Business Council *of* British Columbia

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Water – Blue Gold

Water, water everywhere and not a drop to drink – many will recall the famous musings of English poet Samuel Taylor Coleridge, in *The Rime of the Ancient Mariner*. Mark Twain once remarked, *"whisky is for drinking; water is for fighting over."* Both statements are true.

This paper is more of a primer on water and water management than a discussion of policy issues or options, although at the end we touch briefly on the Business Council's views on water policy in British Columbia, a topic which has been under discussion in connection with the ongoing *Water Act* reform process.

In order to articulate coherent policy there is a need for a solid understanding of the subject matter. This understanding does not currently exist in BC or Canada when it comes to water issues. Water is taken for granted and treated as a right, free for the taking. Water is embedded so deeply in what we do and how we do it that we can't really imagine using or treating water differently than we do now.

Death Without

Air – six to nine minutes

Water – about three to five days

Food – about three weeks

The web of water-related legislation and regulation in BC is complex, often confusing and sometimes contradictory. This could be the result of our geological lottery. Within that abundance we have responded in a piecemeal fashion rather than comprehensively. This has led to is a policy debate that does not necessarily acknowledge the intersecting areas of common interest among British Columbians. Rather, we pit business, communities and environmental groups against one another, with business often portrayed as the villain and little acknowledgement of individuals' and communities' contributions to problems.

Water is scarce. For most of us who live on the Pacific Coast of British Columbia, scarcity may be hard to appreciate. Even British Columbians who live in relatively drier areas of the province have been largely unconcerned with water until recently, as pressures from economic development, particularly in the natural resources sector, and from the growth of certain regions, particularly in the Okanagan, have shone a light on the need to think about water differently.

We are provided water through infrastructure that is largely built by local governments, and are charged a few hundred dollars per year and a further few pennies per year for volumes that are available on demand from any tap almost anywhere, all the time. We really have no concept of the value of water and what it means to the prosperity and sustainability of the economic and social structure in BC.

There is no doubt that water is a key global public policy issue. Wars have been fought over water in the past (1967 Golan Heights, 1989 Senegal and Mauritania dispute over grazing rights on the Senegal River, regular skirmishes between Syria and Iraq over access to water from the Euphrates River), and water-related conflicts are almost certain to occur in the future. In 2009, the World Economic Forum noted that: "we are living in a water bubble as unsustainable and fragile as that which precipitated the collapse of global financial markets ... we have over-leveraged our water for the future; we have no means of paying this back. The bubble is bursting in some places with more to follow."[1]

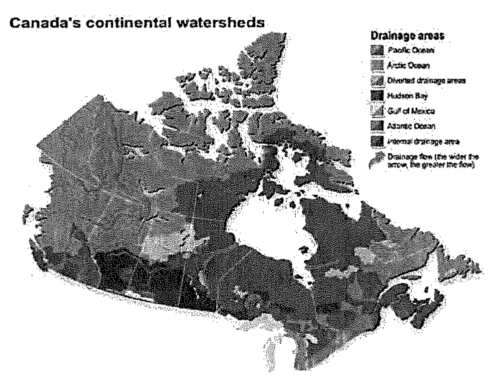
[1] World Economic Forum, Global Agenda 2009.

The Geography of Water – Canada and the World

The earth's water is 97.5% salt and only 2.5% fresh (35 million km^3). Of the latter, 70% (24.4 million km^3) is in the form of ice and snow, 30% (10.7 million km^3) is groundwater, and 0.3% (0.1 million km^3) consists of freshwater lakes and rivers.[2]

By 2025, 1800 million people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be under stress conditions.
Source: UNFAO

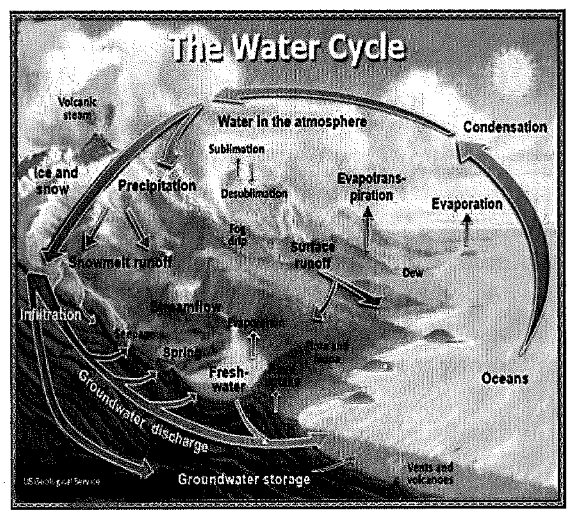
Canada is one of six countries that together hold up to half the world's supply of renewable freshwater (blue water.) The others are Brazil, Russia, Indonesia, China, and the United States. Canada ranks third behind Brazil and Russia in having the most renewable water supplies, with our rivers discharging 7% of the world's renewable water supply – 105,000 cubic meters (m^3) per second – and with almost 9%, or 891,163 square kilometers, of our total land area covered by fresh water.[3]



Water Use

People use energy for water and water for energy. Water is a closed system, and like energy it can neither be created nor lost – it just changes form within the system. Water is essential not only for human physiological needs (about 65% of our body is water) but also, along with energy, as the foundation of social, cultural, economic and political systems. It is essential for life. Water is often referred to as "blue gold."

Water use is ubiquitous. First and foremost we need to drink it to live. There is no substitute for water in the functioning of the human body. It is the only way to truly quench thirst, and any other form of liquid is made partially of water. We also use it to wash, grow food, and produce all of the things that make our modern lives tolerable and pleasurable.



Population growth, and the activities across various sectors that such growth produces, is a main driver for an expanding water footprint. The water footprint is a measure of human appropriation of water resources in terms of water volumes consumed, evaporated or incorporated into products, or polluted per unit of time.

To determine our water footprint we can divide water use into three components:

[2] United Nations Statistics.
[3] Environment Canada Water Quick Facts

- Green water is the volume of rainwater used and is largely passively consumed by agriculture.
- Blue water is surface and groundwater.
- Grey water is the degree of freshwater pollution measured as volume of water needed to assimilate the load of pollutants, based on existing ambient water quality.[4]

Table 1

Canada's World Ranking Footprint

Consumption	GREEN	GREY	BLUE
Water footprint of national consumption per country (mm^3/yr)	27	14	29
Water footprint of national consumption per capita ($m^3/yr/cap$)	41	6	50
Domestic consumption	n/a	18	8
Agricultural consumption			
Domestic	22	18	58
Imports	37	27	22
Industrial consumption			
Domestic	n/a	9 (a)	6 (b)
Imports	n/a	9 (c)	7 (d)

a: USA, China, India, Vietnam, Russia, Serbia, Ukraine, Brazil, Canada
b: USA, China, India, France, Germany, Canada
c: USA, Japan, Germany, UK, France, Italy, China, Spain, Canada
d: USA, Japan, Germany, UK, France, Italy, Canada

Overall, Canada's water footprint ranks us between 14th and 29th of 174 countries, depending on which of the three definitions noted above is used. Volumetrically, we use 49,423 mm^3/year of green water, 4,743 mm^3/year of blue water, and 17,907 mm^3/year of grey water. The ranking shown in Table 1[5] uses these figures compared to a world water footprint for green water of 6,249,537 mm^3/year, for blue water of 943,325 mm^3/year and for grey water of 1,332,202 mm^3/year.

Globally, agriculture is the biggest user of water, accounting for 70%[6] of all withdrawals, and for a remarkable 91% of the total water footprint of humanity. Global industrial water use accounts for 5% of the human water footprint. Global domestic (household) water use is about 4%.

Within agriculture, cereal, meat and milk are the largest water users and account for 27%, 22%, and 7% of consumption, respectively.[7] Canada's agricultural water use footprint is ranked anywhere from 18th to 58th. On the low end, a large part of Canadian agricultural production does not use blue water but relies more on passive use of rainwater (green water).

Canada ranks between 6th and 9th in terms of industrial water use, which is driven primarily by our natural resource extraction industries and large energy sector. For domestic use, we are ranked 8th in relation to surface and groundwater consumption, and 18th when it comes to the level of water pollution.

In a just released paper by the Canadian Council of Academies entitled *Water and Agriculture in Canada: Towards Sustainable Management of Water Resources,*[8] it is noted that Canada does recognize the impact of agriculture on water. The authors recommend a comprehensive list of activities aimed at improving the management of water in Canada, including adapting to new market opportunities, focusing on water efficiency and improved monitoring, additional research, and changes to governance.

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[4] National water footprint accounts: The green, blue and grey water footprint of production and consumption, Volume 1, M.M. Mekonnen and A.Y. Hoekstra, May 2011.
[5] Ibid., Volume 2 (Appendix).

[6] The Economic Impact of Restricted Water Supply: A Computable General Equilibrium Analysis, Berrittella, Hoekstra, et al, 2006.
[7] Ibid.
[8] Canadian Council of Academies

Table 2

Groundwater Extraction by Continent

CONTINENT	GROUNDWATER ABSTRACTION *					COMPARED TO TOTAL WATER ABSTRACTION	
	Irrigation km^3/yr	Domestic km^3/yr	Industrial km^3/yr	Total km^3/yr	%	Total water abstraction** km^3/yr	Share of groundwater %
NORTH AMERICA	99	26	18	143	15	524	27
CENTRAL AMERICA AND THE CARIBBEAN	5	7	2	14	1	149	9
SOUTH AMERICA	12	8	6	26	3	182	14
EUROPE (INCLUDING RUSSIAN FEDERATION)	23	37	16	76	8	497	15
AFRICA	27	15	2	44	4	196	23
ASIA	497	116	63	676	68	2257	30
OCEANIA	4	2	1	7	1	26	25
WORLD	666	212	108	986	100	3831	26

Table 3

Virtual Water Use by Typical Good or Service

Good/Activity	Liters of Water	Good/Activity	Liters of Water
750 lbs. of beef (carcass)	5,200,000	Washing machine	225
Bale of cotton	1,800,000	5 minute shower	100
Average Car	350,000	Slice of bread (30 g) with cheese (10 g)	90
Bale of alfalfa	70,588	Glass of beer (250 ml)	75
Bale of wheat	30,240	Apple (100 g)	70
Bag of corn	21,924	Tub bath	60
Pair of shoes (bovine leather)	8,000	Orange (100 g)	50
Hamburger (150 g)	2,400	Automatic dishwashing	40
Cotton T-shirt (250 g)	2,000	Slice of bread (30 g)	40
Litre of coffee	1,120	Cup of tea (250 ml)	35
Glass of milk (200 ml)	200	Microchip (2 g)	32
Glass of apple juice (200 ml)	190	Potato (100 g)	25
Bag of potato crisps (200 g)	185	Toilet flush	19
Glass of orange juice (200 ml)	170	Tomato (70 g)	13
Egg (40 g)	135	Teeth brushing (tap running)	10
Dozen roses	120	Sheet of A4-paper (80 g/m2)	10
Glass of wine (125 ml)	120	Hand washing (tap running)	8
Banana	107	Barrel of Conventional Oil	7

Much of our collective thinking about water use is related to that which comes from streams and rivers. However, groundwater is an important source of water for many people and communities. It is water from rain, snow, sleet, and hail that has moved downwards because of gravity, and passed between particles of soil, sand, gravel, or rock until it reaches a depth where the ground is saturated. Groundwater is not as well understood, mapped or monitored. When an area holds a lot of water it is called an aquifer. Wells can be drilled to access the water, which is then pumped and piped for human use. It has been estimated that groundwater supplies more than half of the world's drinking water,[9] and withdrawals have gone from 150 cubic kilometers in 1950 to 1,000 cubic kilometers in 2000, increasing steadily in tandem with population. Table 2[10] provides by continent estimates of groundwater extraction in 2010.

Virtual Water

Another important concept is virtual water. It is a measure of total water used along the entire supply chain to produce a good or service. The term is generally applied when discussing trade, and is an attempt to map the flow of water embedded in various products as exchanged within and between countries. Trade is the foundation of any economy without which there can be no modern economic system. Trade requires goods and services for which energy and water are essential elements.

Understanding virtual water content can enable a view of a country's comparative advantage in water-intensive goods, while also facilitating better consumer awareness and choice. While there are some shortcomings with and criticisms of this tool, it is a useful starting point for understanding the water needed to produce common items we demand as consumers. Consumers can make choices using water content as a criterion, much like using nutrition facts as a guide to food choices. Water use is not only what we see in rivers and lakes and flowing out of our taps; it is also embedded in what we buy.

Table 3 shows the global average virtual water content for selected products.[11]

Water Quality

Much of the world's freshwater is polluted from vast quantities of human waste (2 million tons per day added to water courses), industrial waste, and agricultural run-off.[12] The United Nations estimates that the total amount of wastewater produced annually is about 1,500 km^3. This is six times more water than exists in all the rivers of the world,[13] and most of it receives little or no treatment, especially in less developed countries. In many nations, there is a need for significant investments in wastewater facilities. Paradoxically, as incomes rise, there is both more waste and an increased public desire for better environmental conditions, which leads to more wastewater treatment facilities that are expensive and require large amounts of energy to operate.[14]

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[9] Groundwater: a global assessment of scale and significance, Jacob Burke and Karen Villholth, 2007.

[10] Groundwater and Global Change: Trends, Opportunities and Challenges, Jac van der Gun, WWDR4, 2012.

[11] Water footprints of nations: Water use by people as a function of their consumption pattern, A.Y. Hoekstra, A.K. Chapagain, 2005; *Blue Gold* 2008 Documentary Film, 2009 *Tapped* Documentary Film.

[12] UN Water Organization Statistics

[13] World Water Assessment Programme, WWDR1: "Water for People, Water for Life", 2003.

[14] World Water Assessment Programme: WWDR4: Facts and Figures Managing Water Under Uncertainty and Risk, 2012.

It is difficult to compare water quality across countries, as there is not one standard but many. The United Nations has attempted to graphically[15] represent water quality changes, particularly in relation to nitrate loading (from agriculture), and it uses narratives to talk about issues like access to drinking water in developing nations.

Blue Gold

1 US ounce of gold is ~$1,674

1 litre of water is equal to ~34 US ounces of gold

1 litre of water is equal to ~$56,602 if compared to gold

Water Value and Pricing

Water is the quintessential public good, useful and beneficial to all. And while there are mixed views on whether to price water at all, pricing does play a role in water allocation. What society struggles with is relative value based on use and whether water should be treated like any other commodity.

For context, we do pay for water in Canada, although for the most part it is almost free. About 40% of households pay a flat rate for water, regardless of the quantity used, and about 60% pay some sort of volume based amount.[16]

[15] Water for Life Decade

[16] "Are the Prices Right? Balancing Efficiency, Equity, and Sustainability in Water Pricing", in K. Bakker, ed. Eau Canada: The Future of Canada's Water, edited by Steven Renzetti, UBC Press: 2007.

Water Regulatory Context and Policy – Canada

Although provinces have the main responsibility and authority over water – with the exception of land reserved for First Nations – relevant federal legislation includes:

- *Canada Water Act*, which contains provisions for formal consultation and agreements with the provinces;
- *International River Improvements Act*, which provides for licensing of activities that may alter the flow of rivers flowing into the United States;
- *Department of the Environment Act*, which assigns the national leadership for water management to the Minister of the Environment; and
- *Canadian Environmental Protection Act, 1999 (CEPA 1999)*, which regulates many of the substances that have a deleterious effect on the environment.[17]

There is also the *Fisheries Act*, *Navigable Waters Protection Act*, *Northwest Territories Waters Act*, *Mackenzie Valley Resource Management Act*, *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, *Arctic Waters Pollution Prevention Act*, *Canada Shipping Act* and *Dominion Water Power Act*. Health Canada[18] can also help set standards for drinking water quality but it mostly provides a science and research function.

Canada's water policy[19] is made up of two elements: standards for water quality and for promoting efficient use of water. But federal policy has few levers with respect to the latter, given the responsibilities of other levels of government for water distribution.

[17] Environment Canada

[18] Health Canada

[19] Federal Water Policy

Table 4
Water Allocation in British Columbia by Type of Use

	Annual Allocated Volume (cubic decameters)	%		Consumptive	Non-Consumptive
Waterpower Commercial and General	592,587,400	83.8%		0%	100%
Storage	99,549,050	14.1%		1%	99%
Conservation and Land Improvement	8,642,800	1.2%		0%	100%
Industrial, Commercial, Mining and Petroleum	2,305,012	0.3%		90%	10%
Waterworks (municipal systems)	1,796,019	0.3%		100%	0%
Agriculture	1,566,849	0.2%		88%	12%
Aquaculture (fish hatchery)	384,800	0.1%		0%	100%
Waterpower Individual Residential	320,700	0.05%		0%	100%
Domestic	33,782	0.005%		99%	1%
	707,186,412	100.0%			

HOW BC STACKS UP

Geography of Water

British Columbia has only 2% of Canada's water area but has the highest level of precipitation, at about 3,300 millimeters per year,[20] with about half of that occurring on the west coast of the province. Precipitation is expected to increase over the next 35 years,[21] which is both good and bad. One can see why British Columbians, in general, have paid little attention to water. With such largesse, it is perhaps difficult to picture what the problems are.

Water Use

The average British Columbian uses 490 liters of water/day/person, compared to the Canadian average of 274 liters/day/person.[22] The United Nations estimates that the average daily water need per day/person for survival is 50 liters.

Water use statistics for BC are presented in Table 4.[23] While this information is somewhat dated, the relative breakdown in terms of percentages is more or less accurate. Mining accounts for a 0.02% of surface water use, while oil and gas accounts for 0.01% of the total industrial/commercial/mining/petroleum category, which as a category accounts for 0.3% of all water used in BC.

It should be noted that these figures may be slightly higher if the named industries' process water supply (industrial effluent dilution) is taken from municipal waterworks, although not significantly so given that such waterworks also include domestic sewage disposal.

Non-consumptive use of water for electricity generation dwarfs all other types of use in BC, followed by storage and conservation and land improvement activities. Non-consumptive water is maintained in or returns to the closed system from which it came and respects the closed nature of a water system, although dams

[20] Statistics Canada
[21] Potential Impacts of Climate Change on BC Hydro Managed Water, BC Hydro, 2012.
[22] Residential Water Use Indicator Data, Environment Canada.

[23] BC MOE 2006 and Oil and Gas Commission statistics 2010.

and reservoirs alter the timing of flows relative to the ecosystem within which the water stays.

In the scheme of things, industry contributes only 5% to the global water footprint. Industry does require an accessible, reliable and sustainable water supply, but it is not a particularly heavy user. Statistics in Table 4 show that industry uses less than 1% of the total annual allocated volume of water in British Columbia. At the same time, industrial activity contributes significantly to GDP, employment, exports and government revenues. On a per dollar of GDP basis, BC's industrial sector, which includes manufacturing, construction, and mining, oil and gas, and forestry, accounts for 17% of GDP and uses 8 cents worth of water per dollar of GDP, while agriculture, which generates 2% of GDP, uses 41 cents worth of water per dollar of economic output generated.[24]

Groundwater is "out of sight" and in BC it is not currently regulated, yet over 1 million people rely on it for drinking water.[25] While a permit is required to drill a well, there is no systematic monitoring of withdrawals, according to the data collected. Some 95% of wells in BC are for household or family use; in the rest of the world about half of groundwater consumption is for irrigation.

BC Water Quality

Water quality is affected by what we put in it as well as natural background levels of minerals. Just because water is "natural" does not mean its quality is good. Within the waste stream the most important water contaminants are microbial pathogens, nutrients, oxygen-consuming materials, heavy metals and persistent organic matter, as well as suspended sediments, nutrients, pesticides and oxygen-consuming substances, much of it from non-point sources. BC has guidelines for 43 substances and develops new standards as needed.[26] According to a 2006 report (no recent summary data is available) we are meeting water quality objectives 93% of the time across all watersheds in BC.

Since water is a closed system, wastewater treatment is a necessary part of our infrastructure. Most communities in Canada and BC have wastewater treatment plants, largely owned and operated by municipal governments.[27] In BC these systems must meet the requirements of the *Municipal Sewage Regulation*. In July 2012, BC and Canada signed an agreement to make wastewater effluent regulations equivalent, meaning that provincial standards will be the bar that wastewater managers have to meet. This process is still in progress.

Water Pricing in BC

In BC we do pay for water by way of water rentals and most often annual fees to municipal governments for infrastructure.

Tables 5 and 6 show water rentals by sector in BC.[28] There are annual license fees and rents paid for the use of Crown land in the case of electricity generation. British Columbians also pay for water through their electricity rates. In fact, payments from BC Hydro account for 95% of the water rentals collected, at between $350 million and $450 million per year (depending on number of GWh generated) and maybe as high as $500 million if the additional 5% of generation from other sources is added in. Rent

[24] Statistics Canada and BC Stats, 2011 data.
[25] British Columbia's Water Act Modernization Technical Background Report, 2010.
[26] A Compendium of Working Water Quality Guidelines for British Columbia.
[27] 2010 Municipal Water Use Report, Environment Canada, page 11.
[28] Ministry of Environment

Tables 5 and 6

Water Rental Rates in British Columbia

Sector	Based on Volume (per 1,000 cubic metres)	Minimum Annual Rent per License
Agriculture	$ 0.60	$ 25.00
Aqualculture	$ 0.08	$ 100.00
Conservation & Land Improvement	$ 0.01	$ 25.00
Domestic	$ 0.60	$ 25.00
Industrial / Commercial	$ 0.85	$ 100.00
Mining and Petroleum	$ 1.10	$ 100.00
Storage	$ 0.01	$ 25.00
Waterworks (water supply)	$ 1.10	$ 100.00
Waterpower Residential (supplied by the landowner)	$ 0.01	$ 100.00

Electricty Generation		Annual Rent
Commercial Power		
Annual Rebt		$ 103.73
Capacity /kw	$ 2.12	
Output/MwH	$ 1.28	
General Power		
Annual Rent		$ 207.46
Crown Land		$ 120.00
Per hectare of flooded land		$ 7.50
Capacity /kw	$ 4.25	
Output/MwH up to 160k MwH	$ 1.28	
Output/MwH up to 160k to 3m MwH	$ 5.95	
Output/MwH > 3m MwH	$ 7.15	

from industrial consumption is in the order of between $2 million and $2.5 million per year based on rates between $0.85 and $1.10 per 1000 m^3 per year, as is rent from residential consumption, of which 99% is attributable to the cost of municipal waterworks. Essentially, water for residential use is truly free at about $0.45 per year per person, not including infrastructure costs.

If British Columbia were to double rates for residential and municipal waterworks, the average person would still only pay about $1.00/per year. If the rates for industrial consumption doubled from the average of $0.85 to $1.10 per 1000 m^3, they would still amount to a small sum and far less than what industry pays for water when it is embedded in electricity rates. From an economist's point of view, paying for water directly, rather than as part of the price for energy, would be a better way of establishing the "value" of water, and would do more to incent behavioural change regarding conservation and efficiency.

Water Regulatory Context and Policy

In British Columbia, the 1800's gold rush created the need to regulate both mining and water use. This led to the 1959 *Gold Fields Act* that "granted exclusive rights to use water [for mining] in return for a rental payment to the Crown and an obligation to use it beneficially for the purposes stated in the license."[29] This was followed by the 1982 *Water Privileges Act* that vested rights to all water use with the Crown, and then in 1909 by the *Water Act*, which remains in place today (with amendments), including a 1925 amendment that established Crown ownership of water and the current first-in-right/first-in-time and use-or-lose-it policy, among others. Other pertinent provincial legislation includes: *Water Protection Act*, *Oil land Gas Activities Act*, *Drinking Water Protection Act*, *Local Government Act* and *Community Charter*, *Environmental Management Act*, *Dike Maintenance Act*, *Drainage, Ditch and Dikes Act*, *Forest and Range Practices Act*, *Parks Act*, *Environmental Assessment Act* and *Public Health Act*.

[29] Ministry of Environment

Over the past couple of years the BC Ministry of Environment's *Water Act Modernization* process has been aimed at updating water law, policy and practice. The short form version is that the regulatory and policy context for water is as complex as the relationship that water has to our social, cultural and economic identity. All three levels of government are involved in water management in some way, and increasingly First Nations and non-governmental groups are playing or wanting to play some role. Perhaps there are simply too many players and too many rules that are working against each other.

Policy Views in BC

Water is an elixir of life. We cannot live without it. It is essential to and embedded in every part of our economic, social and cultural framework. British Columbia continues to make attempts at modernizing the regulatory and policy construct for water management, and the Business Council has acknowledged that the current "*Water Act* and water resource allocation regime do not provide an adequate foundation to ensure the efficient management, protection and conservation of water resources."[30] While this paper is not intended to summarize the content of the above referenced submission, it is worth repeating several key points:

- a centralized governance structure is preferable;
- water in BC is a comparative advantage if managed properly;
- groundwater should be regulated, monitoring and reporting requirements should be for all users not just large users, and the framework needs to account for regional water abundance or lack thereof;
- flexibility is essential, especially with respect to any kind of minimum flow standards;
- certainty of rights enables long-term planning.

In addition, the Business Council continues to support a ban on the export of bulk water and we do not favour the full commodification of water, although we know that price can influence behaviour and therefore the current model which embeds the cost of water in electricity rates is not transparent or efficient.

Conclusion

Water is a complicated subject around the world and in many ways it is not well understood. We take it for granted, and globally it may become a cause of more inter-state conflict over the coming decades. For the most part, British Columbia is well-endowed with water, which along with energy is part of our competitive advantage. This abundance can foster public complacency, and we probably pay too little for water and/or pay for it in the wrong way. However, there is an opportunity to make improvements to the way we manage water. We should take our time, do it properly, and acknowledge that good management and sound policy is not an "us versus them" proposition.

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[30] Comments on the Ministry of Environment's Policy Proposal for the Water Sustainability Act, March 2011.