacteria and *Escherichia coli*. Coliforms are a group of closely related bacteria that are present in water contaminated with animal or human feces. The presence of *E. coli* indicates recent fecal contamination and possibly the presence of pathogens that may adversely affect human health. The regulations set out reporting and public notification procedures if standards for fecal coliform are not met.

Health Act

Water suppliers are also responsible for meeting requirements of other legislation. The Health Act still contains a number of powers that may be exercised with respect to water quality. The medical health officer and other officials have the authority to deal with health hazards in situations when they believe the health of the public is at danger.

Water Act

The new Ground Water Protection Regulations (GWPR) under the Water Act came into force 2004. The regulations set out to protect ground water quality and quantity. They address issues relating to well construction, flood proofing, and closing unused wells to protect ground water quality. The GWPR also establishes qualifications and provides a provincial registry for drillers and well-pump installers.

Other Acts

Other acts concerned with ownership and/or licensing rights include the Water Act, Water Utility Act, and the Utilities Commission Act. Further information concerning legislation that applies to small water systems is provided in other sections of this Introduction.

Resources

For further information on the above topics, please consult the following resources.

- **British Columbia Water and Waste Association** (BCWWA) website has information on Regulators and Legislation in BC which relates to drinking water. *http://www.bcwwa.org/committees/smallwatersys/regulators.php#federal*
- **Fraser Basin Council. 2005**. Authorities affecting source water protection in British Columbia: Research Paper. *http://www.fraserbasin.bc.ca/publications/documents/FBC_%20Water_Final.pdf*

5. System Risk Assessment and the Multi-Barrier Approach

Fast Read

- *The Hazard Analysis and Critical Control Points (HACCP) approach is a system of **risk assessment** and **risk management** that focuses on identifying and managing the critical points in a water supply system where there may be a hazard. The loss of control could result in an unacceptable safety risk.*
- *Water contaminants can be naturally occurring, or may be introduced to the water system as a result of human activity.*
- *All water suppliers in BC are required to undertake a source-to-tap assessment under the Drinking Water Protection Act (2003).*
- *The multi-barrier approach is universally recognized as the most comprehensive method of protecting drinking water quality. It places multiple barriers, or redundancies, throughout the drinking water system to prevent contaminants from reaching the public.*

5.1 Hazard Analysis and Critical Control Points (HACCP) Approach

The Ministry of Health recommends the Hazard Analysis and Critical Control Points (HACCP) approach in the delivery of safe and reliable drinking water supplies. This is a system of **risk assessment** and **risk management** that focuses on identifying and managing the critical points in a system where there may be a hazard. The loss of control could result in an unacceptable safety risk.

Regardless of whether your source supply is surface or ground water, it is vulnerable to a variety of hazards. **Hazards** are agents of harm – events, conditions, actions, or inactions that have the potential to impact the safety or availability of a water supply.

Risk Assessment

Risk assessment is the process of information gathering. It is defined by the National Research Council (1983) as "the characterization of the potential adverse health effects of human exposures to environmental hazards". Water system risk assessment identifies and assesses potential and existing hazards and vulnerabilities that may compromise the drinking water safety and availability of the entire source to tap system.

The Ministry of Health along with the Ministry of Environment (March 2005) have developed a Source-To-Tap Assessment which guides water suppliers in identifying hazards and vulnerabilities that may threaten the safety or sustainability of their water supply.

Risk Management

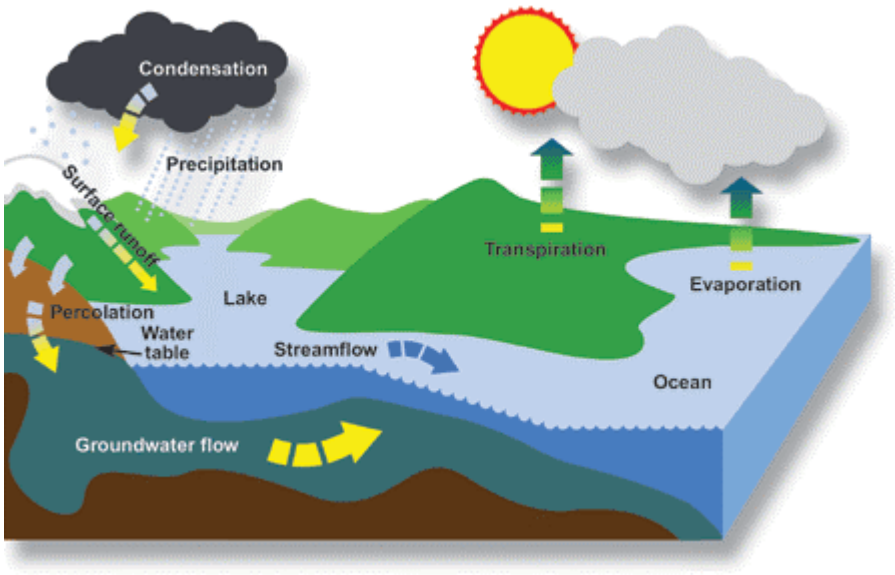
Risk management is the action or strategy developed to reduce or mitigate the hazards and vulnerabilities identified in the risk assessment process.

The multi-barrier approach is a method of risk management. It is universally recognized as the most comprehensive approach to protecting drinking water quality. It places multiple barriers, or redundancies, throughout the drinking water system to prevent contaminants from reaching the public.

5.2 Components of a Water System

Contaminants can be naturally occurring or introduced to a water system as a result of human activity. It is important to know the characteristics of individual water sources in order to determine the origin of contaminants, and to determine the appropriate treatment methods.

As water moves through the hydrologic cycle (see figure below) above and below ground it may pick up contaminants. Examples of these are calcium, iron, heavy metals, nitrates, pesticides, gasoline, and radioactive materials.



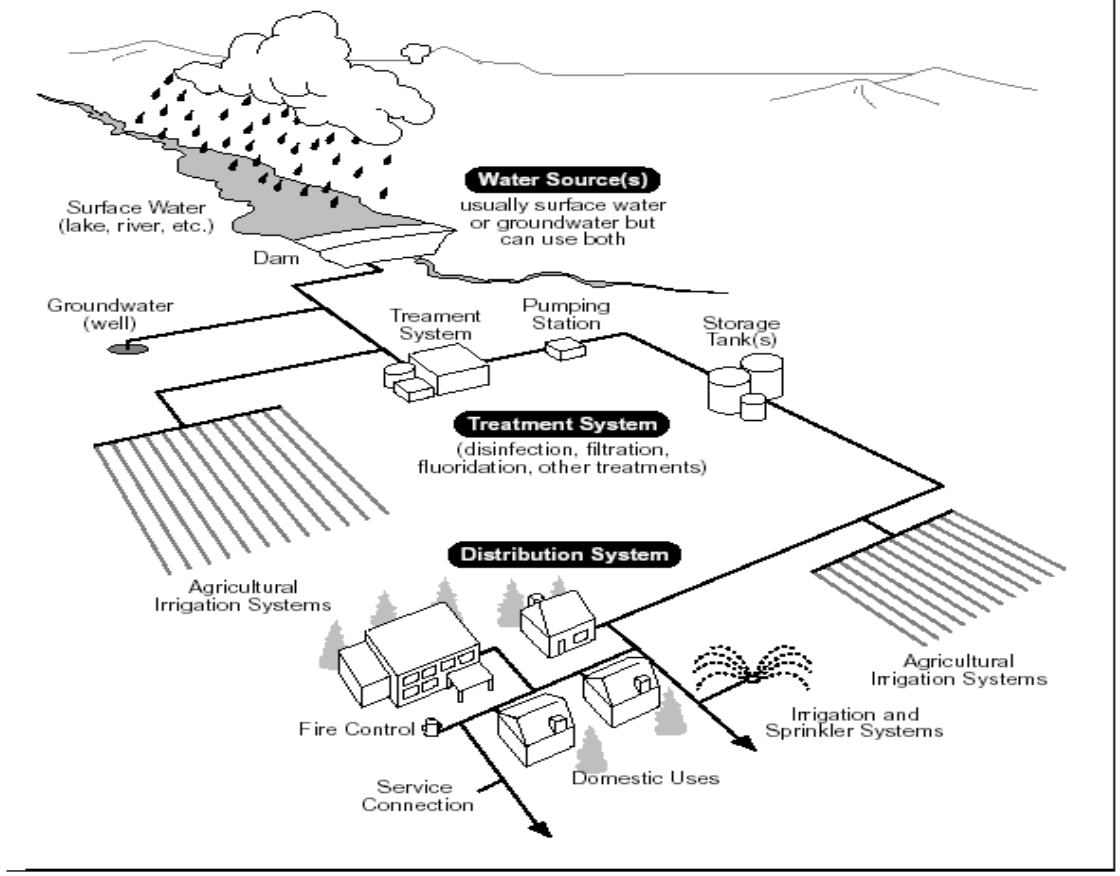
(Source: Environment Canada http://www.ec.gc.ca/water/en/nature/prop/e_cycle.htm)

Water systems provide water that is used for irrigation, fire fighting, industrial processes, and drinking water. Drinking water is water used for human consumption, food preparation, and other normal household purposes. Safe drinking water (also called

"potable" water) is water that is safe to drink and fit for domestic purposes without further treatment.

A typical water supply system includes its source, treatment plant, storage, and distribution facilities. The figure below, showing a generalized water system, is taken from *Drinking Water Quality in British Columbia: The Public Health Perspective*.

Figure 1: A Typical Water System Showing Sources, Treatment and Distribution Systems



Source: British Columbia. Auditor General of British Columbia. (1998/99). Report 5. Protecting Drinking-Water Sources. Victoria, BC: Office of the Auditor General.

http://www.bcauditor.com/PUBS/1998-99/report-5/water.pdf

After entering the system intake, water undergoes one or more types of water treatment. Filtration is a treatment method that removes fine particles and plant material that can interfere with disinfection. Filtration may also remove parasites that are not killed by disinfection. Chlorine and/or other disinfectants are added to the water, killing many of the microorganisms that cause disease.

Following treatment, water is stored and transported to customers through a distribution system that reaches homes, schools, hospitals, fire hydrants, irrigation systems, and other users through "service connections."

Contamination can occur during storage or distribution, for example, through the re-growth of microbes in the pipes, backflow of contaminants from cross-connections, back-siphonage, unprotected storage facilities, and during repairs and construction.

5.3 Source-to-Tap Assessment (Risk Assessment)

All water suppliers in BC are required to undertake a source-to-tap assessment under the Drinking Water Protection Act (2003). These assessments are completed by the water supply organization, with the assistance of the local Drinking Water Officer and others. The goal of this assessment is for the water supplier to identify hazards and vulnerabilities that may threaten the safety or sustainability of a water supply.

The first stage of this process is a survey of the system using the Drinking Water 'Source-to-Tap Screening Tool', developed by the Ministry of Health and the Ministry of Environment (formerly Water, Land and Air Protection). Once the survey is complete the regional drinking water officer (DWO) reviews the results. Based on the review, the DWO may order the water supplier to complete a Comprehensive Drinking Water Source to Tap Assessment (CDWSTA).

The comprehensive assessment tool can also be used in a voluntary capacity. Application of the process outlined in the comprehensive assessment will help water suppliers to thoroughly assess the potential hazards and risks in their system. Some small water systems may be able to complete a CDWSTA in cooperation with nearby water suppliers. This has the benefit of pooling resources and reducing costs. There also may be large stakeholders, such as conservation societies, who have an interest in contributing to this assessment process.

The CDWSTA guideline directs water suppliers to protect the safety of drinking water by identifying both the 'hazards' and 'vulnerabilities'.

1. Hazards that threaten the drinking water include agents of harm, events, conditions, actions, and inactions.
2. Vulnerabilities are considered weaknesses in the risk management plan (which should include the multi-barrier approach). Vulnerabilities include the absence of risk prevention, reduction, or mitigation strategies.

Assessment Modules

The 'Comprehensive Drinking Water Source to Tap Assessment' contains eight modules which identify the hazards and vulnerabilities of a supply system from source to tap. The eight modules are summarized as follows:

1. Delineate and characterize water sources.
2. Conduct contaminant source inventory.
3. Assess water supply elements.

4. Evaluate water system management, operation, and maintenance practices.
5. Audit finished water quality and availability.
6. Review financial capacity and governance structure of water system.
7. Characterize drinking water risks from source to tap.
8. Recommend actions to improve drinking water protection.

A draft copy for pilot assessments of the *Comprehensive Drinking Water Source to Tap Assessment* can be found on the BCWWA's website at http://www.bcwwa.org/index.php.

5.4 The Multi Barrier Approach (Risk Management)

Once potential human health risks have been identified in a water system, a management plan is developed to minimize those risks. The **multi-barrier approach** is universally recognized as the most comprehensive method of protecting drinking water quality because it places multiple barriers, or redundancies, throughout the drinking water system to prevent contaminants from reaching the public.

The multi-barrier approach is a classic **risk management strategy** because it incorporates the following characteristics:

1. The approach is systematic.
2. Distributing risk reduction resources across a number of dimensions provides significantly greater health protection benefit than would be achieved by seeking an unattainable level of safety in any one dimension;
3. There are unique risk factors in each dimension that must be assessed in order to identify the most cost-effective management options for a desired level of risk reduction.

When this approach is applied to a water system, barriers are placed at six identified points or processes: source protection, treatment, distribution systems, operator training, monitoring, and emergency response planning. Human health risks and management strategies are associated with each risk. A brief description of each level is outlined below (Network for Environmental Risk Assessment and Management, 2002).

1. **Source water protection** - Watershed management is an important component of source water protection, and should involve a coordinated approach among stakeholders to develop short- and long-term plans to prevent, minimize, or control potential sources of pollution, and to enhance water quality where necessary. Source water includes surface waters, aquifers or and ground water recharge areas. Water conservation practices will help to prevent water shortages and may improve water quality; they should be an integral part of the long-term source protection strategy.
2. **Treatment** – In order to safeguard public health, it is important that treatment systems be designed and constructed with reference to the results of source water assessments. They should be regularly reviewed and upgraded as necessary.

3. **Distribution Systems** - The distribution system is the final physical barrier in the multi-barrier approach. After water has been treated, its quality must be maintained throughout the distribution system. Diligence is required on the part of the system operator to ensure sufficient disinfection agent is present at all points in the distribution system in order to adequately protect public health.
4. **Operator Training** - Under the new *Drinking Water Protection Act*, all systems must have certified operators. This ensures that all system operators possess a minimum level of training.
5. **Monitoring** - Water quality monitoring should take place at various points in the system. Comprehensive baseline data from the water source supply will help in monitoring any trends of improving or degrading water quality. Source water data strongly influences the design of the treatment system. Once treatment is in place, regular monitoring of the source water allows plant operators to modify treatment if water quality fluctuates. Monitoring at other parts of the treatment plant will help ensure that treatment is working properly and that water leaving the plant is safe for human consumption. Compliance monitoring in the distribution system will help ensure that any problems that arise can be dealt with as quickly and efficiently as possible.
6. **Emergency Response Plan** - all water systems are vulnerable to emergencies. A plan must be in place that can guide response to emergencies, and deliver clear messages to people who need information in a timely manner.

Effective Governance, Sound Management, and Affordability

Effective governance, sound management, and affordability are the essential pillars of any chosen method of risk assessment and risk management. It is essential that a solid foundation is built if safe and reliable supplies are to be delivered.

Inadequate financial resources have been identified as a challenge faced by small water systems. Without sufficient funds, small water systems cannot obtain the technical and managerial resources their system requires.

Sound water system management involves activities in several key areas. These include: strategic planning, administration, operations, financial management, customer communications, and business planning.

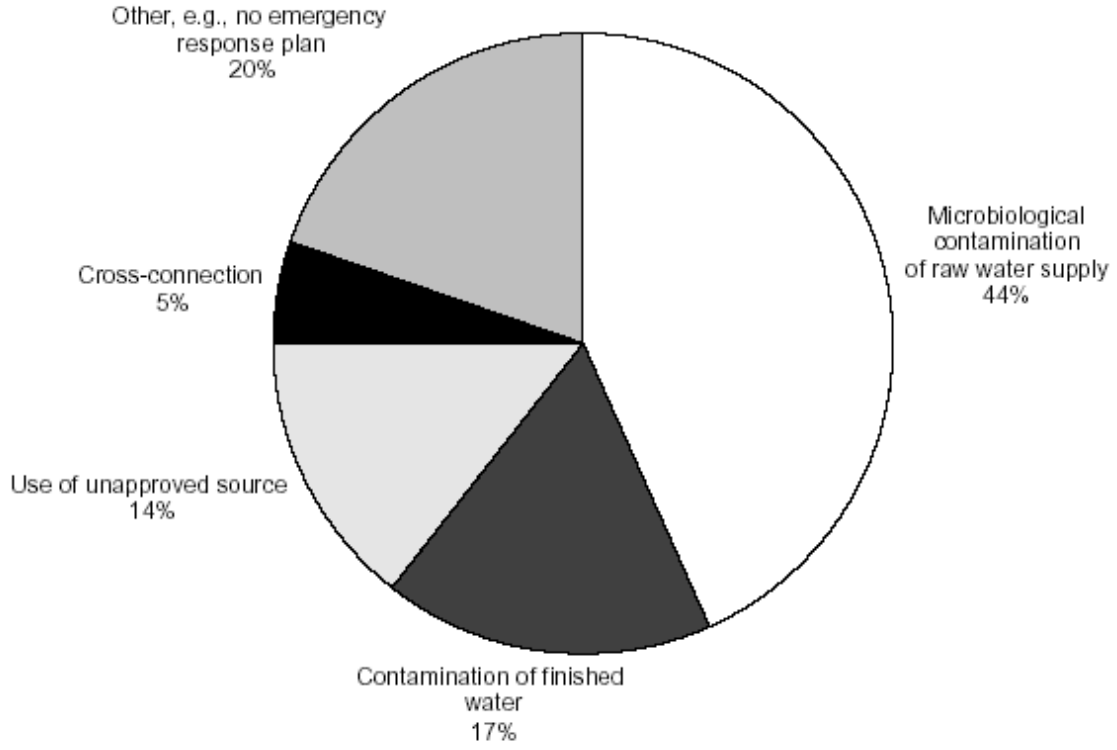
Governance refers to the range of political, social, economic and administrative systems that are in place to regulate the development and management of water resources and the provision of water services at various levels. Governance involves federal, provincial, and local governments as well as water users and stakeholders from both public and private sectors. Successful governance is more likely to occur if these groups are not working in isolation.

(Insert diagram from the BCWWA website on system assessment, see Module 1. The address is: *http://www.bcwwa.org/source-to-tap/documents/mod-1-delineate-&-characterize-source.pdf)*

5.5 Critical Hazards in BC

Risk management includes effective response to critical hazards. The Ministry of Health notes that an average of 76 critical hazards are found each year during inspections conducted by Environmental Health Officers [Ref: 2]. The following figure illustrates the type of hazards found throughout water systems in British Columbia.

Figure 9: Critical Hazards in B.C. Water Systems, Annual Average, 1989 - 1998



A critical hazard is a health hazard that requires immediate attention. On average, 76 critical hazards are found each year during inspections conducted by Environmental Health Officers. Source: Public Health Protection, B.C. Ministry of Health Services.

Source: British Columbia Provincial Health Officer. 2001. Drinking water in British Columbia: A public health perspective.

Resources

For further information on the above topics, please consult the following resources.

- The **Drinking Water Source-to-Tap Screening Tool** can be found at *http://www.healthservices.gov.bc.ca/protect/BC_Drinking_Water_Screening_Tool.pdf*
- The **Comprehensive Drinking Water Source to Tap Assessment** (CDWSTA) can be viewed at *http://www.bcwwa.org/source-to-tap/documents/introduction.pdf*
- **Small Water System Operator Training** *http://www.eocp.org/train.html*
- **Emergency Response Planning for Small Water Systems** *http://www.healthservices.gov.bc.ca/protect/pdf/PHI061.PDF*

6. Managing the Organization

Successful management of a water supply system requires an understanding of both organizational and business issues, as well as the processes and practices which can affect water quality and quantity within the system. Managers must know their system. For a water supply organization, the system means the contributing watershed or aquifer and all other elements necessary to deliver the water to the consumers tap. It may include the watershed, storage and service reservoirs, treatment and disinfection facilities, trunk and service mains, and consumer's plumbing and appliances. Water can be affected at each of these points; they are all inter-related and integrated management is essential.

> Leading and managing a small water organization involves activities in several key areas. These include: governance, strategic planning, management and administration, business planning, financial management, facilities and operations, and customer communication.

All water supply organizations should have a Business Plan in place. Among other things, this document will serve to bring together the important elements of the organization, including strategic planning, administration, finance and customer relations. Preparation of a Business Plan is outlined in one of the following sections.

6.1 Water Governance

Definitions of the term 'governance' vary depending upon the context in which it is used. However, with respect to 'water governance' it refers to how a water supply system is directed and regulated. The term brings to mind the political governance under which our water systems operate. These include the public policy framework developed by federal, provincial and local governments under which supply systems are regulated. However, water governance also includes social, economic, and administrative systems that are involved in the management and development of water resources.

Governance is a topic obtaining a great deal of attention since the tragedies of Walkerton. The Walkerton Inquiry identified clear links between governance, public health, and economic efficiency. Poor governance was a major contributing factor to the water quality problems in the Walkerton supply system.

Good Governance

Good governance is about achieving desired goals within a set of established principles. Effective water governance will require a commitment from all stakeholders including:

- government at all levels,
- water users, and
- the private sector.

This is only possible under a regulatory regime that clearly establishes roles and responsibilities of all parties involved in the process of drinking water distribution from source-to-tap. As well, achieving good governance is more likely realized when local communities fully participate in the process. This will lead to legitimizing both the stakeholders and decision-makers and the decision-making process.

There is no recipe for the process of obtaining good governance. However, there is a consensus on the 6 principles that are inherent in good governance of water supply systems.

1. Establish a clear set of principles. These principles should be tailored to reflect the needs of the community and may include such examples as public health, transparency, user participation, and sustainability.
2. Principles must be ranked according to priority. It is possible that there are times when principles conflict, therefore it is important to establish which principle will receive top priority in a conflict.
3. Create objectives and policies. These are built on established principles. For example, a principle of public participation may in turn lead to an objective of community involvement, and a policy such as access to information.
4. Responsive to change. This involves constant re-evaluation of the system to ensure satisfactory management and operation of the system.
5. A well informed governing body. Decision-makers must be equipped with sound, current information on which to base decisions upon.
6. Welcome participation of all stakeholders. This will lead to legitimizing both the stakeholders and decision-makers and the decision-making process.

6.2 Strategic Planning

A strategic plan articulates the vision for the water supply organization, and describes, through the mission statement and primary objectives, the way that vision will be realized. The preparation of the strategic plan provides the opportunity to assemble individuals responsible for the broad direction of the organization, so that consensus can be developed around important long-term goals. Typically, strategic plan preparation is preceded by an inventory of the system, and then a SWOT analysis: an exercise that identifies strengths, weaknesses, opportunities, and threats.

Strategic planning does not have to be lengthy, elaborate or expensive. Typically the main elements of a strategic plan can be identified and a written summary produced in a very short time: say one of two days. Typically the strategic plan precedes the business plan, and is incorporated into the business plan when that document is prepared. A strategic plan includes a vision and mission statement, and long term objectives.

Vision and Mission - A vision statement is an expression of the way things should be at some defined point in the future. For example, a water system

may prepare a vision statement that starts: *"In ten years, the XYZ water system will have…and provide…"* It is an expression of the desired form and function and achievements of the organization in the future. It may briefly refer to key issues such as health protection, customer service, and financial viability.

The mission statement is usually developed after the vision is articulated. It is a statement of how the water works will achieve its vision. A typical mission statement may start: *"The mission of the XYZ water system is to provide safe and reliable water to our customers by …"*

Objectives - Major objectives should reflect the vision, and expand upon and be consistent with the mission statement. Each major objective focuses on a specific aspect of the organization. It can be expressed in specific quantifiable terms, and should be phrased in a way that makes it clear in the future as to whether or not the objective has been met. For example: *"The XYZ water works will complete construction of a new storage reservoir with a capacity of 500 cubic meters by November 2005."*

In general, major objectives should be established so that each of the key results areas of the water works operation is covered by at least one of the objectives. The key results areas may be defined by reference to the QualServe program, sponsored in part by AWWA. The objectives may be expressed in terms of the QualServe indicators.

The strategic plan may also consider opportunities for strengthening the organization through initiatives such as:

Consolidation – two or more utilities combine their management and operation within a larger organization, thereby reducing costs while maintaining or enhancing water quality;

Regionalization - two or more utilities reach an agreement to meet the combined needs of their communities;

Mutual support - one utility supports another utility for services such as operator training, source water protection, engineering, or financial planning;

Joint procurement - two or more utilities make joint purchases of supplies to get volume discounts or share the cost of full-time certified operators.

6.3 Management and Administration

All water systems have management and administrative systems in place. In some cases the organization may be small and have no formal description of the systems in use. Where written descriptions are prepared they may typically cover the following:

Management Structure - Outlines organization structure and should include a chart showing key positions.

Administrative Systems - Describes the organization's administrative approach, including a brief description of functions such as customer billing, accounts receivable and payable, payroll, customer communication, and administration of regulatory requirements.

Staffing Requirements and Duties - Identifies and lists job duties necessary to operate and manage the water system. These may include: management, operation of treatment equipment, meter reading, receptionist functions, billing, operation of heavy equipment, meter installation, meter testing, water line repair, and management of spare parts inventory and supplies. A position description outlines the purpose of the position, job duties, and minimum qualifications for a person hired to fill the position.

Risk Management and Insurance - Includes, in part, the identification of risks and threats to a system, and the rating of those threats in terms of their severity and probability of occurrence. Risks and threats can then be managed through risk management plans, elements of which may involve use of a third-party insurer, or self-insurance.

Each insurance provider issuing coverage to the BC water industry has its own underwriting requirements and level of comfort with risk. Risk management and liability is an increasing concern for small water systems. Important topics to be addressed include an appropriate coverage limit for purveyors. This has risen from $1 million to $5 million over recent decades.

The Insurance Bureau of Canada (IBC) is a source of information on insurance coverage for the water industry. IBC represents 90 percent of the insurance brokers in B.C. IBC steps in where insurance coverage for particular sectors for some reason may be challenging, for example cost may be prohibitive. IBC has provided assistance with assessing risks and negotiating coverage and rates. In many cases education of insurance providers and brokers as to issues and true risks will help solve problems.

External Advisors - Refers to specialist services provided to the water system by external specialists. These typically include services such as accounting and legal services, and business and engineering advice

6.4 Preparing a Business Plan

A small water system is in the business of providing its customers with a safe and reliable supply of water. Like any other business, a small water system will be most successful if its decision-makers anticipate future changes. A business plan will help in this process. The preparation and implementation of a business plan recognizes the need to look to the future to respond effectively to potential opportunities and threats. The preparation also provides an opportunity to review management and administrative systems, and to describe them in a written form. A business plan will help the water system to build on its strengths and recognize and respond to its weaknesses.

When an investor purchases stock in a business, the investment's value is based largely on the future prospects of the business. The value of a water system to a community

should be regarded in the same manner. The community will look for assurance that the system is equipped to operate successfully in the future. Owners and customers of water systems may face the prospect of making substantial investments in the system. Therefore, they will want assurance that the plan for operating the business is complete and effective.

Many water systems in BC were created at a time when the costs of providing water service were low. Without significant external costs, and in the absence of comprehensive regulations, there was little incentive to focus on the business aspects of the operation. In recent years customer expectations, regulatory criteria, and costs have all risen significantly. This has increased the level of planning, responsibility, and preparedness required of water systems.

Products & Services

A business plan should include a description of the products and services provided. The main product provided by small water organizations is a safe and reliable water supply. Many utilities in B.C also provide other products and services, including guidelines for water conservation and water use, information on the water supply organization itself, and resources that encourage community involvement in projects such as watershed stewardship.

A business plan offers the opportunity to describe the products ands services offered. The following are examples of components that may be included in this section of the business plan.

> **Water Supply** – This section should include water supply statistics. These may include annual amounts provided in recent years, projections of demand for the next few years, and the average and peak daily flows.
>
> **Customer Information** – As more demands are placed on water suppliers, it becomes increasingly important for them to communicate with their customers. This can be done through newsletters, web sites, brochures, demonstrations, and special events.
>
> **Community Involvement** – A water supply organization is more likely to enjoy widespread community support if it is seen as an important and responsive agency, essential to the life of the community. The water supply organization may choose to play a prominent role in community events and programs, reinforcing its position and value in the community.

To summarize, an important means of demonstrating the water system will function effectively in the future is through a well-developed business plan. Further information about the preparation of business plans for small water systems is provided in the appendices.

6.5 Financial Management

Financial management is one of the critical elements in the operation of a small water system, and should be fully described in a main section of a business plan. This important section of the business plan will include a five-year expenditure plan and a cash-flow forecast. Thorough preparation of this section of the plan will help ensure a healthy financial future: one that provides revenues to cover operating costs and to meet the demands for capital expenditures covering system renewal and expansion.

Elements of financial planning for small water systems include:

Five-Year Projections – These will include revenue, operating expense, reserve, and capital improvement information. The forecasts should demonstrate that the organization has anticipated financial needs and has plans to charge rates and taxes sufficient to meet these annual revenue requirements. They should include a revenue and expenditure analysis that compares anticipated water system revenues with planned expenditures; an identification of reserve accounts for emergency funding and equipment replacement needs; and a capital improvement plan that identifies future projects and estimated costs. Worksheets are typically used to illustrate five-year financial projections. Each worksheet provides space for budget data from the prior year, current year, and four years into the future.

Financial Controls – These cover budget preparation and expenditure control procedures. They outline purchasing policies and procedures to ensure appropriate uses of funds. Generally accepted accounting and auditing procedures (GAAP) should be followed.

Rates and charges - This addresses the rates and charges made by the water system**.** Financing a small water system in B.C. is often a challenge. Revenues received are sometimes insufficient to both support operating and maintenance costs and to build a reserve fund for capital improvements. There are a variety of approaches taken by the administrators of small water systems to achieve cost recovery. Many charge a user fee based on parcel tax or a frontage tax. Some irrigation districts charge, in part, on the basis of the land area serviced.

Some fees and expenditures a small water supply system may encounter are: monthly monitoring fees, chemical contaminant monitoring fees, certified operator annual licence renewal fees, continuing education, workers compensation coverage, plan review fees for upcoming projects, engineering fees for project design or planning, equipment replacement expenditures, and debt service.

Rate structures and water pricing that provide incentive for customers to reduce their water use are appearing in utilities around the world. It has been shown that water rates and water rate structures can play an important role in water conservation. Ensuring that "conservation" rates are in effect is an important practice.

6.6 Facilities and Operations

It is good practice to prepare a Facilities Plan for the water system. This document describes the physical facilities owned or operated by the water supply organization. It should describe the technical aspects of the infrastructure and include plans for replacement and expansion. Information from this plan is used to develop the expenditure forecasts used for financial management. The Facility Plan, or a section of the Business Plan, may include the following components:

Physical Infrastructure – A summary of the main elements of the physical infrastructure. This could be in the form of engineering plans, and tables listing the main elements and providing assessment of the asset value, the replacement value and the remaining life, where available.

Asset Management – This process will help ensure that a water system will get the most value from its assets and will help the organization to develop the financial resources to rehabilitate and replace them when necessary. Asset management may include development of a plan to reduce costs while increasing the efficiency and the reliability of assets.

Operator Certification - BC regulations require a certified operator to be in place in most water systems. The plan may include a brief discussion of this issue and the way the organization satisfies this requirement.

Monitoring and Testing - The regulations also impose a requirement on water suppliers to carry out monitoring and testing activities. Requirements may vary from one health region to another. Drinking water officers can advise on the requirements in detail.

Identification of Outside Services - Problems such as line breaks and pump failures occur from time to time. Does the system have the equipment and personnel to make such repairs? The plan may include an appendix that lists the equipment and personnel available. This may include the names of outside services such plumbing contractors and well drillers who will be called to make repairs to the water system in a timely manner.

Emergency Response - The Drinking Water Regulation also requires all small water systems to have an emergency response plan. This should cover situations including those that present a threat to the health of people drawing water from the system.

6.7 Customer Communication

Good communication with customers and stakeholders, and a high level of public involvement, will help to maximize cooperation. Customers who are well informed will be more likely to support important initiatives and decisions.

Most water systems have a captive customer base. Customers cannot readily go elsewhere to obtain water. This does not mean however that customer service is unimportant. For example, many water suppliers in BC are faced with the need for significant increase in the rates and taxes charged to customers. Good customer service leads to better customer relations. In turn this means that customers are more likely to respond positively changes such as increases in water rates.

It is important to communicate frequently with customers and maintain a high level of customer satisfaction. A typical business will only hear directly from a handful of dissatisfied customers; however a typical dissatisfied customer will tell an average of 8 to 10 people about the poor service received.

A typical BC small water system will benefit from a clear communications plan that enables it to maintain regular contact with customers, and to provide them with a range of current and helpful information. This information may be provided in several forms, including newsletters, web site resources, and access to demonstration projects.

Important Topics to Communicate to Customers

Communicating elements of the emergency response plan and results of water quality monitoring are essential to the protection of public health. Communication of information about these topics is also mandatory under the *Drinking Water Protection Act*.

Good stewardship of the resource will be fostered if there is a high level of public involvement. Again, customers who are well informed will be more likely to support important initiatives. A high level of community awareness will improve the effectiveness of the multi-barrier approach, and ultimately safe and reliable drinking water. For example:

- **Source Protection** –Communications among local government and stewardship groups have been key elements of many funding opportunities made available to stewardship societies to improve protection of a community water supply. As an example, the British Columbia Lake Stewardship Society (BCLSS) was formed out of the interest of many concerned volunteer groups that requested support and information from the BC Ministry of Environment, Lands and Parks. The objective was to preserve the water quality of lakes throughout British Columbia.
- **Reporting** - The public should also understand their role in responsible stewardship. For example, they should know how to report illegal dumping or accidental spills that may contaminate drinking water.
- **Treatment** – The type of treatment that a community has available or can afford can often be a source of conflict in many small communities. Effective communication between stakeholders is essential if resolutions are to be found.
- **System Distribution and Maintenance** – Keeping customers and the general public informed about distribution and maintenance will avoid problems and upset customers. Road closures and interruptions of service can be tolerated if individuals are notified and can plan for the inconvenience.

Communication to Support Rate Adjustments

Good customer service leads to better customer relations. In turn this means that customers are more likely to respond positively changes such as increases in water rates.

Many small water systems in BC face increased costs due to:

- Need to comply with new provincial regulations,
- Need to maintain and renew infrastructure,
- Need to operate on a sound business footing.

In the next few years, rate adjustments in many BC water systems will be required. BC is not alone in facing this situation. There is a growing recognition throughout North America that the condition of vital water infrastructure needs serious attention in many locations. The pipes, pumps, reservoirs and treatment facilities that deliver potable water are central to maintenance of the quality of life, the protection of public health and safety, and to continuation of a thriving economy. The burden of paying for construction, operation and maintenance of these facilities falls mainly on customers of the systems. These costs are rising—dramatically in some areas.

The preparation of materials to support rate adjustments should reflect local circumstances. Just as "all politics is local," so are all rate adjustment programs. Paying attention to local circumstances and thinking through the development and delivery of appropriate messages is a vital element of the communications plan.

A communications plan to support rate adjustments should include the following elements:

1. Develop a consistent and structured communications outreach program to build the credibility necessary to support the customer-utility relationship
2. Implement the structured communications program for long-term results; do not allow it to be sidetracked by short-term needs.
3. Build understanding of the way billing practices and rate structure options can affect customer reactions and acceptance of rate increases
4. Undertake regular systematic communications with customers to encourage an appreciation of the true value of water and the need for rate adjustments.

Resources

For further information on the above topics, please consult the following resources.

- British Columbia Lake Stewardship Society (BCLSS) *http://www.bclss.org/*
- Bakker, K. 2003. *Good Governance in Restructuring Water Supply: A Handbook.* Federation of Canadian Municipalities, Ottawa, ON.

http://www.geog.ubc.ca/~bakker/Good_Governance_handbook.pdf

7. Water Conservation

Fast Read

- *Canadians are second only to Americans as the highest per capita water consumers in the world. British Columbians use more per capita than any other province.*
- *If water suppliers are to ensure 'reliable' supplies, they must put in place a water conservation program. Increased demands, arid ecosystems, water quality deterioration, and climate change all threaten supplies, especially in rural BC.*
- *The five elements of a water conservation plan are:*
    - *Specify Conservation Goals*
    - *Develop a system profile*
    - *Prepare a Demand Forecast*
    - *Choose Appropriate Conservation Measures*
    - *Implement the Conservation Plan*

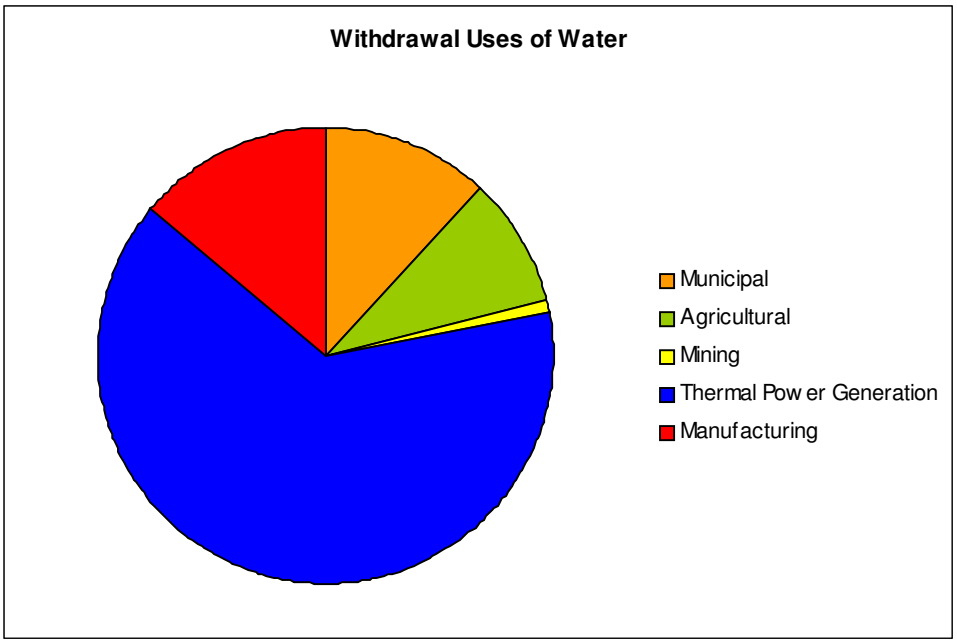
7.1 Water Consumption in BC

Canadians are second only to Americans as the highest per capita water consumers in the world. British Columbians use more per capita than any other province. The population of British Columbia continues to grow, and the province continues to develop. This places increasing pressures on water resource. The water demands per capita have also increased: during the period 1972-1996, the rate of water withdrawal in Canada increased by almost 90% but the population increased by only 33.6 percent.
http://atlas.gc.ca/site/english/maps/freshwater/consumption/domestic

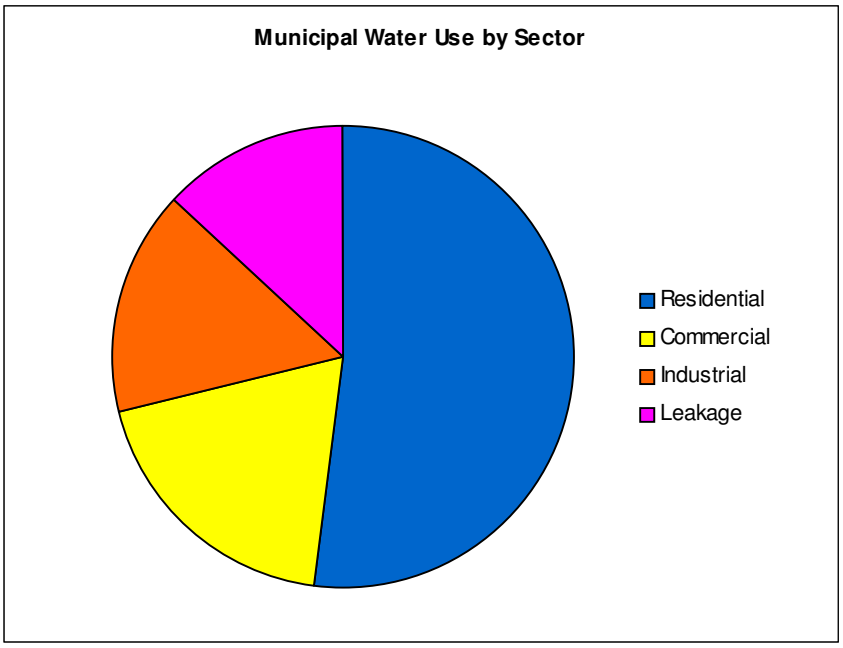
Water usage can be classified into 'in stream' and 'withdrawal' uses. Hydroelectric power generation, transportation, fisheries, wildlife, and waste disposal are examples of in stream use because the water remains in the stream. Withdrawal uses include thermal power generation, mineral extraction, irrigation, manufacturing and municipal use. Water is removed from its source in these instances.

The figure below indicates the five main withdrawal uses are for thermal power generation, manufacturing, municipalities, agriculture, and mining.

(These figures should be reduced in size and the colour choices modified)



In the municipal sector, more than half of the water demand is from residential usage.



7.2 The Need for Water Conservation in BC

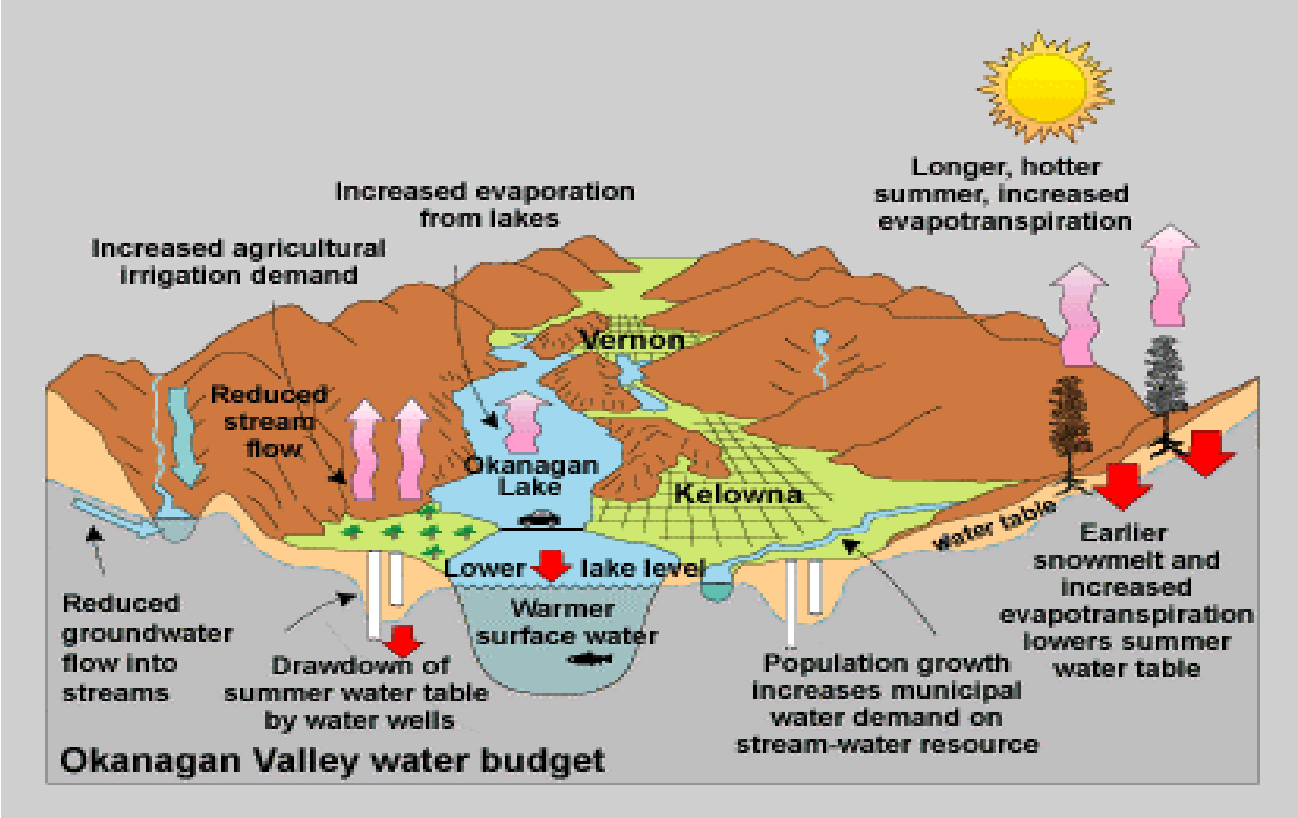
In British Columbia a combination of growing populations, infrastructure development, climate change and rising consumption per capita are straining available water resources in many areas of the province. If water suppliers are to ensure 'reliable' supplies, they must put in place a water conservation program for the reasons discussed below.

Increased Demands - If demand for water exceeds supply a water shortage will develop. Excessive demands can occur as a result of a "thirsty" lifestyle or from an increase in population served by a water system. In rural BC, where ground water accounts for about 40 percent of supply source, withdrawals can lower water tables. During the hot dry summers, the levels may stay low for some time. Compounding this problem are aging water systems that often experience significant leakage, and are in need of upgrading to increase efficiency.

Arid Ecosystems - British Columbia has a diverse range of ecosystems, from the temperate rainforest of the coast to the arid valleys of the southern interior. The dry climate regime includes the Thompson Plateau, the Clear Range, the Okanagan Range, and the western side of the Okanagan and Shuswap highlands. The winters are cold and the summers are hot and dry.

Water Quality Deterioration - Excessive water usage may lead to water quality deterioration; the quantity of water available may also affect the quality. For example less water means there is a lower capacity to dilute and assimilate contaminants. Overuse of water in itself is a hazard that can threaten the quality and sustainability of a water supply source.

Climate Change - Over the past decade, the Earth's mean global temperature has increased by 0.6 $\pm$ 0.2 degrees Celsius. Climate change has already been observed in many parts of British Columbia including the Okanagan Basin. It is predicted that less precipitation will fall as snow, and less water will be stored in the mountains over the winter. Evapotranspiration will increase during the longer and hotter summers.



7.3 Elements of a Conservation Plan

Briefly, developing a water conservation plan for a small water system contains the following five steps.

Step 1: Specify Conservation Goals

The goal of a water conservation plan is to ensure that water withdrawal occurs at a rate that can be sustained by the system and the local environment. The goals set by any system should be specific. For example, some communities choose to reduce consumption by a certain percentage of the current usage.

Step 2: Develop a system profile

The purpose of this step is to assess factors that will influence a conservation plan. It is an overview of the current characteristics of the water supply system. Examples of factors that will affect the plan include: water availability, climate conditions, and age of the infrastructure.

Step 3: Prepare a Demand Forecast

Preparing a demand forecast can be a simple or complex model. For example, it may be based on the anticipated population growth for a community. Alternatively, it may be

complex and include factors such as population growth, climate change, possible water quality deterioration, and downsizing capital projects. Demand forecasts are usually specified for a specific time period.

Step 4: Choose Appropriate Conservation Measures

Conservation measures and incentives will be unique for different communities. An effective combination of measures and incentives will depend upon the current water use patterns observed in a community.

The BC Ministry of Environment has developed a Water Use Efficiency Catalogue for British Columbia (*http://wlapwww.gov.bc.ca/wat/wtr_use_eff_cat_bc/intro.html*). This website contains examples of a variety of tools communities can employ in developing their conservation plan. Briefly, some examples are:

- Legal (bylaws),
- Financial (rebates for water efficient appliances),
- Operational (metering),
- Educational (informing customers about the need for conservation).

Step 5: Implement the Conservation Plan

The final, yet continuous step is to implement the plan using the stated strategies and within an acceptable timetable. The process of conservation planning and implementation requires an ongoing effort on the part of water utility managers.

Resources

For further information on the above topics, please consult the following resources.

- Water Consumption in Canada **http://atlas.gc.ca/site/english/maps/freshwater/consumption/domestic**
- **The BC Ministry of Environment has developed a** Water Use Efficiency Catalogue for British Columbia (***http://wlapwww.gov.bc.ca/wat/wtr_use_eff_cat_bc/intro.html***).
- Ontario Water Works Association (OWWA). 1999. *Water Efficiency: A Guidebook for Small and Medium-sized Municipalities in Canada.*
- ***US Environmental Protection Agency. 2005. PART. Basic Guidelines for Preparing Water Conservation Plans*** *http://www.epa.gov/owm/water-efficiency/wave0319/basic1.htm*

Appendix 1. Resources & Tools for Small Water Systems

There is a growing set of tools and resources available to small water supply organizations in BC. Many organizations in British Columbia exist to support water suppliers and to promote the interests of the BC water industry. Other resources include a range of web sites and publications with valuable information for use by small water suppliers. This section of the Introduction outlines some of these tools and resources.

A.1 Water Related Organizations

Resources are available to small water systems through a variety of organizations, many of which are outlined below.

BC Water and Waste Association

The British Columbia Water and Waste Association (BCWWA), a non-profit association with 3,500 members, is a spokesperson for the water and wastewater industry in B.C. Its mandate is to promote understanding of water and wastewater issues and to encourage all industry members to upgrade their skill levels and training on an ongoing and regular basis.

BCWWA offers a variety of training programs, including seminars, conferences, and courses leading to certification for water system operators. It sponsors Safe Drinking Water Week and has 16 industry committees that work on issues such as drinking water quality, cross-connection control, water use efficiency, operator education, and youth education. BCWWA is affiliated with the American Water Works Association. BCWWA has a wide range of Best Management Practice documents available online at *http://www.bcwwa.org/bmp/index.php*

British Columbia Ground Water Association (BCGWA)

The BCGWA provides "professional and technical leadership in the advancement of the ground water industry and in the protection, the promotion, and the responsible development and use of ground water resources.
www.bcgwa.org.

Environmental Operators Certification Program (EOCP)

EOCP is an independent body managed by an elected board of directors. It has as its objective "to protect human health, the environment, and the investment in facilities through increased knowledge, skill and proficiency of the members of the Program in all matters relating to water treatment and distribution and wastewater collection, treatment, and disposal". The roles and responsibilities of EOCP include classification of water and wastewater treatment systems, providing a certification system, maintaining a database of currently members, communicating with facilities, operators, and regulators. In

partnership with the Ministry of Health and the BC Water and Waste Association, EOCP had developed a curriculum to train and certify water system operators.

Under the new Drinking Water Protection Regulation, all water supply systems are required to be classified by the Environmental Operator's Certification Program (EOCP) so that respective operators can be certified accordingly. In 2000, EOCP created a new category of facility classification called 'small water system'. The organization now offers training and technical assistance to operators responsible for small water systems.
Eocp.org

Water Supply Association of BC

The role of the Water Supply Association of BC is to represent the interests of British Columbia's public, domestic and irrigation water suppliers and their customers.

WSABC has the following four objectives:

1. To foster the interest and promote the welfare of its members in the irrigation and domestic water supply industry.
2. To act as a centre for accumulating and dispatching information to and for its members.
3. To work for and promote the development, conservation and proper utilization of the water resources in British Columbia.
4. To promote the adoption of Federal, Provincial or Municipal legislation that advances the objects of the Association and to oppose legislation that is detrimental to the objects of the Association.
   Water Supply Association of BC. March 2005. www.wsabc.com

Council of Public Engineers

The Public Health Engineers Council is a non-profit society registered in BC and comprises of the Public Health Engineers working for the province. Public health engineers, who are licensed professional engineers, have legislated authority under the Safe Drinking Water Regulation. There are seven public health engineers in the province. They issue permits for construction, alteration, or extension of water systems, provided the applicant has submitted appropriate plans and water quality analysis for the water source. The public health engineers also inspect existing water systems to assess risks and identify deficiencies, and, working with the local environmental health officers, to follow up any problem to find solutions or take appropriate actions. The medical health officers, environmental health officers, and public health engineers are together responsible for ensuring public health protection at all public and community water systems from intake to tap.

The Council of Public Health Engineers of B.C. has developed a practice guideline to assist consulting engineers to know the requirements for approval of a water treatment system in British Columbia. Web site not yet available.

BC Centre for Disease Control (BCCDC)

BCCDC is an independent body, closely associated with the Ministry of Health. The Centre is responsible for the prevention, detection and control of communicable diseases

in British Columbia. Many government polices are based on the science provided by BCCDC.

On behalf of the Provincial Health Officer, the BCCDC leads the surveillance for waterborne disease in the province. BCCDC Epidemiologists assist the local health officials with investigations when a disease outbreak occurs. The investigations determine the source and extent of the outbreak and determine its origin and how to contain its spread. The BC Centre for Disease Control has taken a leadership role in the study of waterborne parasitic outbreaks in British Columbia.

Federal Government: InfraGuide

InfraGuide is a network of individuals who share their experience and knowledge of municipal infrastructure. This sharing brings about the development of best practices management. It was created in 2001 when Infrastructure Canada, the Federation of Canadian Municipalities and the National Research Council came together with the Canadian Public Works Association to help solve the growing infrastructure deficit in Canada.

They have produced a series of publications for use by water systems:

- **InfraGuide for Potable Water** - Technical solutions to the challenges municipalities commonly face with potable water. They include best practices for inspecting distribution systems, protecting water quality in those systems, and choosing the right technology to repair or replace portions of them. InfraGuide documents are found online at: *http://www.infraguide.ca/*

A.2 Publications for Small Water Systems

Provincial Government – Ministry of Health

The Ministry of Health currently has the following publications available on their website related to safe drinking water at:
http://www.healthservices.gov.bc.ca/protect/publications.html

1. **Well Protection Toolkit** - The toolkit is a set of guidelines which outline a six-step approach to developing a well water protection plan for water purveyors, communities and local governments. It also contains information about how the general public can take responsibility for well water protection. The guidelines are published in seven booklets.
2. **Safe Water Supply Vital to Your Health** - This information booklet was developed for individual and small water systems. It is intended to assist with designing, building, and upgrading water systems which do not currently meet provincial standards. In addition, it provides information about maintaining good water quality and protecting sources from contamination.
3. **Emergency Response Planning for Small Water Systems** - The *Drinking Water Protection Act* requires all purveyors of small water systems to have an emergency response plan in case of a threat to public health. This handbook will assist operators of small waterworks systems to develop their own emergency response plan to help protect water system users in the event of an emergency.
4. **Construction and Maintenance of Private Wells** - This pamphlet is intended to provide homeowners with guidelines for constructing and maintaining a private well.

United States – Environmental Protection Agency

Small Systems Information and Guidance. The USEPA has developed a centralized web site to provide information to small water suppliers. It has information on topics such as capacity development, rate setting, and conservation planning to name a few.
http://www.epa.gov/safewater/smallsys.html.

A.3 Other Useful Websites

Waterbucket.ca

A new web-based resource that will give local governments and water suppliers throughout B.C. information on water conservation and sustainability. The WaterBucket is a proactive and interactive online community that brings together, local governments, water utilities, water suppliers and managers.

GreenBC.Org

GreenBC.Org provides access to resources for the planning, design, construction and operation of sustainable infrastructure and sustainable communities. It currently focuses on resources for small water systems. GreenBC.Org includes an “Events” page which provides information on events of interest to small water supply organizations. Over time

this site will cover resources for water supply, wastewater management, transportation, land management, renewable energy, and green homes and communities.

Sustainable Infrastructure Society

The Sustainable Infrastructure Society was incorporated in 2005 as a non-profit society in British Columbia. It was established with support from the BC Ministry of Health. Its office is on the campus of the University of Victoria in Victoria, British Columbia.

The mandate of the Sustainable Infrastructure Society is:

> To assist in the development and application of tools and resources for building the managerial, financial, and operational capacity of water suppliers and other infrastructure organizations in British Columbia.

The Sustainable Infrastructure Society has links to other organizations concerned with water supply and resources. It works closely with the Cooperative Committee of Water Associations (CCWA).

Note: The web site for SIS is under development at the time of publication, therefore please e-Email: AdminSIS@GreenBC.Org for more information.

Appendix 2: Guidelines for Canadian Drinking Water Quality

The following information is related to the Guidelines for Canadian Drinking Water. The guidelines are available online at: http://www.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/toc.htm

Categories of Water Contaminants

- **Microbiological Contaminants** - Health-Based Microbiological Contaminants are any living organisms such as viruses, bacteria and protozoa that at certain levels can cause disease through drinking water. Coliforms and the general bacteria population are not considered harmful but may indicate the presence of disease-causing microorganisms.
- **Health-Based Chemical/Physical Contaminants** - Health-Based Chemical/Physical Contaminants are inorganic or organic contaminants that enter the water from leaching minerals, pollution of raw water with pesticides or industrial-type chemicals or a compound formed during the water treatment process.
- **Radionuclides** - Radionuclides or radiological contaminants are unstable atoms that emit radiation and are demonstrated as harmful to humans.
- **Aesthetic Chemical / Physical Contaminants** - are inorganic or organic contaminants that enter the water from leaching minerals or from pollution of raw water with industrial-type chemicals. Aesthetic contaminants may not be harmful to human health, but can affect the acceptance of the drinking water by consumers by affecting taste, odour or colour.

Microbiological Contaminants

In BC, the majority of drinking water related illnesses have been caused by a small number of microbiological pathogens. Since 1980 there have been 29 confirmed waterborne disease outbreaks caused by microorganisms. Illnesses are caused by drinking water contaminated with bacteria (Salmonella, Campylobacter), viruses, or small parasites (Cryptosporidia, Giardia, and Toxoplasma). Contamination often occurs where public and private systems obtain their drinking water supply from surface waters (creeks, rivers, and lakes). Infected animals or people can contaminate these sources. Infected animals may be livestock, poultry, domestic pets, or wildlife such as beaver, deer or rodents that defecate in or near surface water bodies.

The symptoms experienced by people infected with common water-borne diseases vary with their health condition. Many people will have no symptoms at all and may not know they have been infected. In contrast, persons with suppressed immune systems (e.g. persons who have had a bone marrow or organ transplant, cancer treatment, or have

HIV/AIDS) are at greater risk. Also of greater risk are the elderly, very young, and pregnant women.

Chemical Contaminants

Many chemical substances are essential in maintaining human health, while others pose a threat to health. Elements important to human health include calcium, chromium, cobalt, copper, fluorine, iodine, iron, magnesium, manganese, molybdenum, nickel, phosphorus, potassium, selenium, silicon, sodium, strontium, sulphur, tin, vanadium and zinc (Ref: Kirschmann, J.D. and Dunne, L.J., 1984. Nutrition Almanac 2nd Edition (New York: McGraw-Hill). In contrast, aluminium, cadmium, lead and mercury are toxic, but in widely varying concentrations. Some substances, such as Arsenic, may be essential trace chemicals at low concentrations, and harmful when ingested at higher doses (Frost, 1984).

Radionuclide Contaminants

Radionuclides are atoms that emit ionizing radiation. Like heavy metals, they can be naturally occurring or human-made. Increased attention has been given to these contaminants since medical and biological research discovered that radiation exposure due to the ingestion of radionuclides could be harmful to human health (Wisser, S. 2004). Background radiation is ever present at very low levels, and each day people are exposed to radioactivity in air, soil, and food. In BC there are no large concentrations of industries that use, create, or dispose of radioactive products. However there are regions of the province that have naturally occurring radionuclides due to rock and soil formation and ore deposits. Ground water tends to have higher concentrations of radionuclides due to their contact with rock and soil (British Columbia. Provincial Health Officer. 2001).

Physical Contaminants

Naturally occurring physical contaminants in source water may need to be removed or reduced before the water is supplied to consumers. The make-up of source water also has effects on the biological and chemical treatment processes that may be included in a water system. Physical contaminants in water may make the water unacceptable for drinking, or create, taste, odour, or colour problems.

Changes in pH may have effects. For example a decrease in pH can increase the toxicity of some pollutants including metals and ammonia. Turbidity is a measure of the concentration of suspended matter, which may consist of clay, silt, and fine particles of organic and inorganic matter. High levels of organic matter cause problems that may affect the performance of water treatment systems and may compromise disinfection processes. Physical parameters, which are often monitored, include: temperature, salinity, turbidity, conductivity, pH, dissolved oxygen, and colour (Agriculture and Agri-Food Canada, 2005).

http://www.hc-sc.gc.ca/hecs-sesc/water/water_quality.htm