Introduction

Water is a very important and necessary natural resource that all living things require. The fluids and food we consume provides us with the three litres of water our bodies require each day. Besides drinking water, Albertans use an average of 300 litres everyday. This water is used for bathing, washing dishes and clothes, toilet flushing and lawn watering. Even more water is used per person if we include all the water required to manufacture the many products we purchase.

In Canada, we have vast water supplies that were once the lifeline of early Canadians. Much of our history is based on the ways in which we used this natural resource. Today, these same lakes and rivers are being used in many other ways. Some of these activities have stressed the natural cleansing abilities of these ecosystems to the point where there have been dramatic changes in the quality of water. The Great Lakes for example, have lost several different types of fish populations, the result of the 360 different chemicals which have been identified in these waters. Even so, our water systems have a remarkable ability to recover and through positive action by Government, industry and individual citizens, a concerted effort can reverse much of the environmental damage.

For most Canadians access to good quality drinking water is not a problem and is often taken for granted. This is not the case in many other parts of the world. Each day 30,000 deaths are attributed to contaminated water supplies. Many of these deaths are children under the age of five. This poor water quality is often the result of inadequate sanitation where drinking water supplies are not separate from other human activities.

The answer to what makes good water quality depends on a very important question: You have to ask "What is this water going to be used for?" Someone working in a science laboratory would probably say that good quality water must be pure. But, would that same person want to drink a glass of pure water? Not likely, because pure water has no taste, it's boring. High quality drinking water

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has dissolved gases and minerals that add to the flavor of the water as well as providing us with some of the important minerals that we need to survive. A fish living in an Alberta lake would not enjoy living in pure water, or even tap water. To the fish, high quality water would be a different matter completely with tiny organisms floating in it, a bit of algae, and other characteristics that make the water an important part of a healthy ecosystem. Yet, you probably wouldn't want to drink it! Water quality really is a matter of perspective.

Characteristics of water quality

In the past there were substances in water which scientists only suspected were present but could not be detected or measured. This was usually because their instruments or techniques were not sensitive enough. Today many substances can be identified and measured and there are many labs in Alberta that analyze water samples. As technology improves, measuring and identifying what is in the water becomes more precise.

Knowing how much of a substance is actually suspended or dissolved in the water is important for making inferences about water quality. The most common way to describe how much of a substance is present in a water sample is to use a simple ratio. The term parts per million (ppm) is used to describe how many milligrams of a substance there are in one litre (one million milligrams) of water. Parts per million can also be described as milligrams per litre (mg/l). Scientists can now detect some substances in concentrations as low as 1 part per billion! To compare, using the concept of time as an analogy, 1 ppm would be the same as one second every 12.5 years. 1 ppb is one second every 32 years! As our instruments become more sophisticated, we are able to detect substances even at very low concentrations. Years ago, these substances may have been in the water but were undetected because of their low concentrations.

Water quality features can be placed into one of three categories: physical, biological or chemical. When scientists describe a sample of water, they take into account all three of these characteristics.

Physical Characteristics

The physical characteristics of water are perhaps the oldest set of factors that people have used to assess water quality. For the most part, these features can be crudely evaluated simply by using our five senses, although special instruments are used to accurately measure them. The five most commonly considered physical characteristics are temperature, taste, colour, odour and turbidity.

Biological Characteristics

The biological characteristics of a water body refer to a variety of living organisms that can be found in water. These include microscopic viruses, bacteria and protozoans; as well as phytoplankton (microscopic algae), zooplankton (tiny water animals), insects, worms, large plants and fish. Of significance to humans is that disease-causing viruses and bacteria can be present and transported in water. Many of these pathogens can enter the water system in sewage (human and

animal waste). Scientists have devised a method of determining if water has been contaminated with sewage by identifying and measuring certain bacteria called fecal coliforms. These bacteria are known to live in the intestines of mammals. Although not dangerous in themselves, the presence of fecal coliforms in water indicates that sewage is present and that other disease causing organisms may also be in the water.

Chemical Characteristics

The chemical characteristics of water are numerous. Every substance that dissolves in water can be called a chemical water quality characteristic. This would include gases (like oxygen and carbon dioxide), salts, substances that stimulate plant growth (such as nitrates and phosphorus) and other naturally occurring and man-made substances. Some naturally occurring chemicals such as iron and manganese which are often present in groundwater, can be responsible for staining clothes and plumbing fixtures. Other chemicals, such as Dioxins and Furans are tested in specific sites where their presence is known to occur. There are hundreds of other chemicals that might be tested or monitored, but only a few are done routinely because of the cost and effort involved in such testing.

The amount of dissolved oxygen (DO) available in water is a very important factor in determining the types of organisms that can survive. Trout for example, can not survive if the dissolved oxygen concentrations are less than 5.5 mg\l. Dissolved oxygen is one of the most standard water chemistry tests. Other common tests include determining pH and phosphorous values.

Human Health Concerns

A booklet produced by Health Canada entitled Guidelines for Canadian Drinking Water Quality provides information on what determines good quality water for human consumption. This booklet provides maximum acceptable concentrations for many substances that could appear in drinking water. A great deal of energy and expense is involved in treating water to insure that these substances are kept within specific guidelines.

Drinking water taken from surface waters in Alberta must be at least filtered and disinfected to provide protection from fluctuations in water quality. In addition, water may undergo additional treatment as it is required.

Once we have taken the water into our homes, it is just as important to insure that this wastewater is treated before being returned to its source. In Alberta, no municipality or industry is allowed to discharge untreated waste water into a river or lake. The water must be treated to remove harmful substances. Waste water that cannot be treated economically is allowed to be injected into deep wells so that it does not pollute surface or ground water.

Household sewage is treated in one of three ways - at a sewage plant, in a sewage lagoon, or in a septic field. In all cases the sewage is held in tanks or ponds while bacteria and other micro-organisms break down the wastes. This is called biological treatment. In some cases, chemicals are added to remove phosphorus or

kill microorganisms. Chemicals are sometimes added to remove phosphorus or kill (disinfect) micro-organisms. Industrial wastes are treated in a similar manner. Industries which produce waste water either treat it themselves or pay municipalities for treating the waste water.

The purpose of this treatment is to return clean water back to the rivers and lakes. Proper treatment ensures that few harmful substances are put back into the water. In some cases, the treated water is recycled by the industry using the water or it can be used to irrigate golf courses or maintain natural wetlands.

In most instances, the treated water that returns to the lake or river still contains some pollutants. These mix with the water and disperse. At these diluted concentrations, natural processes can usually eliminate the pollutants. The amount of pollutant that can safely be put into a river is called assimilation capacity. Things that can affect assimilation capacity are amount of water flow, water temperature, amount of ice, weather conditions and the type and amount of biological activity occurring.

There are many laws and regulations to control the amount and kind of substances that are permitted in our waters. Every sewage plant and every industry which discharges waste water is licensed by the government. These licenses contain detailed standards for the quality of the effluent**.** Every plant must measure the quality of their effluent and report it to the government. If the effluent standards are not met, the government and the industry or municipality work together to solve the problem. The government regularly monitors sixty chemicals in Alberta's rivers. When one of these chemicals exceeds limits, investigators look for the source and take action to stop further pollution.

Effects On Living Things

As humans, we often forget that we are sharing this natural resource with many other organisms. Many of our activities can change the quality of the water in a way that affects the health and behavior of other organisms. The addition of pollutants to a river or lake tends to reduce the amount of oxygen available to organisms in the water. There are at least two reasons why this occurs. Effluents containing organic waste are broken down by bacteria which require the use of oxygen. Secondly, some of the compounds within the waste may change chemically if oxygen is present in the water. As this process, known as oxidation occurs, the dissolved oxygen concentration in the water decreases.

One way of determining water quality is to sample the types of organisms that are living in a specific area. As water quality changes, the types of organisms that live there will also change. Organisms that can tolerate lower quality water will be more evident as the intolerant organisms die off or move away.

What Causes Water Quality To Change?

Water quality changes can be the result of naturally occurring events or as a result of human activity. When water vapour in the air condenses to form rain, it may pick up tiny air-borne impurities that become part of the rain drop. As rainwater

seeps through rocks or soil, it may dissolve minerals or other water soluble substances that give the water some of its chemical characteristics. Flowing water picks up many objects and carries sediments. Water quality also changes with the seasons as temperature, volume of flow, turbidity and biological activity respond to the seasonal differences.

Apart from the natural changes, Humans are responsible for a great many changes to the quality of water. These changes can be a result of industrial, agricultural, municipal or recreational activities.

Water Pollution

Water pollution occurs when the quality of the water is altered in a way that affects either the organisms living in the water or the suitability of the water for uses such as swimming, stock watering, and drinking.

Organic pollutants are usually produced by biological activity, especially during the decay of once-living materials. Sources include runoff from barnyards and dumps, improper disposal of human wastes, and dead plants and animals. Other sources include gasoline and oil from automobiles and trucks. A new class of organic pollutants has been manufactured by man. Man-made organic compounds that do not occur naturally are another source of organic pollutants. The insecticide, DDT is one of these. Because DDT is not easily broken down by natural processes, it lasts for a long time in the environment.

Inorganic pollutants are the minerals and salts dissolved in water and the silt suspended in water as a direct result of the actions of man. Many of these substances are found naturally in water. The actions of man can increase the amounts to where it is not possible to drink the water safely. Sources include fertilizer runoff from farm fields, sand and salt from our roads, erosion from fields and banks, ore mining, burning fossil fuels and industrial wastes. Metals like mercury, lead, arsenic and cadmium are also inorganic pollutants. They can create serious health problems at very low concentrations. Sources include industrial wastes, improper disposal of car and truck batteries, and household products like nickel-cadmium batteries and small watch and transistor batteries.

Biological pollutants are the bacteria, viruses, protozoans and worms which are carried by water from one host to another. Algae can also be a biological pollutant when they occur in large numbers. Some of these pollutants can cause diseases in humans and animals. “Beaver Fever” or Giardiasis is a well-known disease. Although it is called Beaver Fever, it is really a human disease caused by a single-celled parasite which lives in the intestines of humans and many other animals. When the parasites reproduce, they form cysts which pass out of the intestines with wastes. These cysts can live for two months in water. If you drink water contaminated with these cysts, you can become ill. The giardiasis parasite is removed from our water by the filters in the water treatment plant. The disease is mainly a problem in wilderness areas where people tend to assume that untreated water is safe to drink or in communities that do not have effective filtration

systems. Sources of biological pollution include treated and untreated human sewage, organic pollution, and animal waste.

What Can You Do?

In Alberta, fresh water is inexpensive and plentiful. Most people use and dispose of far more water than they need. There are things that individuals can do to cut down on the amount of sewage water they produce and still have the comforts of modern life.

Don't Waste Water

- Showers use less water than baths.
- Repair leaky taps.
- Keep cold water in the fridge so you don't have to run the water until it's cold.

Use your Garbage Pail

- Food scraps should be thrown into the garbage or onto the compost heap.
- Fats and oils gum up the sewage system. Use the garbage.
- The sewage treatment plant cannot handle solid wastes (things that should go to a landfill site). The only thing that should go into your toilet is human waste and tissue paper.

Watch What you Throw Down the Sink

- An important source of heavy metal contamination is household products. Zinc in shampoos and ointments and lead in some paints are two sources.
- Don't throw solvents, paints, or oil based compounds down the sink.
- Pesticides and herbicides can kill bacteria in the sewage treatment plant. These materials should be disposed of through your local toxic round-up program.
- Use biodegradable detergents.

Every person has a role to play and a responsibility toward maintaining water quality. Your small contributions can add up to a great deal. Think of how much fun you can have fishing, swimming, boating, or camping near a lake or river. Water is important. We need it to live.

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