Water-Energy Nexus

From Stream to Steam

Emerging Challenges for BC's Interlinked Water and Energy Resources

By Ben Parfitt with
Jesse Baltutis and
Oliver M. Brandes

NOVEMBER 2012

POLIS Project on Ecological Governance
University of Victoria

CCPA
CANADIAN CENTRE for POLICY ALTERNATIVES
BC Office

FROM STREAM TO STEAM:
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November 2012

This paper is part of a two-part series addressing the water-energy nexus in British Columbia, published in partnership between the POLIS Project on Ecological Governance at the University of Victoria and the Canadian Centre for Policy Alternatives. The project is primarily supported by the Gordon and Betty Moore Foundation, the Bullitt Foundation, the Vancouver Foundation, and the Walter and Gordon Duncan Foundation. It is also supported by the University of Victoria Eco-Research Chair of Environmental Law and Policy and the University of Victoria Centre for Global Studies.

This paper is also part of the Climate Justice Project, a five-year research project led by the CCPA–BC and the University of BC. The Climate Justice Project studies the social and economic impacts of climate change and develops innovative green policy solutions that are both effective and equitable. The project is supported primarily by a grant from the Social Sciences and Humanities Research Council through its Community-University Research Alliance program. Thanks also to Vancity and the Vancouver Foundation for their financial support of the Climate Justice Project.

Editing: Laura Brandes, POLIS Project on Ecological Governance

Design: Nadene Rehnby, Hands on Publications

Cover photos: Williston Reservoir / W.A.C. Bennet Dam, Garth Lenz; False Creek Energy Centre, Jesse Baltutis; Okanagan, JeremyOK/Flickr

ISBN: 978-1-77125-039-9

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Contents

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REVIEWERS

To ensure the accuracy of the content of the report, a thorough practitioner and expert peer-review process was employed. Many of our reviewers chose to remain anonymous. However, we would like to thank the following individuals for their input and suggestions throughout the development of this report: Laura Brandes (POLIS Project on Ecological Governance), David Brooks (POLIS Project on Ecological Governance), Jim Bruce (Forum for Leadership on Water), Rod Dobell (Centre for Global Studies, University of Victoria), Mike Donnelly (Regional District of Nanaimo), John Finnie (Regional District of Nanaimo), Tanis Gower (Watershed Watch Salmon Society), Peter Kirby (Xeitl Limited Partnership), Seth Klein (Canadian Centre for Policy Alternatives), Carol Maas (POLIS Project on Ecological Governance), Jennifer Miles (Regional District of North Okanagan), Jon O'Riordan (POLIS Project on Ecological Governance), Craig Orr (Watershed Watch Salmon Society), Kevin Reilly (Capital Regional District), Andrew Rosenberger (Watershed Watch Salmon Society), Karena Shaw (School of Environmental Studies, University of Victoria), Stuart Simpson (Xeitl Limited Partnership), Joel Ussery (Capital Regional District), Anna Warwick Sears (Okanagan Basin Water Board).

EXECUTIVE SUMMARY

From Stream to Steam

Emerging Challenges for BC's Interlinked Water and Energy Resources

BRITISH COLUMBIA'S INTERCONNECTED water and water-derived energy resources are vital assets that show signs of being under increased stress across the province. Population growth, climate change, and increased industrial activities are together pushing the limits of secured access to water and energy resources across the province. In the face of these mounting pressures, the challenge of ensuring access to water and energy resources for future generations requires addressing how decisions regarding one resource may impact another. Integrating decision-making around the management of BC's interlinked water and energy resources is critical and will have implications for their sustainable use, now and into the future.

Population growth, climate change, and increased industrial activities are together pushing the limits of secured access to water and energy resources across the province.

Some of the noteworthy challenges emerging in BC include:

- Sharp projected increases in the natural gas industry's demand for water and energy resources — demand that will result in permanent removal of water from the hydrological cycle as well as undermine the province's clean energy and climate change objectives.
- Local or regional droughts that have triggered temporary restrictions on water withdrawals and led to reductions in hydroelectric production.
- Continued increases in urban populations that could push demands for water beyond the point that current sources can supply, thus requiring local water utilities to spend millions of dollars to access new water sources and to build new energy-intensive water-treatment facilities.
- Catastrophic events such as forest fires (which appear to be increasing in number and severity due to climate change) that threaten to damage lands around drinking water reservoirs to the point where municipalities must spend millions to build new water treatment plants.
- Increased potential for incremental drawdown of water from hydroelectric reservoirs for purposes other than hydro production, meaning that either new sources of expensive private-sector or public-sector power may have to be built in BC or purchased from out-of-province power producers.

This report points to a number of deficiencies in how the province currently manages water and energy.
GARTH LENZ PHOTO

These and other challenges point to the need for a concerted effort to more effectively manage these interconnected resources. This report points to a number of deficiencies in how the province currently manages water and energy. These include:

- Lax water-reporting requirements. There is presently no publicly available database that reports on actual water usage in the province, and in many cases the province does not even require major water users to record what they use.

- Low industrial water-use fees that encourage waste. Currently, natural gas companies involved in water-intensive hydraulic fracturing (fracking) operations pay nothing for the water they use, or nominal charges of $2.75 per Olympic swimming pool equivalent. In Quebec, such usage would generate a water-use fee of $175 per Olympic swimming pool equivalent.

- Conflicting provincial policies. On one hand the provincial government promotes a dramatic expansion in natural gas industry and mining industry activities that will lead to significant increases in water withdrawals, water pollution, and increased demands for energy. On the other hand, the province is committed to a revised *Water Act* that alleges to place a premium on protecting ecological values and a new *Clean Energy Act* that commits the province to dramatically reduce greenhouse gas emissions.

- The continued lack of commitment to ensure that the cumulative effects of various land-use activities do not reach a point where our water and water-derived energy resources are compromised.

While many roadblocks stand in the way of a comprehensive and coordinated approach to managing the province's interlinked water and energy resources, there are inspiring stories from across BC that suggest that with the right changes in policy, such resources can be managed more responsibly for the benefit of all British Columbians.

The report concludes that more effective governance of our interlinked water and energy resources should be a top priority. This includes ensuring that water and energy policy initiatives are coordinated at the provincial government level so that the objectives of any one policy do not undermine the objectives of others. It also includes ensuring that there is adequate space for local and regional authorities to play a meaningful role in decisions that will directly affect their ability to deliver water (and related energy services) to their constituents.

Because governance reforms take time, the report recommends four actions that can be taken immediately. If implemented, such actions will improve the management and conservation of water and energy assets, setting the stage for improved governance in the years ahead. The four recommended actions are:

1. PUBLISH ACCURATE, TIMELY REPORTS ON WATER USE. There is currently no publicly available report on actual water usage in the province.

2. APPROPRIATELY PRICE WATER AND ENERGY RESOURCES. Low prices for water encourage waste. Current prices for power place a higher burden on residential versus industrial power users.

3. PROMOTE RESOURCE RECOVERY TO CONSERVE WATER AND ENERGY RESOURCES. Resource recovery means that instead of having to rely on new sources of water or power, existing "waste" resources are reused.

4. PRIORITIZE WATERSHED HEALTH AND FUNCTION. Currently, some municipal and regional authorities have the ability to control events on the lands surrounding community water supplies, some of which are also hydroelectric reservoirs. Protecting such lands greatly improves prospects for water resources being conserved and protected.

This report concludes that more effective governance of our interlinked water and energy resources should be a top priority.

Introduction

Just as water produces energy, energy provides water services. This relationship, known as the water-energy nexus, is of increasing interest to academic, business, environmental, and public policy leaders — and for good reasons.

IN 1961, WORK BEGAN on one of the largest earth-filled dams in the world. Over the course of the next few years, an army of workers moved nearly one million dump truck loads of rock into place to build the massive edifice that measured nearly a kilometre thick at its base and that tapered to the width of a two-lane road at 82 metres in height.

With its completion, the gently curving 2.2-kilometre-long structure changed the face of British Columbia forever. Named after the province's then premier, W.A.C. Bennett, the dam flooded the upper Peace, Finlay, and Parsnip river valleys, and its associated powerhouse became the single largest source of hydroelectricity in the province.

Today, the dam and the massive reservoir it created are perhaps the single most powerful reminder that British Columbians have of the essential role water plays in generating the energy they use every day. What is less apparent, but no less important, is that the electrical power generated at the dam, and other dams throughout the province, is essential for a host of water-related services — everything from the power needed to pump, treat, and heat water, to the power needed to create steam, to the power needed to treat municipal wastewater and sewage, to the power needed to treat and dispose industrial effluents.

Just as water produces energy, energy provides water services. This relationship, known as the water-energy nexus, is of increasing interest to academic, business, environmental, and public policy leaders — and for good reasons. As populations increase, demands on finite water resources and energy services threaten to push the limits of what our environment can sustain. Another compelling reason to pay heed to the water-energy nexus is climate change, which may result in significant alternations to precipitation patterns, with all that implies for altered water availability and the power derived from water.

The primary objective of this report is to shed light on some of the emerging areas of concern around the water-energy nexus in British Columbia, because decisions regarding the management of the province's interlinked water and energy resources will have far-reaching consequences. These include potentially significant impacts on community prosperity and social equity, the provincial economy, provincial climate change policies and goals, food security, and the healthy functioning of watersheds, without which our publicly owned water resources and the energy derived from them may be seriously jeopardized.

Maintaining healthy watersheds, in particular, should be an overarching goal. As described in this report, major industrial water and power users— industries that may overuse and so contaminate water that it is effectively removed from the hydrological cycle forever—threaten to tax our water and energy resources. Without attention to the cumulative impacts that combined industrial activities may have on watershed lands, our publicly owned water resources and the power derived from them are at risk. This, in turn, places our economy at risk because a vibrant economy depends on a healthy environment.

The primary goals of this report are to:

- Introduce and provide specific examples of actions or events underway in the province that have or could have a significant bearing on BC's water-energy nexus;
- Catalyze a broader dialogue about where BC is heading with regards to the management of our interlinked water and energy resources; and
- Spur innovative thinking about possible policy solutions and legal and governance reforms to better address the challenges and opportunities of the water-energy nexus—solutions that are economically, socially, and ecologically sustainable.

A key finding in the report is that the provincial government is making laudable attempts to revise water policies and energy policies while simultaneously pursuing the goal of lowering provincial greenhouse gas emissions. However, its efforts on these three fronts—combined with its attempts to foster expanded economic activity in the province's traditionally strong resource sectors—appear to be uncoordinated at best, and at worst in conflict with one another.

The W.A.C. Bennett dam, at 82 metres in height and impounding 70 cubic kilometres of water, is BC's single largest source of hydroelectricity and the world's seventh largest reservoir by water volume.
GARTH LENZ PHOTO

To effectively address the water-energy nexus, clear and consistent water, energy and climate policies are a prerequisite. Clarity and consistency is achieved when policy initiatives are linked and are driven by common principles. Achieving this requires changes to how we govern our interlinked water and energy resources.

This report concludes that improved governance of water and energy resources should be a top public priority. Changes in both top-down and bottom-up governance structures are needed to ensure there is consistency between different policy objectives and that local and regional knowledge is effectively utilized.

Bearing in mind that such changes will not occur overnight, the report recommends that four actions be taken immediately. These actions would make for more effective governance while broader changes to governance approaches and structures are considered:

1. PUBLISH ACCURATE AND TIMELY REPORTS ON ALL PROVINCIAL WATER USE. At present, the BC government publishes no data on actual water use in the province, including information on industries that consume large quantities of water. A major reason for this is that in many cases industrial water users are not required to meter or report the water they use. This critical lack of data undermines the sustainable management of BC's water and water-derived power resources.

2. APPROPRIATELY PRICE WATER AND ENERGY RESOURCES. In many cases, large industrial users of water are charged little, if anything, for the water they use. This encourages the wasting of water resources, including those that feed the province's hydroelectric reservoirs. Setting higher prices results in greater conservation, and may result in water utilities saving tens of millions of dollars each in increased infrastructure investments to pump and treat water and ongoing associated energy costs.

3. PROMOTE RESOURCE RECOVERY TO CONSERVE WATER AND ENERGY RESOURCES. Currently, opportunities are being squandered to capture the energy in waste streams (e.g. heat from wastewater and sewage) and to reuse wastewater. Resource recovery projects, in addition to making simple good sense, have added benefits because they reduce demands elsewhere on our water and energy systems.

4. PRIORITIZE WATERSHED HEALTH AND FUNCTION. Most watershed lands in BC lack protections and are gradually suffering hydrological damage, such as polluted or reduced water supplies, which could negatively impact water and water-derived energy resources in future years. Currently, some municipal and regional authorities have the ability to control events on the lands surrounding community water supplies. Protecting such lands greatly improves prospects for water resources being conserved and protected.

This report was published by the University of Victoria's POLIS Project on Ecological Governance and the Canadian Centre for Policy Alternatives. It is the first report in a two-part series addressing the water-energy nexus in British Columbia. In the future, work under the auspices of this cooperative research effort will focus on more specific policy proposals and reforms for BC, complemented by a series of proposed action items. The primary objective of this ongoing research is to ensure that the link between water and energy resources guides future decision-making in the province and that important water-related services—and supporting ecosystems—are maintained.

How a Lack of Data Undermines Management of Our Water and Energy Resources

WATER IS ESSENTIAL FOR LIFE and is the most important natural resource we have. The energy derived from water is also a vitally important asset.

Yet, a review of what data exists in the public domain with respect to water reveals that the provincial government, which has jurisdiction over water resources, publishes little, if any, data on actual water use by major water users in British Columbia. One provincial agency, BC's Oil and Gas Commission, recently began publishing some limited data on the water used by the province's natural gas industry. But this is the exception to the rule. At this point, BC residents cannot turn to a single, publicly accessible database that pinpoints where water is being withdrawn, in what quantities, and to what use it will be put.

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This lack of critical baseline information is not unique to the province and is, in fact, common to other Canadian provinces and territories.[1]

All that British Columbians have access to are *estimates* on water use. Of those estimates, about all that can be said with certainty is that those for surface water use are somewhat more reliable than those for groundwater use, because groundwater use remains largely unregulated.[2]

Such a lack of reliable, publicly available, regularly updated water-use data is troubling when viewed against the numerous (and sometimes conflicting) policy initiatives that have been launched in recent years by the provincial government, and that will have significant bearing on BC's water and water-derived energy resources.

1 National Round Table on the Environment and the Economy, 2011. In this publication it is noted that, "All provinces and territories would benefit from developing a 'toolkit' of common water-quantity measurement techniques that could measure and quantify actual water intake and discharge volumes."

2 Christensen, 2007. The author notes that: "With the exception of requirements specifying training and qualifications for those who drill wells and reporting of some new well construction…[the] siting, capacity and quantity of withdrawals of groundwater are unregulated."

What little information is in the public realm is largely out-of-date and, therefore, not very useful. The most recent province-wide estimates were published in 2006 and rely on data that is in some cases almost a decade old. Furthermore, the data is not based on *actual* water use but on the volumes of water that were licensed for use. This is because in many cases the actual water used is unknown. To underscore this point, we reviewed water licences issued to companies in BC's pulp and paper industry. The review showed that in virtually every case pulp and paper companies were not required to meter their water use or to report even an estimate of the water that they used (see *Water Reporting in BC's Pulp and Paper Sector*). At best, the estimates are an approximation and more likely are simply partially informed guesswork.

WATER REPORTING IN BC'S PULP AND PAPER SECTOR

As part of the research for this paper, a review of water licences assigned to companies operating pulp and paper mills in British Columbia was conducted.

Companies that operate or have operated pulp mills in the province hold a total of 31 active water licences. In all but one case there is no requirement to meter the water used or report on its use. In the one exception to the rule, the requirement stipulates that the pulp mill operator in the Cranbrook area "may" be required to meter the water used.[3]

Water licences confer rights of access to prescribed volumes of water. Known as "first-in-time, first-in–right", the earlier a licence is assigned, the higher "seniority" right applies to that licence. This typically means that in times of water shortage the holder of an older licence is allowed to take their full allocation of water before less senior licence holders are entitled to take theirs.

Responsibility for assigning water licences resides with BC's Ministry of Forests, Lands and Natural Resource Operations, but was historically the responsibility of the provincial Ministry of Environment.

3 Water licence #C118620 states that: "The Regional Water Manager may require that works be installed to meter and record the rate of flow and quantity of water diverted under this licence and may be available upon request for inspection by the Regional Water Manager." This, alone among all water licences issued to pulp mills in the province, is the only licence that makes mention of a potential water metering and water-use reporting requirement.

The published estimates show that the sectors with the highest allocations of surface water for consumptive use in BC are the industrial sector (1.89 billion cubic metres),[4] municipal water systems (1.79 billion cubic metres) and the agricultural sector (1.38 billion cubic metres).[5]

Water is pumped to irrigate farm crops, water is pumped and/or heated in various industrial, commercial, mining, and petroleum industry operations, and water is pumped and treated in energy-intensive ways by large municipal waterworks.

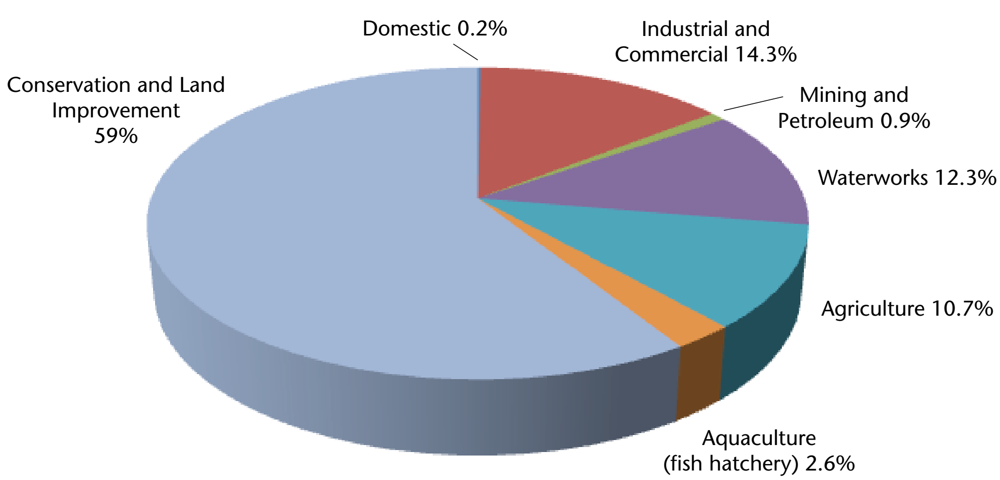
Much of this water use also carries significant environmental costs. Treated wastewater that is returned to surface waters, such as rivers and lakes, may contain organic or inorganic pollutants that were not present in the water when it was withdrawn for initial use. There is also a growing amount of water consumed in some industries where no water treatment occurs at all, for example the water used in natural gas hydraulic fracturing (fracking) operations. This water is not currently treated and is of such high toxicity that it cannot be returned to the surface water sources from which it originated. It is typically disposed by way of pressure-pumping deep underground, and thus carries both a heavy water and energy footprint.

In the absence of significant efforts to conserve water resources, it is likely that water use and embedded energy inputs associated with its use will climb in the years ahead. This includes:

- rising water and energy consumption in expanding industries, such as the province's natural gas sector;
- rising water and energy consumption due to increased irrigation as farmers are forced to respond to altered temperatures and soil moisture regimes due to climate change; and
- growing urban populations potentially demanding more water, leading to more energy requirements to pump and treat water and wastewater.

The most recent province-wide estimates were published in 2006 and rely on data that is in some cases almost a decade old. Furthermore, the data is not based on *actual* water use but on the volumes of water that were licensed for use.

BC Surface Water Allocated by Sector (Excluding Waterpower)



Note: Data March 2003 to 2006

Source: BC Ministry of Environment, Water Stewardship, Surface Water Allocation in BC
www.env.gov.bc.ca/wsd/water_rights/surface_water/index.html

4 The data actually lists "industrial/commercial use," but the vast majority of this water use would be in heavy industries such as the province's pulp and paper sector.

5 British Columbia Ministry of Environment, 2006.

Treating wastewater from hydraulic fracturing (fracking) operations is not required. After being used, the water is of such high toxicity that it cannot be returned to the surface water sources from which it originated and is often pressure-pumped into injection wells for disposal.
GARTH LENZ PHOTO

The lack of reliable information on where water withdrawals occur and at what volume is of even more significance when one considers that much of BC's power is hydroelectric. It appears that such power sources are being pushed close to the limits of supplying what residential users, public utilities, large and small industrial, and agricultural users consume.

Later in the report (see Feature Case Study 4) we look at just how taxed BC's hydroelectric sources may be. For now, it is noted that in five of the past 10 years the province was in a net energy trade deficit, an indication, perhaps, that domestic demand may increasingly be pushing the limits of what can be supplied.

All but two per cent of the surface water allocated in the province is held by the hydropower sector. It is estimated that in 2006 water allocated to the sector totalled 700 billion cubic metres, of which nearly 600 billion was allocated directly for hydropower production. The remainder was assigned to storage for future hydropower production. This translates into enough water to submerge Greater Vancouver under 250 metres, well in excess of the height of even the highest skyscraper in the region — the 201-metre, 62-storey Shangri-La tower.

What this indicates is that vast amounts of water are presently used to provide the energy that British Columbians rely on. A good deal of that energy is tied up in the movement, treatment, and use of water. The exact amount is unknown, but it is considerable. Consider that fully one-quarter of household energy consumption alone goes to heat water.[6] This is but one example of the manifestation of the water-energy nexus. There are many, many more.

6 BC Hydro, 2012a.

In the next section of this report, we will look at four case studies, two of which demonstrate that there could be increased demands on water from some of BC's hydroelectric reservoirs for purposes other than making power. Given the massive size of some of these reservoirs, such withdrawals would be small in the broad scheme of things, but they would translate into lost power potential at a time when BC's hydroelectricity providers are confronting potentially significant increases in demand from expanding sectors of the economy, such as the mining and fossil fuel sectors. This, in turn, would lead to increasing pressure to build more hydroelectric power facilities, with all the implications that has for water quality, water flows, and other environmental values.

This underscores the need to think carefully about the interconnections between water and water-derived energy resources and to embrace effective policies that will bring greater clarity to how best to manage such resources. Since water is the source for hydroelectric power, full public disclosure of all water use is essential. This includes all water withdrawn from hydroelectric reservoirs and the streams and rivers feeding such reservoirs.

PART TWO

Running Hot And Cold: Case Studies on the Water-Energy Nexus in BC

Both water *and* energy conservation efforts are necessary to address the challenges ahead and to ensure that we have resilient, healthy watersheds and communities in future years.

THE FOLLOWING FOUR FEATURE CASE STUDIES capture some of the challenges and opportunities ahead on the water-energy nexus in BC. Two core themes run through all four. The first is the need to embark on concerted conservation efforts. The second is the need to better integrate water and energy management activities through coordinated policies. Even then, difficult decisions lie ahead about where to place priorities. Water is limited and the power to be derived from it is limited too. This will necessitate trade-offs. Social and economic well-being depend on reliable access to water and to power. But, because water and hydroelectricity supplies are limited, constraints must be placed on potentially harmful land-use practices so that water quality and water quantity is maintained.

Given projected increases in population and potentially significant increases in industrial activities, both water *and* energy conservation efforts are necessary to address the challenges ahead and to ensure that we have resilient, healthy watersheds and communities in future years.

Conservation gains are most likely to occur in jurisdictions where proper attention is paid to accounting for how many resources are used, and where a proper price is placed on such resources. In that regard, there is considerable room for improvement in British Columbia and elsewhere in Canada when it comes to water resources. In 2006, a report by the POLIS Project on Ecological Governance's Water Sustainability Project found that over one-third of Canadian households still did not have water meters, that the country charged among the lowest prices for water use, and that its water consumption rates were among the highest in the world.[7]

While pricing energy and water resources effectively is an obvious prerequisite to significant conservation gains, care must be taken to ensure that whatever pricing regimes are pursued are

7 Brandes, Renzetti and Stinchcombe, 2010.

equitable and fair to all users. Recent work by the Canadian Centre for Policy Alternatives has shown, for example, that when it comes to hydro pricing, industries that are poised for major increases in hydro consumption would pay substantially less for that power due to residential power users paying more.[8]

The following four feature case studies are complemented by numerous other case studies in an appendix accompanying this report. The appendix case studies are grouped into two broad categories according to whether they contribute positively to or undermine the effective management of water and energy resources. A map that pinpoints the geographical location of the case studies in the appendix can be found on page 50 of this report.

The case studies in the main report and appendix guided us in developing the four recommended actions that anchor this report, and that we believe would result in the better management of BC's linked water and energy resources.

FEATURE CASE STUDY 1: MUNICIPALITIES AND THE WATER-ENERGY NEXUS

Like many communities in BC, Abbotsford and Mission are experiencing sharp increases in their populations. Divided by the Fraser River, which cuts between them, the two cities are serviced by a single water and sewer authority.

Currently, Abbotsford/Mission Water & Sewer Commission (AMWSC) supplies water to some 135,000 residents. When the needs of local industrial, commercial, institutional, and agricultural users are also considered, the equivalent of another 80,000 people rely on the water system.[9] Within 20 years, the utility may need to meet the needs of twice as many water users.[10] That reality now sees many municipalities wrestling with tricky questions of supply and demand.

Three water sources currently supply Abbotsford and Mission.[11] In periods of peak demand, water withdrawals have approached the maximum available. In 2007, 2008, and 2009, local residents and businesses consumed roughly 90 per cent of that amount, prompting AMWSC to warn that meeting peak demand would be increasingly difficult without new water sources.[12]

What those new water sources could be remains undecided, but some sources, groundwater in particular, are unlikely candidates for reasons having to do with insufficient supply and growing concerns over potential nitrate contamination from agricultural operations. By far the most studied water source to date is Stave Lake, a hydroelectric reservoir north of Mission. Engineering reports describe how water would first be pumped uphill from the lake to a new water treatment plant. Once treated, the water would be gravity fed down 24 kilometres of new water lines to Mission and then to Abbotsford. In 2011, the total projected cost of the project was estimated at $300 million.[13]

By far the most studied water source to date is Stave Lake, a hydroelectric reservoir north of Mission.
PHOTO COURTESY BC HYDRO

8 Calvert and Lee, 2012. The report notes that just one liquefied natural gas plant on BC's coast could result in residential and commercial hydro users subsidizing the plant's hydro usage by $125 million per year.
9 Abbotsford Mission Water & Sewer Services, 2012.
10 Abbotsford Mission Water & Sewer Services, (n/d).
11 Abbotsford Mission Water & Sewer Services, 2010. More than 60 per cent comes from Norrish Creek. Forty-five wells supply 31 per cent, and the remainder comes from Cannell Lake.
12 ibid.
13 Abbotsford Mission Water & Sewer Services, 2011.

A combination of the hefty price tag and a proposal to enter into a public-private partnership (most Canadian water and sewer services are provided by public utilities) prompted the Mission council to reject the project in the spring of 2011.[14] In a subsequent referendum, Abbotsford's residents also rejected the project, putting it at least temporarily on hold.

In May 2012, AMWSC laid out a number of water source options, including Stave Lake. Others included accessing smaller volumes of water from other surface water sources that could potentially be developed faster and at lower cost. Such projects would theoretically provide for a growing population's needs for 20 years, while a larger more expensive project such as Stave Lake would theoretically meet needs for a century.[15]

The struggle to find more water is one major challenge. The other is addressing seemingly unquenchable demand.

The struggle to find more water is one major challenge. The other is addressing seemingly unquenchable demand. On its web page, *Our Water Matters*, AMWSC acknowledges that while it may be necessary to develop Stave Lake, the project could be delayed through conservation efforts that reduced per capita water consumption by 25 per cent over five years.[16]

AMWSC could have chosen an even more aggressive reduction of 45 per cent. According to a report it commissioned, which was written by researchers with the POLIS Project on Ecological Governance's Water Sustainability Project, a reduction of that magnitude was not only achievable but would accommodate the region's growing population.[17]

The encouraging news on the conservation front is that numerous other jurisdictions have already shown that significant reductions in per capita water use are possible. In 2006, for example, Environment Canada reported that per capita residential water use averaged 327 litres per day.[18] This rate of consumption is more than twice as high as residential water consumption in some of the European Union's most prosperous countries, such as France, the United Kingdom, and Germany.[19]

In more recent years, encouraging downward directions have been noted in high-water-consuming jurisdictions, such as the United States,[20] and marked declines have occurred in some of that country's most water-stressed regions, including the Las Vegas area.

A general downward trend may also be underway in Canada. Environment Canada reports that per capita water use took a downward dip between 2006 and 2009, although the agency cautioned that the decline may have been influenced by generally favorable climatic conditions during that time.[21]

14 With respect to the provision of both municipal water and sewage services, there is ongoing conflict over the issue of privatization. Large multinational water companies, such as Suez and Veolia, are lobbying to take over municipal systems. Historically, water and wastewater services in Canada have been public (municipally owned). The push to privatize has major repercussions for future water management and public control over decision-making.

15 Abbotsford Mission Water & Sewer Services, 2012.

16 Abbotsford Mission Water & Sewer Services, 2012.

17 Maas and Porter-Bopp, 2009. The research found that it was possible to secure "the water necessary for a thriving Abbotsford-Mission region through conservation efforts." It concluded that "a 45 per cent reduction in annual average daily water use by 2031 would be required" to meet the growing region's water needs without the region having to find and develop a new water source.

18 Environment Canada, 2011.

19 United Kingdom Department for Environment, Food and Rural Affairs, 2008. The report notes that residential water consumption in France, the United Kingdom, and Germany was respectively 150, 150, and 127 litres per capita per day.

20 US Geological Survey, 2009. The document notes that in the U.S. total water use in 2005 was down slightly from the total water used across the country five years earlier, and five per cent below levels in 1980, the year of the highest total water withdrawals.

21 Environment Canada, 2011.

In Abbotsford and Mission, current conservation-oriented actions include issuing bi-monthly, as opposed to annual, water bills; installing smart meters that provide hourly water-use data; landscape and irrigation audits; lawn sprinkling restrictions; rebates for water-saving toilets, washing machines, and fixtures; and a short-lived introduction of two-tiered water pricing in the high water-use summer months.[22] Such efforts appear to be having the desired effect.

"We've seen [per capita water use] decreases in both our average and peak days in the last two years. But we're not ready to jump up and down yet because we haven't seen the same weather patterns that we did in 2006 and in 2009 when it was very dry," said Kristi Alexander, the AMWSC's water planning and process engineer.

Whatever conservation successes are recorded, there will be corresponding energy savings.

In Abbotsford and Mission, the energy required to treat water, sewage, and wastewater in the hot and dry year of 2007 was 37,409 gigajoules.[23] To offer perspective, this is approximately equivalent to the energy consumed by 350 average Canadian households that same year.[24] This may seem inconsequential, but what makes the energy-use figure important is that current water-pumping costs in Abbotsford and Mission are minimal due to most of its water system being gravity-fed. AMWSC has told the municipal councils in Abbotsford and in Mission that water-pumping charges would be significantly higher in the event Stave Lake was developed as a supply source.

Energy costs related to water pumping and water treatment have many BC municipalities looking at the energy potential in wastewater and sewage.

The exact costs associated with the additional water pumping and increased water treatment are not known precisely. In addition, the municipalities would also have to compensate BC Hydro for the value of lost power potential at the reservoir due to less water being available to run through turbines.

Abbotsford and Mission are not alone in confronting the challenges posed by the water-energy nexus. Energy costs related to water pumping and water treatment have many BC municipalities looking at the energy potential in wastewater and sewage. This push toward resource recovery is another action item endorsed in this report. Energy, in the form of heat, often goes unused yet is there for the taking (see *The Sunny Side of Sewage* on page 20).

The struggle to address demand and supply issues in Abbotsford and Mission exemplifies what many communities confront as populations climb and tensions arise due to limited water availability and the need to protect environmental resources. It also highlights why devising policies to better conserve and make informed decisions about water and energy resources makes sense. Conserving water conserves energy, which in turn helps lower greenhouse gas emissions.

22 Kristi Alexander, personal communication, May 16, 2012. Alexander, water planning and process engineer with Abbotsford Mission Water & Sewer Services, noted that in 2011, a two-tiered rate was applied in the summer months in the community of Abbotsford, but it was subsequently rescinded by a vote by the city council in spring 2012. During the imposition of the two-tiered rate, more than one-third of water customers exceeded the threshold and had to pay higher rates. A significant number of those exceeding the threshold turned out to have leaks in their water systems — a fact that may not have come to light had customers not been confronted with higher bills that forced them to question their water use. (Personal communication with Kristi Alexander, May 16, 2012.)

23 A. Wakeford, personal communication, February 9, 2012.

24 Natural Resources Canada, 2009.

THE SUNNY SIDE OF SEWAGE

When the Olympic Village on the banks of Vancouver's Southeast False Creek (SFC) opened in 2010, it was touted as "green" in part because of the development's unusual heating system. When it commenced operation, SFC became the first centralized or district heating system in North America to have raw sewage as its primary head source.[25]

Sewage, it turns out, is an important part of the water-energy nexus, as it can be both an underutilized source of water and an underutilized source of energy.

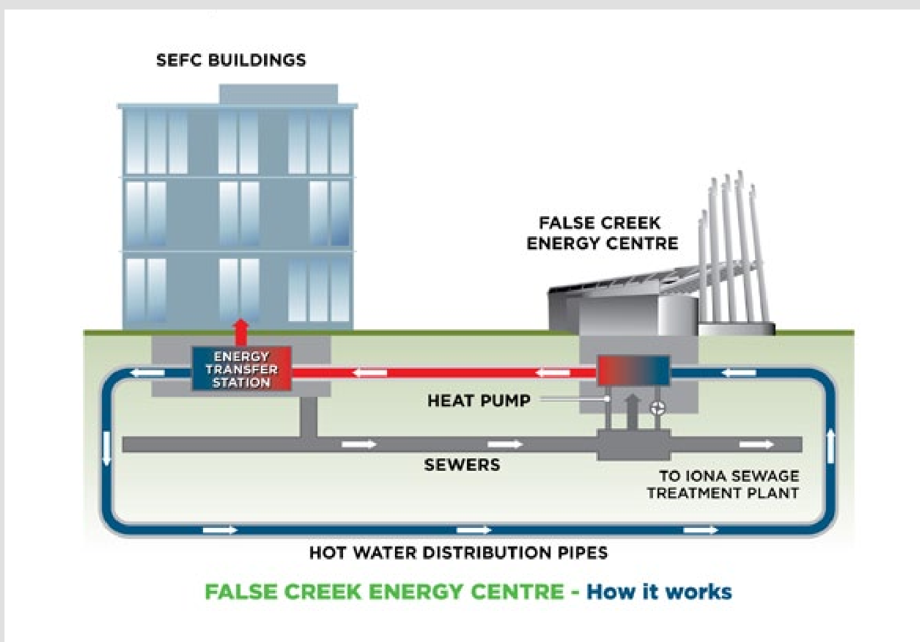
The system uses water as the so-called "working fluid" to carry the heat captured from the sewage stream. The water temperature is later raised to the desired temperature by a heat pump and then distributed to local buildings via heavily insulated piping that ensures minimum heat loss.

It is expected that when the site's buildings are fully occupied, people living in 560,000 square metres of floor space will have 70 per cent of their annual energy requirements met by the new system, with the remaining heat met by a combination of solar and natural gas energy.[26]

The innovative district heating system does more than just capture energy from what is typically a wasted resource. It also reduces greenhouse gas emissions by roughly half, compared with a conventionally heated housing project.[27]

Vancouver's Southeast False Creek became the first development in North America to use raw sewage as the primary heating source in its centralized heating system. When fully occupied, it will have 70 per cent of its annual energy requirements met by the new system.

PHOTO COURTESY JESSE BALTUTIS; ILLUSTRATION COURTESY FALSE CREEK ENERGY CENTRE



25 Infrastructure Canada, 2010. The document notes that the only similar systems in the world at that time were in Oslo, Norway and Tokyo, Japan.
26 Baber, 2010.
27 Baker, 2009.

FEATURE CASE STUDY 2: DOWN ON THE FARM

Farms of all description rely on water. Next to municipal waterworks and the industrial and commercial sectors, agricultural operations are the third largest consumers of water in BC. This water usage, primarily for crop irrigation, is widely anticipated to increase. Statistics Canada reports that the farm sector's projected water use in 2030 could increase by 50 per cent compared with 2005 use. Such an increase would be explained by a host of factors, including:

- farmers switching production to higher-value crops such as blueberries and raspberries;
- drier summers that, depending on the crop and irrigation methods chosen, may necessitate more water use; or
- farmers investing in "insurance" irrigation systems to hedge against the uncertainties posed by climate change.

Increased irrigation will have varying implications for the water-energy nexus, depending on three important factors:

- what crops are grown (certain crops are more water-intensive than others);
- what irrigation technologies are employed (certain irrigation systems are more water-intensive and therefore more energy-intensive than others); and
- local geographical realities.

Currently, the farming sector has access to 27 per cent of all water allocated for consumptive use in the province, with significant energy cost associated with moving the water.

PHOTO COURTESY JEREMY HIEBERT

The latter is especially important. Depending on the locale, the energy associated with water pumping varies dramatically. In some regions in BC, irrigation water is gravity fed and thus of less concern from an energy perspective. This includes most of the Okanagan region. But in other regions (e.g. Kamloops and area, the North Thompson, the Cariboo, Vancouver Island, the Fraser Valley, the Similkameen and Nicola river valleys) pumping is required.

There are three important reasons to be concerned about the water-energy nexus as it applies to farming. The first is the sheer volume of water used. According to the Ministry of Environment, BC farming operations have access to 27 per cent of all the water allocated for consumptive use in BC.[28] The second is the energy cost associated with moving that water around. The third is that the runoff of water from agricultural operations often contains nitrates that may be toxic to fish and wildlife. These pollutants can also render groundwater aquifers unusable as drinking water sources or require that much more sophisticated water treatment technologies be deployed (with all of the additional energy such treatment entails) to treat the contaminated water to an acceptable standard.

Due to variations in soil, topography, and climate, just five per cent of BC lands are suitable to farm. These lands may be under greater water stress, and potentially energy stress, than other regions.

But the sector's water and energy usage has far greater significance at a regional level. Due to variations in soil, topography, and climate, just five per cent of BC lands are suitable to farm. These lands may be under greater water stress, and potentially energy stress, than other regions. For example, in the Okanagan the sector accounts for nearly 65 per cent of all water use.[29]

As part of its commitment to revise and update the *Water Act*, in 2008 the BC government launched its Living Water Smart plan, which is devoted to raising awareness about water management issues and potential changes to water policy and law reform. It notes that in some areas of the province farms account for more than two thirds of all water withdrawals, with consumption rates highest in "the hot, dry summer months when water supplies are most vulnerable."[30]

Such consumption can be a formidable barrier to sustainable water use, particularly in regions that are hot and dry to begin with. This may explain why the Okanagan region has recorded noteworthy successes in reduced water consumption as a result of new, tiered water-pricing structures (see *When the Price is Right* on page 23).

The BC government is also aware of important regional variations in irrigation rates and how by working with farmers through its *Living Water Smart* program and other initiatives it can improve irrigation efficiencies and reduce farm-related water consumption.

The focus on irrigation is understandable. Eighty-four per cent of the water consumed in agricultural operations is for irrigation, while most of the rest goes to water livestock.[31] Another key reason to focus on irrigation efficiency is that farms are big *consumptive* water users. Of the water used in agriculture, little is returned to the source that it was drawn from. At times, this simply cannot be avoided. Water is essential for plant growth, particularly during the germination period. However, there are times when crops can fare well with less water or less water-intensive irrigation methods.

By improving irrigation, the provincial government believes not only that farmers can be more water-efficient but also more profitable because of "reduced energy consumption and pumping costs."[32] Greater efficiencies in irrigation may also translate into reduced threats to groundwater contamination, with attendant savings in water treatment costs.

28 British Columbia Ministry of Environment, 2006.
29 van der Gulik, Neilsen and Fretwell, 2010.
30 Government of British Columbia, (n/d).
31 National Round Table on the Environment and the Economy, 2011.
32 Government of British Columbia, (n/d).

PHOTO COURTESY JEREMY HIEBERT

WHEN THE PRICE IS RIGHT

British Columbia's warm south-central interior is ideally suited for growing crops. But water availability is an ongoing concern for the local water purveyor, the South East Kelowna Irrigation District (SEKID).

Of the 2,300 water connections under the SEKID's control, more than 400 connections are for irrigators, and irrigators account for 85 per cent of all the water used.[33]

Because the SEKID draws its water from reservoirs that are primarily fed by rain and melting snow, there is limited opportunity to replenish water supplies during the generally dry and high-use summer months. The region is also considered particularly vulnerable to the impacts of climate change, which could both decrease water supply and increase water demand.

In 1994, in response to a series of droughts, the SEKID installed water meters and provided local orchardists with meters to monitor soil moisture. The meters gave irrigators valuable data that could help reduce the over-watering of crops, which helped bring down water use.[34] To drive even further efficiencies, in 2000 the SEKID took the added step of introducing a flat water rate for "basic" water allotments and then charging users on a so-called "volumetric rate" for water use beyond the basic amount.

In 2003, more punitive pricing measures were introduced. At the end of that irrigation season, two irrigators paid nearly $1,400 each for exceeding the basic water allotments rate by more than 70 per cent.[35] A year later the number of so-called "large abusers" dropped to zero, demonstrating the overwhelming success of the SEKID's conservation measures.

33 Government of Canada, Policy Research Initiative, 2005.
34 ibid.
35 ibid.

However, efficiency gains will not be achieved across the board. Some crops are not amenable to certain irrigation technologies. For example, drip irrigation doesn't really work for grain crops and would be prohibitively expensive to install. The rate of improvement will vary tremendously depending on whether water and energy efficiencies are achieved by farmers continuing to use the same irrigation methods, by improving the designs of the systems they use, or whether they opt to install entirely new systems and/or concentrate on growing other crops.

For example, drip irrigation is one of the most highly efficient irrigation methods, with an efficiency rating of about 93 per cent. The efficiency rating of a travelling gun system is considerably lower at 65 per cent, and irrigation done with a straight gun has an efficiency rating of just 55 per cent (see *Irrigation Water Demands*).

Through work with farmers, officials with BC's Ministry of Agriculture and Lands have encountered irrigation systems where the energy costs to the farmer were two-and-a-half times higher than they had to be. Ted van der Gulik, a senior engineer with the ministry's Sustainable Agriculture Management Branch reports that the problem with some systems is that they are old and poorly designed. In other cases, the irrigation method chosen simply requires more energy than would another system. For example, 60 horsepower generators for a travelling gun irrigation system versus 10 horsepower generators for a drip system.

When such power differential is considered in light of the water efficiency numbers noted earlier in this section of the report, it is clear how increased water use can translate into significant increases in energy use, and how the water-energy nexus is negatively impacted.

Fixing existing problems is not, however, without costs. Individual farming operations may be out tens of thousands of dollars if existing irrigation systems are replaced entirely.

IRRIGATION WATER DEMANDS

In 2003, researchers assessed water usage under different irrigation regimes across the Okanagan Basin. Part of the research quantified the irrigation water used over the course of the year for all crop types, and assigned averages based on the area of land and irrigation method.

The following are a few examples.

Irrigation Method	Irrigated Area (ha)	Average Irrigation Demand (m^3)	Average Water Required (mm)
Drip	1,522	6,441,575	423
Sprinkler	3,955	30,215,066	764
Pivot	435	2,467,882	567
Traveling Gun	1,835	14,512,782	791
Gun	273	3,192,373	1,171

Source: van der Gulik, T., Neilsen, D., & Fretwell, R. (2010 February). *Agriculture Water Demand Model. Report for the Okanagan Basin.* Retrieved from www.agf.gov.bc.ca/resmgmt/publist/500Series/500300-3_Agric_Water_Demand_Model-Okanagan_Report.pdf

Hans Schreier, a professor emeritus at the University of British Columbia's Institute for Resources, Environment and Sustainability, says efforts to increase irrigation efficiency make sense. But Schreier, whose interests include watershed analysis and land and water interactions, says that more than just chasing irrigation efficiencies is needed to lower farm-related water and energy consumption.

Not all agricultural crops are the same when it comes to the amount of irrigation water that is needed to grow them, Schreier says. In the Okanagan region, for example, there is huge variation in the water used to produce forage for cattle and the water used to grow grapes in a vineyard. The latter requires more than twice the water than the former.[36] Competition for irrigation water also extends to watering the turf on golf courses, which are among the region's most intensive irrigators. However, there are encouraging signs that utilizing municipal wastewater streams could lessen such water demand (see *Greening with Grey* on page 26).

Intensifying irrigation in the region, meanwhile, plays out against a backdrop of a general lack of data on how much water is naturally lost—through processes such as evaporation—from surface waters that are irrigation water sources. Although, efforts are underway to characterize such losses in the water-stressed Okanagan region.[37]

Beyond questions about the agricultural sector's water use at a regional or watershed level, loom other questions with potentially unforeseen consequences for the water-energy nexus.

A prime example is a proposed third dam on the Peace River, below the existing Peace Canyon and W.A.C. Bennett Dams. Should the dam be constructed, it would result in the loss of 5,000 hectares of productive farmland. Larry Peterson, a long-time resident of the Peace River region and someone who once farmed the productive lands along the stretch of river that could one day be a reservoir, said that if these lands were to be actively farmed, they could provide enough crops to sustain all of the region's 65,000 residents.[38]

In the absence of these lands being cultivated, crops must be produced elsewhere, and then processed and transported. The result of which is water and energy exports by another name.

There is huge variation in the water used to produce forage for cattle and the water used to grow grapes in a vineyard. The latter requires more than twice the water than the former.

OKANAGAN PHOTO COURTESY MAGALIE L'ABBÉ/FLICKR

36 van der Gulik, Neilsen and Fretwell, 2010.

37 Gerding, 2011. A three-year study of water evaporation rates on Okanagan Lake was launched in the summer of 2010 and is being led by the Okanagan Basin Water Board and Environment Canada. With perhaps a metre or more of water loss each year due to evaporation, gaining knowledge of the exact nature of such losses is critical to effectively manage water resources.

38 Fawcett, 2010. "Site C Would Drown a Vital Breadbasket." *The Tyee*. Retrieved from http://thetyee.ca/News/2010/04/06/VitalBreadbasket/

PHOTO COURTESY CITY OF VERNON

GREENING WITH GREY

The water utility in Vernon, BC has helped lower the boom on additional freshwater withdrawals with a unique irrigation program that uses greywater or treated wastewater from a municipal wastewater treatment plant.

Water from the plant undergoes various treatments and is stored in a reservoir about seven kilometres from Vernon's Water Reclamation Centre.[39] During the irrigation period, the treated wastewater is drawn out after receiving a final treatment with chlorine. It is then used to irrigate nearly 970 hectares of land to the south of the city, including three golf courses, a seed orchard, a tree nursery, and lands used for cattle grazing and hay production.

Using this recycled water offsets the need to further draw down the region's finite freshwater supplies. However, the diversion and treatment of wastewater has embedded energy costs. So, water is saved, but at the expense of additional energy consumption.

One way to avoid such costs may be to concentrate on utilizing greywater closer to its source. For example, in response to declining rainfalls, the state government in Western Australia has encouraged local governments, industries, and homeowners to install greywater systems that allow wastewater to be captured and reused nearer its source. In 2010, the government set out a detailed code of practice for greywater reuse.[40]

Similarly, in water-starved cities in the United States much more attention is being paid to the missed opportunities associated with household wastewater. About a decade ago, municipal politicians in Tucson, Arizona, convinced state legislators to make it legal for area residents in the arid city to irrigate their trees and garden plants with greywater from their kitchen sinks or washing machines. TIME Magazine subsequently reported that in 2007 the state rolled out a tax credit of up to $1,000 for homeowners who elected to install household greywater-capture and reuse systems. In 2010, a law went into effect in Tucson that required all builders to include greywater plumbing in new construction projects (which TIME Magazine reported was a first for a municipal government anywhere in the United States).[41]

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39 City of Vernon, (n/d).
40 Government of Western Australia, 2010.
41 Feldman, 2011.

FEATURE CASE STUDY 3: THE NATURAL RESOURCE SECTOR — INCREASING COMPETITION FOR WATER AND POWER RESOURCES

Throughout the world, demand for water and for power is on the rise as populations grow. BC is no exception, as witnessed by new proposals to increase domestic hydroelectric power supply and to access new water supplies to furnish not only the needs of growing populations but industrial demand, particularly in the province's water- and energy-intensive resource sector.

As urban and industrial centres in China and other Asian economies rapidly grow, the demand for forest, mineral, and energy resources is also increasing. The BC government, which has historically relied on the royalties, tax dollars, and jobs derived from the extraction, processing, and exportation of such resources, has made it a priority to expand its trade of these resources.

As we will see, the push to increase exports, particularly exports of water- and energy-intensive mineral and fossil fuel resources, appears to fundamentally contradict or undermine other provincial objectives, including the BC government's commitment to lower greenhouse gas emissions, encourage more clean energy production in the province, and modernize BC's outdated *Water Act*. This case study looks at the escalating demands for water and for power in BC's natural gas sector in particular, and is a prime example of the need for greater coherence of government policies aimed at safeguarding BC's water and energy resources and meeting the province's goals for reducing greenhouse gas emissions.

In early 2011, the BC government unveiled an employment strategy that set as a goal a dramatic expansion in resource industry activities, with a goal of eight new mines in the province by 2015 and three liquefied natural gas facilities by 2020.[42] None of these projects is necessarily a *fait accompli*, and progress will be influenced, to a high degree, by what happens in international marketplaces. But, it does underscore the priority that provincial governments continue to place on big developments in the natural resource sector. Should these projects materialize, they would have significant implications for BC's water and energy resources.

Natural resource industries — including the pulp and paper, agriculture, thermal electric, oil and gas, and mining sectors — are the most intensive water users in Canada, and some of them are predicted to need access to much larger water supplies in the coming years. This includes the natural gas sector, which increasingly utilizes water-intensive hydraulic fracturing or "fracking" methods to increase the flow of gas from tightly bound rock formations.[43] All of these sectors also need access to power to utilize water in their manufacturing processes, in their wastewater treatment facilities, to pump water, or a combination thereof.

Natural resource industries — including the pulp and paper, agriculture, thermal electric, oil and gas, and mining sectors — are the most intensive water users in Canada, and some of them are predicted to need access to much larger water supplies in the coming years.

As demands for water and for power increase, BC's hydroelectric network may need to expand, as the existing power supply appears close to insufficient to meet current needs in peak demand and/or low-water years. A more plausible outcome, given current constraints with the existing hydroelectric network, is that new power sources will be used. The most likely sources would be thermal and powered by natural-gas-fired turbines.

It remains to be seen how escalating water and water-derived power needs in this growing sector of the resource economy could play out in terms of increased hydroelectric capacity. Currently, several run-of-river proposals, a proposed third dam on the Peace River below the existing W.A.C. Bennett and Peace Canyon Dams, and natural-gas-fired turbines are all under consideration and/

42 British Columbia, Office of the Premier. (2011, September 22).

43 National Round Table on the Environment and the Economy, 2011.

or are undergoing environmental reviews. Regardless of how many facilities get built and what power sources they ultimately use, their construction and operation will serve to underscore the many tensions between various provincial policies relating to water and energy resources and climate change. Reconciling the contradictions between such policies (as we will see in the last two sections of this report) is essential if our interlinked water and energy resources are to be managed responsibly in the coming years.

Should this additional capacity materialize, or even if it does not, signs point to increased tensions over access to finite water and water-derived power resources (see *The Shale Gas Boom: Rising Tensions at the Intersection of Water and Energy in BC*).

THE SHALE GAS BOOM: RISING TENSIONS AT THE INTERSECTION OF WATER AND ENERGY IN BC

Extracting the natural gas found in shale rock formations is a challenge. To get the gas to flow out of the tightly bound rock, companies typically pressure-pump large quantities of water into the ground down wellbores and out into the surrounding rock. The pumping technique, known as hydraulic fracturing (fracking) creates cracks in the rock that liberate the trapped gas.

In BC, hundreds of thousands of cubic metres of water are pressure-pumped into the ground at individual hydraulic fracturing operations.[44] If fresh water is used, it becomes so toxic as a result of being pumped underground that it is typically lost to the hydrological cycle forever. The predominant "water treatment" method of choice is to pump this toxic wastewater deep below the earth's surface for permanent disposal.

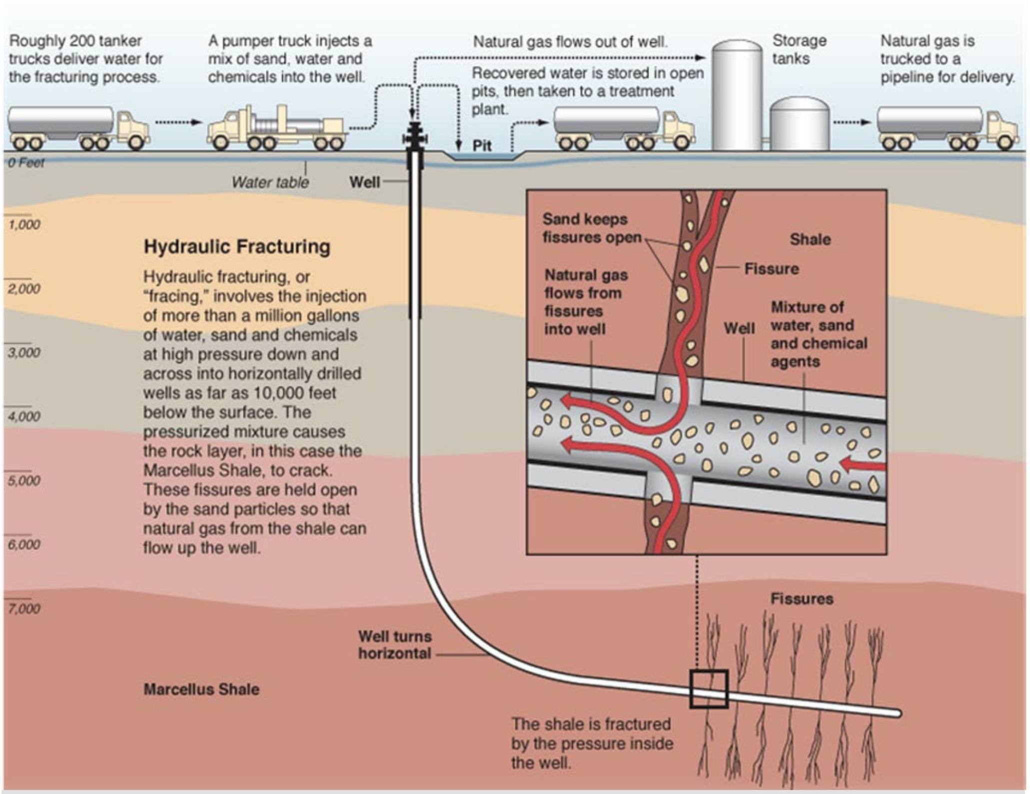
As the industry expands, these gas production techniques underscore rising tensions over competing demands for water and water-derived power in the province.[45] A case in point is Williston Reservoir, the largest body of fresh water in the province and its most important hydro source. Not only have natural gas companies recently drawn water out of the reservoir, giving rise to tensions between the industry and BC Hydro (the Crown corporation and provincial electrical power provider), but they also actively draw water out of the Peace River and its tributaries. During parts of 2010 and 2012, industry water withdrawals had to be temporarily suspended due to droughts.

The amount the companies paid for that water is also emerging as a public policy issue of note. Under short-term water withdrawal permits, known as Section 8 permits, companies paid nothing for the water. Under longer-term water licences, they paid $2.75 for every 2,500 cubic metres — an amount equivalent to filling one Olympic-size swimming pool. This compares with new industrial water-use fees introduced in January 2011 in the province of Quebec, where many industrial water users, including oil and gas companies, are now required to pay $175 for access to an equivalent amount of water.[46]

44 In 2010, the amount of water used at one multi-well gas well operation in northeast British Columbia totalled 1.5 million cubic metres of water, which is equivalent to about 600 Olympic swimming pools.

45 Parfitt, 2011.

46 National Round Table on the Environment and the Economy, 2011.



Extraction of natural gas found in shale rock formations is a water- and energy-intensive operation, requiring hundreds of thousands of cubic metres of water to be pressure-pumped into the ground at individual hydraulic fracturing operations.

GRAPHIC BY AL GRANBERG

Noting the new industrial water-pricing regime in Quebec, in 2011 Canada's National Round Table on the Environment and Economy reported that "political acceptability continues to be an important potential barrier to the adoption of water charges" in some Canadian provinces, but that recent polling has shown that western Canadians generally support setting a price on water that is sufficient to ensure conservation—a price that should be levied on individuals as well as industrial water users.[47]

Given that the industry generally pays little, if anything, for the water it uses, higher pricing could foster greater conservation. The challenges posed to water and energy resources by a rapidly expanding natural gas industry have already resulted in individual companies taking some conservation-oriented actions. For example, certain companies are capturing and reusing the toxic wastewater that flows back up wellbores following fracking operations. Others are using highly saline water from deep aquifers, rather than fresh water, as the primary fracking fluid.

Another key public policy question as far as the water-energy nexus is concerned relates to the lost power potential at the reservoir as water is diverted for uses other than hydroelectric production. Before natural gas companies gained rights to divert water from Williston Reservoir, they first had to come to an agreement with BC Hydro to compensate the power utility based on the value of lost power generation. At this point, it is difficult to predict how much power potential will be lost in future years. This will be influenced by a wide range of factors, including market rates for hydro, market rates for natural gas, and precipitation rates.

47 ibid.

No activity highlights the importance of the water-energy nexus in BC more than the direct generation of power from water sources, be it in the form of conventional hydroelectric dams and reservoirs or run-of-river hydro projects.
PHOTO COURTESY NIX-PIX

FEATURE CASE STUDY 4: WATER POWER

No activity highlights the importance of the water-energy nexus in British Columbia more than the direct generation of power from water sources, be it in the form of conventional hydroelectric dams and reservoirs or run-of-river hydro projects. Water is the overwhelming source of power in the province and will remain so for the foreseeable future.

Two river systems, the Peace and Columbia, are the primary hydropower sources in BC. Were it not for the water impounded in reservoirs behind dams built on these systems, the province's biggest power provider, the public electric utility BC Hydro, would be without 80 percent of its current power production.

The amount of water stored in these reservoirs is enormous. For example, approximately 70 cubic kilometres of water is stored at the W.A.C. Bennett Dam, BC Hydro's largest dam. On average, that volume of water is diverted every two years through turbines housed in a powerhouse carved deep into the canyon walls beside the dam — a process that keeps many lights burning in BC homes.

Water held in hydroelectric reservoirs begins as rainfall, melting snow, or ice. Year after year, those water sources feed reservoirs. The water is released in stages, allowing the captured water to return to watercourses below the dams. This "flow-through" of water sometimes leads people to refer to hydroelectric power production as "sustainable." But this is incorrect. In years where there is less rainfall or snowmelt, less power may be produced, and in periods where there is more rainfall or snowmelt, more power may be produced.

This helps to explain why BC Hydro, which accounts for about three-quarters of the province's domestic electricity production, reported in 2011 that the power produced at its various facilities ranged from 52,140 gigawatt hours to 39,303 gigawatt hours — a spread of nearly 25 per cent.[48] Such a marked range in power production over a relatively short period of time underscores the highly variable nature of hydroelectric power production.

48 BC Hydro, 2011.

These swings also underscore the challenges ahead for the power provider as the province's population increases and as power-intensive industries expand production (see Feature Case Study 3). In its 2010 *Electricity Load Forecast* document, BC Hydro estimated that demand for electricity in the province could increase by as much as 40 per cent over just 20 years.[49] Assuming such growth occurred, there would be obvious challenges for BC Hydro and other power producers to meet demand, particularly in low-water years.

Supply, however, is not just determined by water availability at BC Hydro facilities, as University of British Columbia professor George Hoberg and University of Victoria PhD candidate Amy Sopinka point out.[50] There are two other significant electricity producers in the province, and portions of the power produced in BC sell on export markets, just as power produced outside of the province may be purchased for domestic use.

About 20 per cent of BC-made electricity comes from industrial producers, primarily Alcan in Kitimat and Teck Cominco in Trail. Another six per cent originates from a privately owned power network operating in BC's Kootenay region (the oldest electricity provider in the province) and now owned by Fortis.

Statistics Canada provides details on the power produced from all three major power sources, as well as the total amount of power exported from and imported into the province. The data, which Hoberg and Sopinka analyzed and which is expanded on here, reveals that in the past ten years the total power generated annually varied by a significant amount. The most power was produced in 2007 and the year of lowest domestic production was 2010, for a spread of 18 per cent.

Total Power Production, Exports, and Imports

Year	Power Generated (GWh)	Net Power	Surplus	Deficit	Net Purchase (%)
	GWh				
2002	64,944,991	62,635,744	2,309,247		
2003	63,050,922	60,535,471	2,515,451		
2004	60,495,613	61,966,017		1,470,404	2.3
2005	67,811,173	65,789,978	2,021,195		
2006	62,021,396	68,560,975		6,539,579	9.5
2007	72,216,986	69,257,289	2,959,697		
2008	65,853,852	68,229,677		2,375,825	3.5
2009	62,201,456	65,838,960		3,637,505	5.5
2010	59,477,155	62,466,791		2,989,636	4.8
2011	66,395,166	63,484,224	2,910,942		

Source: Statistics Canada Can Sim Tables 127-0001, 127-0002, 127-0003. Retrieved from: www5.statcan.gc.ca/cansim/home-accueil?lang=eng.

49 BC Hydro, 2010.

50 Hoberg and Sopinka, 2011.

The data also shows that in five of the past 10 years the province was in a net energy trade deficit. In other words, its power purchases exceeded the power it sold.

Years in which the province was in an energy trade deficit could indicate that there was not enough water inflow into BC's hydroelectric reservoirs to generate the power necessary to meet domestic needs. If this were the case, the conclusion would be that the province was not self-sufficient in its domestic power production.

However, net trade deficits (and net surpluses for that matter) may also be explained by other factors, making it difficult to correlate surpluses and deficits with self-sufficiency or a lack thereof. First, jurisdictions, including BC, elect to purchase power at different times of the year because prevailing market prices make it less expensive to purchase power than to produce it. In other words, they choose to produce less power in response to favourable purchase prices. Another important factor is that in some cases choices have been made to produce less power from certain installed sources. For example, BC Hydro's Burrard Thermal Generating Station (a natural-gas-fired thermal plant in Burnaby) is capable of providing 7.5 per cent of the utility's power production. But in the past five years (2007–2011), the most power produced at the facility amounted to two per cent of the utility's overall power production. Another important factor that changes the deficit/surplus picture relates to the power that BC is entitled to under the Columbia River Treaty but that it has historically not taken. If this power is accounted for, BC would only have been in a trade deficit twice it the past decade. Although, as Hoberg and Sopinka caution, the so-called "Canadian entitlement" under the treaty may not be a "reliable" power source in future years.[51]

As part of a suite of policy changes aimed ostensibly at ensuring electricity self-sufficiency in the province and increasing domestic electricity production from "green" or "renewable" energy sources, the provincial government introduced its *Clean Energy Act* in April 2010.

Despite these caveats, when the Statistics Canada data is looked at over a longer time horizon it appears that in the past decade the province has entered into a phase where residential and industrial demands for power are beginning to test the limits of available domestic supply. In the first 20 of the past 30 years, there was only one year in which a very small electricity trade deficit was recorded, and that was in the last year (2001) of that time period. In the past 10 years, an electricity trade deficit was recorded, on average, one in every two years.

All of this assumes importance in light of recent initiatives by the provincial government. As part of a suite of policy changes aimed ostensibly at ensuring electricity self-sufficiency in the province and increasing domestic electricity production from "green" or "renewable" energy sources, the provincial government introduced its *Clean Energy Act* in April 2010. The initiative, the foundation for which was laid with two successive provincial energy plans in 2002 and 2007, has been a flashpoint for public debate. Much concern has focused on:

- the increasing number of long-term water licences being awarded by the province to private power producers in the service of new run-of-river hydro projects, and the minimal, if any, public consultation around the licence issuances, particularly with affected First Nations;
- the increased costs that ratepayers may pay for power supplied by such projects — power that BC Hydro would be required to purchase under contracts signed between it and the independent power producer; and
- the potential for a new, very large hydroelectric dam on the Peace River (Site C).

51 ibid. The authors note: "Some argue that this Canadian entitlement [about 1,350 MW of power] should be considered part of the domestic energy resource, since by treaty BC is entitled to that electricity for domestic use. If it were calculated that way, the province's net trade balance would look more favourable. Important to recognize, however, is that there is no guarantee that the Columbia River Treaty will continue under its current terms after its minimum length of 60 years expires in 2024. This means that BC may not be able to rely on the Canadian entitlement as a source of electricity in the long term."

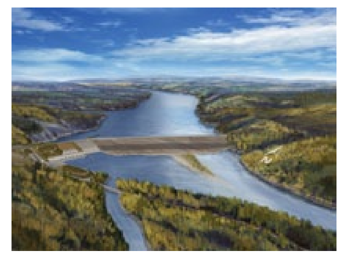
Regarding the proposed Site C dam, the equivalent of all the power produced at the dam (and much more) would likely be used to facilitate a formidable expansion in energy- and water-intensive industrial activities. Such an expansion would have significant environmental consequences in numerous watersheds. Moreover, the power rates paid by industrial power users are less than those paid by residential users, meaning residential power users subsidize or underwrite the costs of industrial users.

The *Clean Energy Act* included a list of objectives relating to BC Hydro, including:

- that BC Hydro was self-sufficient in its power production by 2016;
- that BC Hydro was self-sufficient in low-water years and that it had reserves of excess "insurance" power;
- that all new electricity generation had "zero net greenhouse gas emissions"; and
- that "clean" or "renewable" electricity continued to account for at least 90 per cent of total generation.

As we will see in the next section, many of these requirements were subsequently rescinded.

The policy turnaround strongly suggests that the government's policy priorities shifted, and that it chose to place more emphasis on boosting provincial revenues from royalty payments and payroll taxes through expanded mining and natural gas industry activities. Given projections about how much energy both these industries could require in future years, the government may have concluded that it was unrealistic to expect that sufficient additional hydroelectric power could be brought on line quickly enough to meet industrial needs. Or, it may have concluded that insisting mining and gas sectors use "clean" hydroelectricity would actually cost those industries more money than if they powered their plants with more readily available, cheap natural gas.



Regarding the proposed Site C dam, the equivalent of all the power produced at the dam (and much more) would likely be used to facilitate a formidable expansion in energy- and water-intensive industrial activities.

SITE C CONCEPTUAL DRAWING COURTESY BC HYDRO

This has all kinds of implications for the water-energy nexus. As we saw in the previous case study, expanded natural gas industry operations will result in increasing withdrawals of water (in some cases from hydroelectric reservoirs) and, because of the subsequent pollution of such water, its permanent withdrawal from the hydrological cycle.

With the door open to the gas industry powering its plants with gas-fired turbines, there will be additional consequences for water resources (both immediately, in the form of the water used in such plants, and in the future, in terms of the significant increases in greenhouse gas emissions associated with the combustion of more natural gas).

If, however, such industrial use is removed from the equation, a recent analysis (Calvert and Lee, 2012) suggests that even in the face of population growth, and with increased usage of such things as electric cars, BC's power needs could be met by more stringent conservation efforts and demand management. In other words, by replicating the success stories on water conservation noted elsewhere in this report, we could eliminate the need to build many of the projects that the *Clean Energy Act*'s architects envisioned having to build to make the province self-sufficient in energy production.

Nevertheless, in the event that new power projects do come on line and that they do involve hydroelectric sources—be they conventional dam and reservoir systems or less conventional run-of-river projects—impacts on lands and waters are inevitable. To what degree, when and where, will depend entirely on the type of facilities built and their location, but none will be without its impacts.

PART THREE

BC's Shifting Policy Terrain and the Water-Energy Nexus

AS THE PROVINCE'S POPULATION increases and uncertainties arise over the impact that climate change may have on our water and water-derived energy resources, the policies that BC pursues to safeguard both resources become increasingly important.

Recent policy initiatives announced by the government include:

- A modernized *Water Act*.
- A *Clean Energy Act.*
- A jobs and economic plan built around expanded resource industries, which effectively undercuts aspects of the first two initiatives.

Each can influence how our water and water-derived energy resources are managed. When these initiatives are considered, three critical questions arise where the water-energy nexus is concerned:

1. Do the initiatives have common objectives?
2. How might the initiatives be in conflict?
3. What is — or should be — the public's interest?

What follows is a brief description of each initiative and an explanation of where conflicts between them may arise. The purpose is not to propose detailed changes to individual initiatives (a topic that will be addressed in the next report in this series). Rather, it is to highlight what is already underway and where tensions may, or are likely to, arise.

Once the conflicts or tensions between the initiatives are understood, it is easier to grasp why much more coordinated approaches to managing our linked water and energy resources are needed.

THE WATER ACT

The principal legislation governing the management of water resources in BC is the *Water Act*. When it came into force in 1909, the province was far different than it is today. The most notable difference was its small, dispersed population, which barely registered 500,000 residents.

But population size was not the only difference. Back then, with the exception of farming operations, water-intensive industries were a rarity. Large urban populations, with their heavy demands for water and energy services, had yet to emerge, and major hydroelectric developments were still decades off.

Public attitudes toward water and water-derived energy resources were far different than they are today. Water was seen as an abundant, and at times even dangerous, resource; the disastrous flooding of the lower Fraser river in 1894 and the destruction of farms and homes in rural communities were still very fresh in people's minds when the *Water Act* became law.

In the ensuing decades following the *Water Act's* proclamation, BC's population increased by a factor of nine to more than 4.6 million, with the number of residents in Vancouver alone exceeding 600,000.

With the steady increase in population; growing demands for water and energy in cities, as well as the farming and manufacturing sectors; serious groundwater contamination in some regions of the province; and concerns over impacts on water resources due to climate change, the province decided in 2008 that the time had come to modernize British Columbia's century-old water legislation.[52]

With the steady increase in population; growing demands for water and energy in cities, as well as the farming and manufacturing sectors; serious groundwater contamination in some regions of the province; and concerns over impacts on water resources due to climate change, the province decided in 2008 that the time had come to modernize BC's century-old water legislation.
GARTH LENZ PHOTO

52 British Columbia, Ministry of Environment, 2009.

Early in that process, the government released a discussion paper that summarized why the *Water Act* needed to be updated. It made an explicit link between water and energy resources stating that:

> *Over the next 25 years the population of B.C. is expected to increase by 1.4 million people and our climate is changing. Population growth means increased demands on our water resources for drinking, for irrigation, for power generation and increased effects on the water from land-based activities such as urbanization, forestry and other resource extraction activities.*[53]

The same paper noted that water was already becoming scarce in some parts of the province and that site-specific scarcities could increase in the years ahead. There were then 5,000 locations where water users were encountering water shortages in BC and where restrictions on water takings were being contemplated. It also noted a growing concern over the state of groundwater resources, with sampling showing declines in water levels in a third of cases.[54]

As outlined by the provincial government, some of the major changes contemplated under a revised *Water Act* are:

- greater protections to ecological values associated with our water resources, including legal protection for environmental flows;
- greater community involvement in water planning;
- encouraging more efficient use of water resources and water conservation; and
- new regulations on groundwater including rules governing large groundwater withdrawals.[55]

The changes contemplated under an updated provincial water legislation are significant and if enacted could have a strong bearing on how BC's water and energy resources are regulated and managed in the coming decades. The proposed changes are not, however, occurring in isolation. If our linked water and energy resources are to be managed responsibly, a central question must be asked: to what extent will other policy objectives alter or undermine a modernized *Water Act?*

THE CLEAN ENERGY ACT

The 2010 *Clean Energy Act*, for example, sets an overarching objective of "electricity self-sufficiency."[56] (Although, as we will see, this significant requirement was subsequently dropped in February 2012.) Given the central importance of hydroelectric production, this almost certainly means more production from such sources in the years ahead. The legislation also set out other ambitious objectives:

- "demand-side" measures by the provincial power authority, BC Hydro, to reduce expected increases in power demand by at least two-thirds by 2020;

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53 British Columbia, Ministry of Environment, 2010.

54 ibid.

55 The list is derived from: Government of British Columbia. (n/d). *Background on* Water Act *Modernization*. Retrieved from www.livingwatersmart.ca/water-act/

56 Government of British Columbia, 2010a.

- generating at least 93 per cent of domestically produced electricity from "clean" or "renewable" sources, and building the transmission infrastructure required to transmit such electricity;

- energy conservation and efficiency through the use of clean or renewable resources; and

- staged reductions in greenhouse gas emissions in the province — 33 per cent below 2007 levels by 2020 and 80 per cent below 2007 levels by 2050.

All of these objectives, and more, had an important underlying benchmark against which progress in meeting energy self-sufficiency and heightened domestic green energy production would later be assessed: BC Hydro would be required to be self-sufficient in power production during low-water or "critical water" conditions.[57]

From the perspective of trying to sustainably manage natural resources, the low-water requirement in the *Clean Energy Act* made a certain amount of sense. If a reservoir fails to fill with the desired amount of water produced by rainfall and/or melting snow packs, then not as much water can be diverted through turbines and, therefore, not as much electricity can be produced. Basing electricity self-sufficiency around low-water years acknowledges that water resources are finite. The only truly secure hydroelectric power is what can be generated in years where the least amount of water is available. Anything more is, in essence, a bonus upon which we cannot rely.

The only truly secure hydroelectric power is what can be generated in years where the least amount of water is available. Anything more is, in essence, a bonus upon which we cannot rely.

As we have seen elsewhere, the variation in BC's hydroelectric power production has been considerable over the years. If domestic electricity self-sufficiency is the goal, this would seem to indicate that more hydroelectric facilities must be built, unless significant gains are made in lowering industrial and residential power use.

A confounding problem, however — and one that lends credence to the arguments of many who have criticized the *Clean Energy Act* — is that BC exports and imports electricity. Requirements that BC Hydro obtain additional electricity from independent or private power producers raises the possibility that a) much of the new power produced would be locked in at a higher price that BC Hydro would have to pay and b) the door would potentially be open for more power exports.

A generous reading of the Act's "self-sufficiency" requirements was that its principle aim was to ensure that the province was truly self-sufficient in hydro production in low water years. But as noted previously, BC is an active exporter and importer of power, and critics of the government's energy initiatives see the changes as an attempt to smooth the transition to more of a power export agenda, with the gateway open to more power production (and potentially more power exports) with much of that additional power coming from private or independent power producers.

Critics of the self-sufficiency requirement also noted that when it was considered in the broader context of the overall *Clean Energy Act*, it had the potential to come at a considerable cost.

"The fundamental problem with self-sufficiency and insurance is that it was forcing BC Hydro to buy new sources of electricity supply at prices well in excess of their market value — electricity that BC Hydro did not in fact need to ensure a reliable, environmentally responsible, cost-effective supply," notes Marvin Schaffer, an economist and adjunct professor in the Public Policy Program at Simon Fraser University.[58]

57 Government of British Columbia, 2010b.

58 Schaffer, 2012.

When the goals of a revised *Water Act* are considered alongside the *Clean Energy Act* as it was initially proposed, obvious tensions between the two initiatives emerge. If a fundamental goal of a revised *Water Act* is to better protect ecological values and to ensure that certain water flows are maintained for water services, fish, and wildlife, how do such objectives square with building more hydroelectric facilities, which clearly have impacts of varying degrees on water flows? Reconciling them poses formidable challenges that may ultimately require—indeed demand—changes in the way in which our interlinked water and energy resources are managed, as well as changes to related governance structures.

It may be that maintaining or exceeding minimum water flows on river systems where new conventional hydroelectric facilities are built can harmonize the objectives in both policies. Similarly, by situating new run-of-river operations on river stretches above waterfalls where certain fish species, such as salmon, cannot reach, such operations may be more compatible with new water-quality objectives. But, it is unlikely that this will become clear until the public sees the actual details of a new provincial *Water Act* and its regulations. In the meantime, significant concerns abound about the environmental impacts that many proposed hydro projects may have on the environment.[59]

BC's Jobs Plan calls for eight new mines by 2015 and up to three liquefied natural gas (LNG) processing plants by 2020. If developed, such an expansion would result in dramatic increases in greenhouse gas emissions, escalating water use, water quality degradation, and more industrial demands for power.

BC'S JOBS AND ECONOMIC PLAN

Where tensions between provincial policies on the water-energy nexus are most evident, however, is in BC's more recently unveiled economic and jobs plan. This is particularly so when the *Clean Energy Act's* requirements to lower greenhouse gas emissions are concerned. When details of the plan were released in September 2011, a major priority was to increase jobs in the natural resources sector.[60]

The plan called for eight new mines by 2015 and up to three liquefied natural gas (LNG) processing plants by 2020. Facilitating such an expansion will result in dramatic increases in greenhouse gas emissions, escalating water use, water quality degradation, and more industrial demands for power. It is estimated, for example, that to power just one LNG terminal from hydroelectric sources would gobble up eight per cent to 10 per cent of BC's existing hydroelectric production.

Realizing the enormity of the power potentially consumed in such industries, in February 2012 the government elected to waive the self-sufficiency aspects of its *Clean Energy Act.* Instead of having to meet future power needs based on low-water years, the hydro provider was told it could now base its plans on "average" water flows. The provincial government also waived the requirement that BC Hydro provide an "additional" 3,000 gigawatt-hours of so-called "insurance" power by 2020.[61]

More recently, and likely in recognition of the huge strains that rapidly expanding natural gas and mining industries would place on the province's hydroelectric grid, the BC government further announced that it would amend its *Clean Energy Act* and allow natural gas to be declared a "clean" fuel, when such gas was used to provide power to new LNG processing plants.[62,63]

59 Hill, 2012.

60 Government of British Columbia, 2011.

61 British Columbia, Ministry of Energy and Mines, 2012.

62 Legislative Assembly of British Columbia, 2012. On May 29, 2012, BC's Minister of Energy, Mines and Natural Gas stated that the power required to electrify three new LNG terminals and three new mines would use the equivalent of two Site C dam's worth of power.

63 Bailey, 2012.

What this could ultimately mean is that the government is incapable of meeting its ambitious greenhouse gas emissions reduction goals. Just the emissions associated with burning natural gas at three proposed LNG plants would be enough to increase BC's emissions by more than nine per cent.[64]

The government's abrupt amendments of provisions in the *Clean Energy Act* underscore the tensions between its initially stated clean energy and energy self-sufficiency goals and its jobs and economic policies. But there are also rising tensions between its efforts to modernize the *Water Act* and its jobs and economic agenda. This came to light in 2011, when the government committed $24 million over two years to "eliminate" a backlog of more than 6,700 natural resource industry applications. The backlog included requests for long-term rights of access to water by mines and energy companies.[65]

Expediting water use approvals for such sectors poses obvious challenges for the management of provincial water resources. It will result in large volumes of water being rendered so toxic that the water is essentially lost to the hydrological cycle forever, and it will likely result in increased cumulative impacts in watersheds where natural gas and mining companies operate.

What the tensions between the government's water, energy, and economic/jobs objectives reveal is that there is little top-down coherence in how the provincial government is choosing to manage BC's water and energy resources. In particular, there is an absence of any assessment or review process to ensure that economic development goals are not in conflict with water and energy policies.

There is an overarching need, highlighted in the tensions and contradictions between the various policy initiatives, for governance reforms and for concrete actions that will immediately improve prospects for the sound management of these interlinked resources, a topic to which we now turn.

64 Parfitt, 2012.

65 Legislative Assembly of British Columbia, 2011. In the Speech from the Throne it was revealed that the provincial government aimed to halve the backlog of natural resource industry applications, including water applications, in a little more than one year with a priority placed on the mining industry. It is worth noting that this has its parallels in recent actions by the federal government, which has announced, among other things, changes to the federal *Fisheries Act*, the federal environmental assessment review process, and review processes under the National Energy Board, all of which are aimed at reducing the time period during which proposed new industrial projects (e.g. mines or energy industry projects) are assessed and subsequently approved or rejected by federal regulatory bodies.

PART FOUR

Charting a New Course

Provincial agencies whose mandate is to protect our water and energy resources must be better equipped to deal with challenges, as well as be transparent in the decisions they make and the baseline information used to support their decisions.

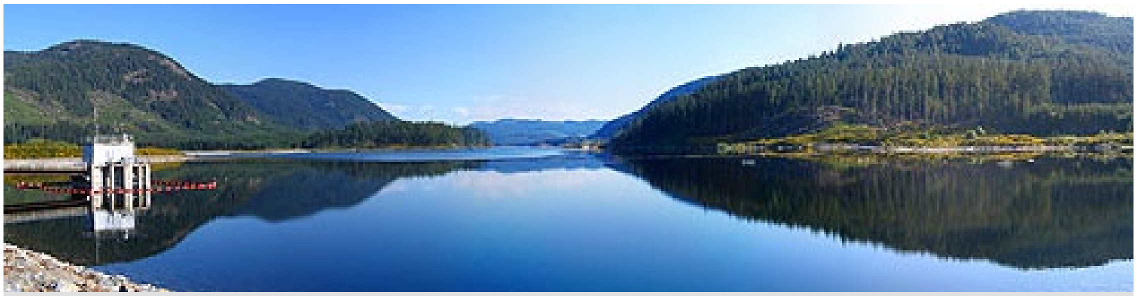
EARLIER IN THIS REPORT, we noted how British Columbia does not collect good, reliable data on actual water usage in the province and how the lack of such data is a significant barrier to effective governance of our interconnected water and energy resources. We have also looked at how policies relating to the province's water and energy resources are shifting, are often unco-ordinated, and, at times, are at odds with one another. In light of the challenges outlined in the case studies in this report, this lack of data and lack of policy coherence is a significant barrier to the effective management of these crucial resources.

What these deficiencies further suggest is that improved governance must be a key overarching objective or principle that guides decision-makers, political leaders, and policy analysts as reforms are made to the way we manage our water and energy resources. This necessarily requires leadership from senior governments—especially the province. Provincial agencies whose mandate is to protect our water and energy resources must be better equipped to deal with challenges, as well as be transparent in the decisions they make and the baseline information used to support their decisions. This instils public confidence that such resources are being responsibly managed.

It also requires more effective "bottom-up" governance that ensures the people, communities, and regions most directly impacted by critically important decisions around the allocation and uses of water and energy resources have a stronger say in such decisions, of which there is good historical precedence in British Columbia (see *Watershed Reserves and Regional Water Boards* on page 41).

In addition to the important issues of who decides and how decisions are made, effective governance is further characterized by openness, transparency, accountability, science-based decision making, fairness, and equity.

As part of our ongoing work under the auspices of this project, the POLIS Project on Ecological Governance's Water Sustainability Project at the University of Victoria and the Canadian Centre for Policy Alternatives intend to more fully address questions of effective governance in future publications related to the water-energy nexus.



WATERSHED RESERVES AND REGIONAL WATER BOARDS

Often, the challenges that society confronts with regard to the water-energy nexus revolve around how decisions are made and who is making them.

Tensions arise when the people and communities most closely tied to resources feel they are not part of the decision-making process. Given the importance of water and energy resources to community health and prosperity, effective governance places a premium on healthy, functioning watersheds and the communities that depend on them.

This has been understood in BC for some time. As Vancouver-based researcher Will Koop noted following an exhaustive review of documents in provincial archives, "dozens and dozens of drinking watersheds in BC were protected through *Land Act* Watershed Reserves in the early 1900s."[66] Koop would go on to write in great detail about how this designation—and the powers it appeared to confer on local communities and governments to have a substantial say in how resources in watershed lands were managed—was subsequently eroded, leaving community water supplies vulnerable to a host of land-use activities.

Despite the erosion of the designation, which Koop traced to pressures to open up lands to industrial logging, there are some communities in the province that retain strong influence over their drinking watershed lands. The Greater Vancouver Regional District (GVRD)'s three major watersheds (the Capilano, Seymour and Coquitlam watersheds) are held under a 999-year lease by the GVRD. The City of Victoria has similarly strong powers over the majority of lands surrounding its drinking water reservoirs, primarily because it owns the lands outright.

Another important example of strong local or regional leadership on water governance is the Okanagan Basin Water Board (OBWB). Founded in 1968 and legislated in 1970, the OBWB was created to improve the oversight and management of water resources over 8,000 square kilometres of land that take in everything from the height of land down to the shorelines of Okanagan Lake.

The board includes representatives from the three Okanagan regional districts, the Okanagan Nation Alliance, the Water Supply Association, and the Okanagan Water Stewardship Council (a multi-stakeholder group established by the OBWB to provide independent science-based advice on water issues).[67] Since its creation, the OBWB has helped spearhead some of the most detailed gathering of information on local water resources and how they are used of any region in the province. This has served to greatly enhance local and provincial understanding of the challenges faced in the region and created what might be called a new "basin culture" that better balances the needs of community development and healthy watershed function.

66 Koop, 2007.
67 Okanagan Basin Water Board, 2012.

The City of Victoria has strong powers over the majority of lands surrounding its drinking water reservoirs, such as the Sooke Reservoir, which is the primary municipal water supply for Victoria.

PHOTO COURTESY CAPITAL REGIONAL DISTRICT

At this point, it is important to reiterate that while substantive changes to governance structures may not be achieved for some time, there are actions that can be taken now that would improve the management of our water and energy resources. In the next section, we present four proposed actions for immediate consideration. These actions have been informed by the case studies found throughout the main body of the report, as well as those in the appendix. Before turning to these actions, we want to make a few observations with respect to recent efforts by the provincial government to improve governance.

The first has to do with resource management decision-making and oversight by the provincial government. In October 2010, the provincial government launched an ambitious restructuring of its so-called "dirt" ministries, amalgamating them into one super ministry. The announcement set in motion a new Ministry of Natural Resource Operations (the name of the ministry was short-lived and subsequently replaced with Ministry of Forests, Lands and Natural Resource Operations). With the change, the new ministry assumed many of the operational responsibilities of the former Ministries of Forests, Environment, Energy, Agriculture, and Aboriginal Relations. This included responsibilities for allocating water resources, with the obvious implications that has for the water-energy nexus.

It is important to reiterate that while substantive changes to governance structures may not be achieved for some time, there are actions that can be taken now that would improve the management of our water and energy resources.

One view of these changes is that they hold potential for a more coordinated and integrated approach to the management of natural resources at a landscape level — the argument being that having different functions housed in different ministries makes such coordination more difficult to achieve. While this coordination and integration has yet to be realized, it could be headed in the right direction. Much will depend on what the provincial government chooses to do by way of expanding the ministry's mandate and providing it the necessary staff and budget to meet the task of managing multiple natural resources in an integrated way.

In the absence of an expanded mandate and sufficient capacity, however, there is a risk that such a new super ministry will be incapable of improving upon what several ministries operating independently did before it. The end result could be that various land uses, singly or in combination, continue to have increasingly negative consequences for our interlinked water and energy resources (see *Cumulative Effects in the Kiskatinaw River Watershed* on page 43).

As the evidence suggests, the mandate to adequately address cumulative effects currently does not exist. The work of the Ministry of Forests, Lands and Natural Resource Operations is further complicated by the fact that it does not have sole authority when it comes to important decisions around the issuance of water licences and temporary water-use permits. The provincial Oil and Gas Commission (OGC), for example, has been delegated authority under the current *Water Act* to issue short-term water-use permits to oil and gas companies. This has allowed the OGC to assign rights of access to large volumes of water outside of the ministry's purview. In other words, despite efforts to bring things together under one umbrella, key decision-making powers appear to remain fragmented in separate silos within different provincial agencies.

A second, more pessimistic view of the recent restructuring is that it had little to do with coordinating land-use activities and monitoring and managing cumulative effects, and more to do with ensuring that industry applications to access water, forest, mineral and fossil fuel resources were processed more quickly and efficiently. This appears to be borne out in the ministry's own annual service plan report for 2010/2011. It notes how a "coordinated approach" to dealing with permit and licence applications resulted in sharp declines in the number of letters of notice issued to First Nations and in the length of consultation time frames prior to the ministry ruling on various resource applications.

PHOTO COURTESY ARTHUR CHAPMAN/FLICKR

CUMULATIVE EFFECTS IN THE KISKATINAW RIVER WATERSHED

In March 2011, BC's independent Forest Practices Board released a report that assessed the effectiveness of the province's current approach to addressing the cumulative effects of various land uses on defined areas of land. The study was launched in 2008, before changes to the provincial cabinet structure that created the new Ministry of Natural Resource Operations (now the Ministry of Forests, Lands and Natural Resource Operations), which amalgamated key functions from several existing ministries. The report focused on one watershed in northeast BC, the Kiskatinaw River Watershed near Dawson Creek.

The report concluded that the cumulative effects of various land uses in the watershed had led to a loss of key habitat for a local caribou population. It also found that forest soil losses were building, and that there was a moderate to high risk that by 2017 local water courses could be degraded by increased flows of forest soils and other sediments into local creeks and rivers. Lastly, the report flagged concerns over potential losses in water quantity by 2017 due to increased activities in the watershed, particularly in the form of natural gas drilling.

The report found unambiguous evidence that a host of land uses were leading to deterioration in the quantity and quality of water, as well as a deterioration of forest soils and increased threats to wildlife. It noted that there were more than 1,200 explicitly authorized land-use activities in the watershed including:

- 15 forest licences (licences to log Crown timber);
- 24 range permits (to graze cattle);
- 33 water licences and 13 licenced waterworks;
- 25 temporary water-use permits for oil and gas companies;
- 29 coal mining tenures; and
- 802 right-of-ways, primarily for oil and gas pipelines and utilities.

The Forest Practices Board concluded that these activities, and a host of others, were authorized by various ministries or agencies "more or less in isolation" of each other. And the Board went on to note that while this was set to change with the new Ministry of Natural Resource Operations, the change in provincial cabinet structure was in and of itself insufficient "to adequately manage cumulative effects."

This report concludes that improved governance is an essential prerequisite to more effective management of our interlinked water and energy resources.

PHOTO COURTESY TBATTY

The same annual report noted that the ministry's "integrated approach" to issuing permits and licences enhanced its ability to "understand the cumulative effects of multiple resource activities on our land base." It stated that such an approach ensured "resilient communities for families today and into the future." Left unsaid, however, was the critical issue of how to, in the Forest Practices Board's words, "adequately manage" such effects.

The evolution of this new super ministry has raised many questions about how to manage natural resources in a more coordinated way. While there have been criticisms that the changes are insufficient to address cumulative effects, the encouraging thing is that the provincial government has signalled a willingness to try new things.

As noted, this report concludes that improved governance is an essential prerequisite to more effective management of our interlinked water and energy resources. While there are some encouraging signs that the provincial government understands the critical importance of the water-energy nexus, it has yet to effectively integrate its policies and management approaches. Reorganization and institutional changes are needed to achieve coherence in overall provincial policies and to ensure improved governance both within, as well as across or between, sectors (e.g. forestry, agriculture, the fossil fuel industry). Such changes must also include improved monitoring, data collection and public access to such information, as well as public participation in review and decision-making processes.

PART FIVE

Conclusion and Recommended Actions

AT THE OUTSET OF THIS REPORT we noted that in order to manage our interlinked water and energy resources more effectively changes to governance structures are required. However, such changes will not occur overnight and will likely require ongoing discussions between provincial, local, or regional authorities and First Nations.

In the interim, there are a number of actions that could be embarked on that would increase prospects for greater resource conservation and set the stage for more effective governance in the years ahead.

We conclude that the following four interlinked action items would set the province on a more productive course in the management of key water and energy resources and would instil greater public confidence that these key resources are being managed with an eye to the future and the significant challenges posed by population growth, industrial diversification, and climate change.

Changes will not occur overnight and will likely require ongoing discussions between provincial, local or regional authorities and First Nations.

ACTION 1: PUBLISH ACCURATE AND TIMELY REPORTS ON ALL PROVINCIAL WATER USE

Effective management of water resources requires that the general public, large water and power users, and regulatory agencies all have access to accurate and comparable water use data. This includes information on the so-called "flow through" water that spins hydroelectric turbines. Without such information, we cannot manage our water and water-derived energy resources responsibly.

A recent report by the National Round Table on the Environment and Economy explored water use across all of Canada's natural resource sectors. It cited the lack of baseline information on water withdrawals as a pressing national problem saying:

> *Good policy development and solid management decisions require sound evidence and information. Information is derived from data, and in the context of water quantities in Canada, this data is not as comprehensive or as readily available as it should be. To effectively implement water policies and management strategies we need to improve our understanding of both water supplies and water demands. With increasing competition for water resources, governments need better data, not just to make sound allocation decisions today, but also to ensure there is enough water for the future.*[68]

The Round Table found that no Canadian province does an exemplary job in such data collection. However, it is provincial governments that, by and large, are responsible for allocating and managing most water resources within their borders. The need for access to crucial baseline information on actual water use is especially relevant to BC, given the province's stated commitments to modernize its water legislation and clean energy commitments, which are strongly focused on hydroelectric energy sources.

Sustainable water management is possible only when we know what we have, what we use and from what water sources, and what we can reasonably be expected to have — and need — in the future.

BC currently has no publicly available water use database. One explanation for why this is the case is that the provincial government does not uniformly require major water users to actually report on the water they use. As part of the research for this report, we looked at water licences issued to pulp and paper mills. The pulp and paper industry is a significant user of water. In only one case was a pulp mill required to keep a record of actual water consumed, and even then the company was only required to report its water use if requested to do so.

There is historical precedence in the province, however, for collection and public dissemination of resource use data, most notably in BC's forestry sector. For more than two decades, the government has maintained a sophisticated dataset that provides up-to-date information on trees logged across the province. It reveals information on the volume of trees logged by species and grade, location, time of year, company or licensee, and on revenues collected, among other information. The data is available online and users can do their own customized searches of the database to gather very specific information.

A publicly available water database in which much the same type of information could be collected (e.g. volume of water withdrawn, source, user, rental fee) would simply require, as a condition of a water licence or temporary water-use permit, licence and permit holders to meter their water consumption and report from what body of water they made their withdrawals. The accuracy of such reporting could then be verified through random audits by a provincial ministry.

As the regulator, the provincial government would have an increased stake in ensuring that the data collected was accurate by placing a high enough price on the water that it more than covered the additional costs of operating the database.

68 National Round Table on the Environment and the Economy, 2011.

ACTION 2: APPROPRIATELY PRICE WATER AND ENERGY RESOURCES

When the National Round Table on the Environment and Economy reviewed water usage by Canada's natural resource industries, it concluded that pricing was an important and necessary tool to ensure that water resources were conserved to the full extent possible.

"If it is more expensive to use water, firms will reduce their use and seek alternatives," the Round Table concluded. "In essence, water charges affect costs, and firms and customers will adjust their water use in response to the price change."[69] This view of how water prices can impact use — and increase productivity and efficiency — is supported by a number of more formal economic studies and analyses.[70]

The Round Table did not say what price should be set for water in such industries. It did, however, present an instructive example from Quebec, where the provincial government decided in 2011 that industrial water users who withdrew more than 75 cubic metres of water per day would be subject to higher water charges. Users would pay an initial rate of $70 per every million litres of water withdrawn. This works out to $175 for each Olympic swimming pool worth of water. In BC, the corresponding figure is in some cases zero cents and in others about $2.75.

Under-pricing resources encourages waste — and misses a valuable opportunity for the government to secure resources for effective protection and management of water. Imposing higher prices, on the other hand, promotes conservation, which is of ultimate benefit to our water and energy resources, as well as water and energy users.

With strong evidence that pricing can play an important role in driving conservation and innovation, a central challenge is to ensure that principles of equity apply if and when higher pricing of our water and energy resources is implemented.

At a practical level, in addition to setting a higher price, what impacts might a volume-based pricing system have on the water-energy nexus in BC? Earlier in this document, we talked about the increasing stresses on water resources in the Abbotsford and Mission areas, which are both serviced by the same water provider. Different water pricing regimes apply, however, between the two communities. In Mission's case, water users play a flat rate for their water, while in Abbotsford water charges are tied to water use. A 2012 publication by Abbotsford /Mission Water and Sewer Commission shows that water use in Mission is, on average, 50 per cent higher than in Abbotsford.[71]

With strong evidence that pricing can play an important role in driving conservation and innovation, a central challenge is to ensure that principles of equity apply if and when higher pricing of our water and energy resources is implemented. In other words, pricing for household water must be designed in a manner that ensures lower-income households and households with large numbers of family members are not adversely impacted.[72]

In addition, given the very high water and energy demands in the industrial sector, it is critical that new projects such as mines, natural gas well developments, and liquefied natural gas plants pay a sufficient cost for the water they use, for any new electricity generation and/or electricity transmission infrastructure they may require, and for the full environmental costs associated with both the water used and the wastewater or industrial effluents produced. Otherwise, other businesses and households will be effectively subsidizing such activities.

69 ibid.
70 Espey, Espey and Shaw, 1997.
71 Abbotsford Mission Water & Sewer Services, 2012c.
72 Barlow, 2012.

Presently, with one exception, BC's water pricing system is not based on actual water use. BC Hydro is the only major water user that pays based on a calculation of the water used. BC Hydro pays the provincial government a fee based on the water used to generate power at its facilities. All other water fees collected by the provincial government — be they fees collected from a pulp mill operator or a municipal water utility — are not based on actual water use, but on the maximums assigned to the user as outlined in their water licences. Basing the fees on actual water use and increasing the fees to reflect the true costs of water withdrawals makes sense from a water and energy conservation perspective. But it is only possible if proper data reporting is required. Thus Action 1 and Action 2 are inextricably linked.

ACTION 3: PROMOTE RESOURCE RECOVERY TO CONSERVE WATER AND ENERGY RESOURCES

By conserving resources, we forestall having to develop other sources of water and power and take some pressure off resources that will likely face further challenges in light of climate change.

As stated at the outset of this report, with BC's population poised to climb and with demand for water and power resources escalating in both existing and emerging industries, the pressure on our finite water and power resources is rising. As such, efforts to conserve such resources — whether water itself or water-derived power — make sense.

By conserving resources, we forestall having to develop other sources of water and power and take some pressure off resources that will likely face further challenges in light of climate change.

Earlier in the report, we explored what conservation might mean in a practical sense for residents in the communities of Abbotsford and Mission, where the local water provider confronts the expensive proposition of having to spend $300 million to pump water from a new water source, treat the new water prior to its distribution into the water network, and then treat all of the wastewater produced by the region's growing population. If various tools aimed at *reducing* per capita water use succeed, not only may there be significant savings in terms of forestalled investments in new municipal water infrastructure, but energy savings as well.

Elsewhere, we saw how by capturing otherwise wasted heat in a municipal sewage stream, 16,000 residents in Vancouver are able to have most of their home-heating and water-heating needs met. More widespread use or *reuse* of the heat potential from otherwise wasted resources again takes pressure off of our existing water and water-derived energy systems, to the ultimate benefit of everyone.

Finally, we saw how in the community of Vernon efforts to recycle treated wastewater are providing a valuable source of irrigation water for everything from golf courses to hayfields. The gain for the environment is immense: less drawdown of freshwater in a region of the province known for its hot, dry weather.

It is clear how this proposed action item ties in closely with Actions 1 and 2. Greater attention to data collection and appropriate pricing of water and energy resources make it easier to promote policies aimed at resource recovery.

ACTION 4: PRIORITIZE WATERSHED HEALTH AND FUNCTION

This action item most closely ties to the overarching objective or principle of governance reform and will by necessity require changes in the way senior and local levels of government approach the management of water and energy resources.

Earlier, we noted how the cumulative effects of various land-use activities in defined watershed lands have the potential to seriously degrade land and water resources to the point where water quantity and quality can be irreparably harmed.

Given the linkage between water availability and power production, unchecked developments in watersheds can have serious consequences for both water and energy resources. These challenges are only increased as the impacts of climate change are increasingly felt in watersheds across the province.

Changes in site-specific precipitation patterns as a result of climate change will likely have further negative consequences for many regions of the province and for specific watersheds. At various times of the year, some regions of the province may be more prone to drought or flooding than others. Adequately protecting watershed lands so they are resilient in the face of anticipated changes to our climate will be vital to conserve water and energy resources.

In prioritizing watershed health and function as a key strategy for conserving water and energy resources, the provincial government should consider the benefits that have accrued to regions where watershed protection has been made a public policy priority. The Greater Vancouver Regional District, for example, holds a 999-year lease to its watershed lands, and has explicit policies to control land-use activities in and around its three major reservoirs, with the express purpose of protecting water resources.

Protecting the healthy functioning of watersheds means that potential costs to further treat water, with all the embedded energy costs associated with such treatment, can in many cases be avoided.

Protecting the healthy functioning of watersheds means that potential costs to further treat water, with all the embedded energy costs associated with such treatment, can in many cases be avoided.

PHOTO COURTESY PETE TUEPAH

Map of Appendix Case Studies

The map below shows the geographical location and page number for each of the case studies in the appendix.

The positive case studies highlight instances in which one or more of the recommended actions in the report are already being pursued. The positive case studies are numbered 1 through 10.

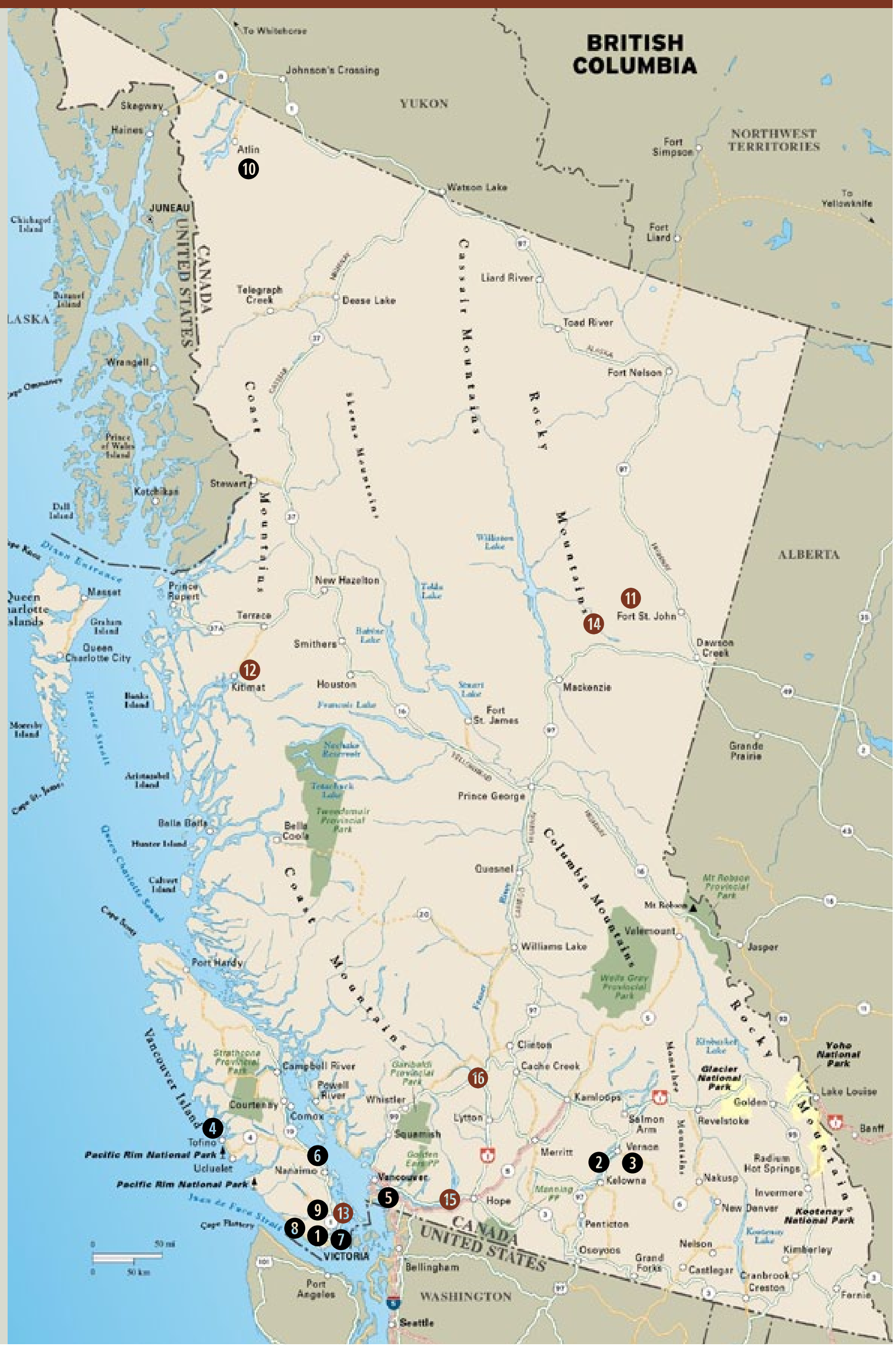
The negative case studies exemplify communities or projects where, if the recommended actions in the report were pursued, there would be more positive outcomes for water/energy resources. The negative case studies are numbered 11 through 16.

POSITIVE CASE STUDIES

1. **Living Water Smart, Victoria, p. 52**
2. **Water Supply and Demand Project, Okanagan Basin, p. 52**
3. **Greater Vernon Water, Vernon, p. 53**
4. **Volumetric Water Billing, District of Tofino and Regional District of Nanaimo, p. 54**
5. **Southeast False Creek, Vancouver, p. 55**
6. **Harmac Pulp Mill, Nanaimo, p. 55**
7. **McLoughlin Wastewater Treatment Plant, Greater Victoria, p. 56**
8. **Solar Panel Installations for Hot Water and Electricity Production, T'Sou-ke First Nation, p. 56**
9. **Sooke Lake Reservoir and CRD Source Lands, Capital Regional District, p. 57**
10. **Atlin Hydro Project, Atlin, p. 58**

NEGATIVE CASE STUDIES

11. **Proposed Site C Hydroelectric Dam, Peace River System, p. 59**
12. **Proposed Liquefied Natural Gas Plant, Kitimat, p. 59**
13. **BC Jobs Plan, p. 60**
14. **Hydraulic Fracturing, Hudson's Hope, p. 61**
15. **Stave Lake Water Supply and Treatment Project, Abbotsford and Mission, p. 62**
16. **Town Creek Watershed, Lillooet, p. 63**



APPENDIX

Further Case Studies: The Water-Energy Nexus in Action in BC

The Positive

The following case studies provide examples of how each of the four recommended actions identified in the report has real-world applicability. If broadly adopted, the recommended actions could improve the prospects for more effective governance of water and energy resources in British Columbia in the years ahead. The case studies are divided into five categories, drawing on the overarching core principle of the report and the four recommended actions.

- Core Principle: Policy Coherence and Improved Governance
- Action 1: Publish Accurate and Timely Reports on All Provincial Water Use
- Action 2: Appropriately Price Water and Energy Resources
- Action 3: Promote Resource Recovery to Conserve Water and Energy Resources
- Action 4: Prioritize Watershed Health and Function

Individual case studies were placed in the category of "best fit." However, certain examples may illustrate elements from more than one category. Each positive case study is meant to depict how the core principle of policy coherence and improved governance or one of the report's four recommended actions is already being successfully implemented in the BC context.

CORE PRINCIPLE: POLICY COHERENCE AND IMPROVED GOVERNANCE

❶ CASE STUDY: LIVING WATER SMART, VICTORIA

Living Water Smart is a provincial government initiative to modernize the rules governing water management and water use in BC. The initiative is intended to help the province better cope with the pressures on water resources from a changing climate, population growth, and economic development. The initiative may lead to substantive changes to rules governing the allocation of water, groundwater regulation and protection, and ensuring mandatory minimum flows in rivers and streams. Updating BC's 100-year-old *Water Act* is a core component of Living Water Smart. The *Water Act* modernization process aims to meet four commitments:

- Protect ecological values and aquatic environments;
- Improve water governance arrangements;
- Adopt a more flexible and efficient water allocation system; and
- Regulate and license groundwater withdrawal.

The *Water Act* modernization process is a significant opportunity to create new water governance structures that utilize knowledge and expertise at the watershed level to inform policy development. Ideally, it would be accompanied by a corresponding modernization of energy policies, thus reflecting the interconnected nature of water and energy resources. As well, decision-making processes around water and energy issues and policy development would improve opportunities for communities and regions to be more directly involved, particularly at the watershed level.

Action 1: Publish Accurate and Timely Reports on All Provincial Water Use

❷ CASE STUDY: WATER SUPPLY AND DEMAND PROJECT, OKANAGAN BASIN

The Okanagan Basin has among the lowest water supplies per person of any region in Canada, with major water users, including the agricultural and tourism sectors, competing for access to water, along with the basin's growing residential population. The *Water Supply and Demand Project* of the Okanagan Basin Water Board "examines patterns of water licensing and availability across the valley, and evaluates the potential impacts of climate change" on the basin's water resources.[73]

The project includes studies on groundwater, stream flows, environmental water needs, and water use (balancing water supply and demand through a computer accounting model). Key findings from the studies are available for public use, and assist utilities in keeping an ongoing record of how much water is being used. This is critical when planning for the recurring water shortages expected in the region due to an increasing population and changing climate.[74]

The project helps the region understand patterns of water use and the potential impacts of population growth, climate change, and land use on the environment. The models employed are essential for planning to meet current and emerging water supply and demand challenges, and are illustrative of the benefits of publishing accurate, timely information on water use for planning decisions.

73 Okanagan Basin Water Board, (n.d.).

74 ibid.

❸ CASE STUDY: GREATER VERNON WATER, VERNON

Through its water utility, Greater Vernon Water, the Regional District of North Okanagan employs an inclining block rate to charge residents for the water they use. Mandatory metering of all residential customers in Greater Vernon was implemented in 2005. As of 2010, all agricultural customers were also required to install meters for irrigation water.

Residential water rates include a base fee of $78.12 per quarter, plus an increasing tiered charge per cubic metre.[75]

Tier Level	Consumption (m^3)	Rate ($/$m^3$)
Tier A	0-10	$0.00
Tier B	>10-20	$0.00
Tier C	>20-40	$0.98
Tier D	>40-80	$1.20
Tier E	>80	$1.74

For commercial water customers, the fee is based on the size of the water meter. Water meters are sized to appropriately match the diameter of their associated water supply pipes, as meter size determines the accuracy of measuring water volumes. The commercial water fee ranges from the base rate of $78.25 for a water supply pipe with a diameter of 16mm or smaller (common to smaller businesses) up to $1,615.10 for a water supply pipe with a diameter of 160mm (more typical of large scale commercial or industrial connections).[76] In addition to those base fees, commercial customers are charged a consumption rate of $1.09 per cubic metre.[77] Agricultural water customers are charged fees based on the amount of water their property has been allocated. The allocation fee is $59.50 per hectare per quarter. If a customer's water use within a year exceeds their allocation, as of 2012 they will be charged an over-use fee according to the following tiers.[78]

Tier Level	Over-Allocation Percentage	Rate ($/$m^3$ per year)
Tier A	0-10% over allocation	$0.05
Tier B	>10-30% over allocation	$0.10
Tier C	>30-50% over allocation	$0.20
Tier D	>50-70% over allocation	$0.40
Tier E	>70-90% over allocation	$0.80
Tier F	Over 90% of allocation	$1.09

75 Table adopted from: City of Vernon. (n.d.). *Utilities User Rates*. Retrieved from www.vernon.ca/services/finance/utility_user_rates.html

76 ibid.

77 ibid.

78 Table adopted from: Regional District of North Okanagan. (2012). *Bylaw No. 2527: A bylaw to impose rates for the Greater Vernon Regional Water Supply Local Service Area*. Pg. 8. Retrieved from www.rdno.ca/bylaws/Bylaw_2527.pdf

Through conservation-oriented pricing, customers have more control over their water bills. Water utilities are also better able to recoup the operational costs of providing water services, with revenues being reinvested into the water supply system to repair leaky or outdated infrastructure. One of the goals of conservation-oriented pricing is that "people will change the value they place on water and modify their actions accordingly."[79] If a reduction in total water demand is achieved, this can have associated energy cost savings for the municipality through reductions in energy for treatment, pumping, and distribution of water and wastewater.

A secondary measure being undertaken by Greater Vernon Water to reduce its operational costs, which are largely energy costs, is to separate agricultural from domestic water supply. Raw, non-potable water will be diverted to a separate agricultural distribution system before treatment. This will result in a substantial reduction in energy use by the water treatment plant as agricultural demand averages around 150 megalitres per day during the summer while domestic demand peaks at about 30 megalitres per day.[80]

❹ CASE STUDY: VOLUMETRIC WATER BILLING, DISTRICT OF TOFINO AND REGIONAL DISTRICT OF NANAIMO

Following water shortages during the summer of 2006, the District of Tofino revised its water rate structures in an effort to reduce water use and to address a growing municipal infrastructure deficit.[81] The new rate structure has five pricing tiers based on water consumption, and different rates for residential and business users.[82] Seasonal water surcharges were also imposed to discourage excessive consumption in summer months. In 2009, an additional $1.50 levy on every cubic metre of water used was also introduced.[83] Tofino now charges among the highest rates for water in the country, with consumers at the top tier paying $3 per cubic metre in the winter and $4.60 per cubic metre in the summer.[84] The rate hikes were justified as essential for raising the capital to improve on the water infrastructure deficit, as well as reducing overall water use rates.[85]

The Regional District of Nanaimo is another example of how volumetric water billing has been used to reduce water demand and encourage efficiency. The District operates eight water systems, called Water Services Areas, which are fully metered. Customers are billed based on an inclining block system with six different consumption tiers, ranging from the minimum rate of $0.28 per day up to $3.19 per cubic metre for any use over 3.51 cubic metres per day.[86] The pricing regime was designed to collect 75 per cent of the cost per cubic metre through user fees. Generally, the remaining costs are covered by parcel taxes.

Both the Tofino and Nanaimo examples illustrate the positive benefits of appropriate pricing regimes to influence water use rates. In the case of the Regional District of Nanaimo, the inclining block pricing system was developed through an extensive public input process. It has sent a strong price signal to heavy water users, while allowing for a reduction in costs associated with reduced use. Through an overall reduction in per capita water use, municipalities can realize energy savings on wastewater treatment costs, as well as energy savings in water treatment, pumping, and distribution costs.

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79 Brandes, Renzetti and Stinchcombe, 2010.
80 Mills, 2012.
81 Brandes, Renzetti and Stinchcombe, 2010.
82 ibid.
83 ibid.
84 ibid.
85 ibid.
86 Finnie, 2012.

ACTION 3: PROMOTE RESOURCE RECOVERY TO CONSERVE WATER AND ENERGY RESOURCES

❺ CASE STUDY: SOUTHEAST FALSE CREEK, VANCOUVER

Located in Vancouver's downtown core, the new Southeast False Creek neighbourhood, built on former light industry grounds, is among the most energy efficient neighbourhoods in Canada. The Neighbourhood Energy Utility (NEU) captures heat from the municipal sewage stream and distributes the heat, via hot water, to buildings in the community. When the heated water leaves the NEU facility, it goes to energy transfer stations (located within each building) that produce the space heat and domestic hot water for distribution to the building's residents. [87] Metering is used in the energy transfer stations for energy measurements and billing purposes.[88]

The sewage captured by the NEU facility goes into the city's collection system and then to the treatment plant in Richmond. In addition to the captured heat from municipal sewage, rooftop solar heaters on three buildings produce hot water.[89] The total heat extracted meets about 70 per cent of the neighbourhood's annual energy needs, and reduces carbon emissions by more than half of what they would be if natural gas was the sole heat source. [90] Southeast False Creek was designed around the principle of integrated resource recovery, with ancillary benefits to the overall reduction in water and energy use in the community.

Once the dedicated NEU is developed to its full capacity by 2020, the service will provide space heat and domestic hot water to 16,000 residents and an area covering more than 560,000 m^2. [91] With BC's population expected to grow substantially over the coming decades, developing new sources of water and power to meet community needs, including recovering "waste streams" for reuse, will result in reduced pressures on water and energy resources that will likely face further challenges in light of a changing climate.

❻ CASE STUDY: HARMAC PULP MILL, NANAIMO

Nanaimo Forest Products is building an electrical generation plant at its Harmac pulp mill site to produce 25 megawatts of power—adding to the existing 30 megawatts already produced on site from a turbine installed in the 1960s.[92] Some of this additional electricity will be sold to BC Hydro.[93] The company reached a 15-year deal with BC Hydro to sell excess electricity produced "from wood biomass using recaptured steam energy to help power the generator" for sale back to the grid.[94] Through the sourcing of electricity for the provincial power grid from unconventional sources, such as resource recovery in pulp mills (of which BC historically has an abundance), the province can diversify its power sources away from a heavy reliance on new energy from hydropower. The generation plant will cost $45 million and take 18 months to build.[95] The mill is also using federal funding to improve energy efficiency and environmental performance.[96] This will result in an estimated 11 gigawatt hours per year of electricity savings—the

87 City of Vancouver, (n.d.).
88 ibid.
89 British Columbia, Ministry of Community Development, 2009.
90 Georgia Strait Alliance, 2012.
91 Baber, 2010.
92 Moneo, 2012.
93 Foresttalk.com, 2012.
94 Barron, 2012.
95 Foresttalk.com, 2012.
96 Barron, 2012.

equivalent of powering approximately 990 homes for one year.[97] Recovering electricity potential from sources traditionally viewed as "waste" material can provide additional power to meet BC's electricity demand. This is especially important as the major hydro facilities in the province face increasing energy demands from growing populations and industrial sectors, as well as the potential for great variations in water flow timing, duration, and intensity due to climate change.

❼ CASE STUDY: MCLOUGHLIN WASTEWATER TREATMENT PLANT, GREATER VICTORIA

Utilizing a former industrial site, the McLoughlin Wastewater Treatment plant is proposed as a centralized facility for treating wastewater in the expanding Victoria region (excluding the Saanich Peninsula and District of Sooke).

The McLoughlin Wastewater Treatment plant has been proposed for completion by 2018, at an estimated cost of $782.7 million (including biosolids processing, all pump stations, and piping), and with an annual operating cost of $14.5 million. Integrated within the design of the new treatment plant are considerations for future resource recovery options, including:

- energy and residuals from organic solids;
- wastewater heat energy;
- water reuse;
- nutrient recovery; and
- pressure energy.[98]

Though this project will consume a lot more energy than what is currently used for wastewater and sewage treatment in the Victoria region, there are compelling and up front efforts to lower the water-energy footprint through implementing future resource recovery technologies. There is the potential for annual resource recovery revenues of $3.1 million by 2030,[99] and the potential for annual carbon offsets of 18,500 tonnes from gas and heat recovered from wastewater.[100] A separate initiative is also currently underway, looking at extractions of heat from trunk sewers and water mains using heat pump technology.

❽ CASE STUDY: SOLAR PANEL INSTALLATIONS FOR HOT WATER AND ELECTRICITY PRODUCTION, T'SOU-KE FIRST NATION

T'Sou-ke First Nation, located on the southern tip of Vancouver Island, has installed a 500-panel solar system[101] with a 75 Kilowatt capacity[102] for use by their community, making them the largest solar energy producing community in BC.[103] The project's major energy benefits come from:

- heating water using solar water heaters in almost half of the 90 homes in the community (as heating water is one of the largest uses of domestic electricity, the solar panel-heated water significantly reduces domestic hydro bills);

97 McGarrigle, 2012.
98 Capital Regional District, 2008.
99 Capital Regional District, 2011.
100 Capital Regional District, 2010.
101 Lavoie, 2012.
102 Kimmett, 2009.
103 CBC News, 2009.

- conservation and education programs to inform and engage residents on the benefits of and financial savings from energy conservation; and
- generating clean, renewable energy that meets all the energy needs of the T'Sou-ke Nation's administration and produces surplus to sell to BC Hydro.

The result has been a reduction in domestic hydro bills in the community and an increase in the nation's income since BC Hydro purchases surplus clean energy. T'Sou-ke Nation aims to bring all their domestic buildings to "net zero." This means that over a period of one year, the nation will create and sell as much electricity as it consumes. Decentralized electricity generating systems, as found in T'Sou-ke Nation, show the potential for:

- Wider-adoption of similar systems across BC;
- Greater community control and ownership of electricity sources; and
- Savings in long-term energy costs (once upfront costs have been recouped), which allows for more effective management and use of energy resources.

These improved governance arrangements require integration and alignment of community decision-making input with provincial policy development processes.

ACTION 4: PRIORITIZE WATERSHED HEALTH AND FUNCTION

❾ CASE STUDY: SOOKE LAKE RESERVOIR AND CRD SOURCE LANDS, CAPITAL REGIONAL DISTRICT

British Columbia's Capital Regional District (CRD) supplies drinking water for residential, commercial, institutional, industrial, and agriculture uses to approximately 340,000 people within the Greater Victoria area on the southeast corner of Vancouver Island in British Columbia.

The primary water supply for Greater Victoria is the Sooke Lake Reservoir, with a storage capacity of just under 93 million cubic metres. Secondary drinking water sources are reservoirs in the Goldstream River watershed (Butchart, Lubbe, Goldstream, and Japan Gulch reservoirs), which has a catchment area of 2,281 hectares and reservoir storage capacity of approximately 10 million cubic metres.[104] The Goldstream reservoirs are used mainly as a reserve system, for when the Sooke Reservoir cannot meet demand. Approximately 98 per cent of the catchment lands in the Sooke and Goldstream water supply areas are owned and controlled by the CRD. [105]

In addition, in 2007 the CRD purchased 8,791 hectares of land in the nearby Leech River watershed, to protect future drinking water supply lands. When required, water from the Leech River will be transferred through an existing tunnel to supplement the level of Sooke Lake Reservoir. This acquisition nearly doubled—to approximately 20,000 hectares—the area of land protected by the CRD for source water protection. The purchase of the land could also allow the CRD to avoid approximately $150 million worth of investments into a new water treatment facility.[106] In comparison, the purchase of the Leech River watershed lands was $58.9 million, and was funded through an increase in the wholesale water rate that costs the average CRD household about $23 per year.[107]

104 Capital Regional District, 2012.
105 ibid.
106 Capital Regional District, 2007a.
107 ibid.

The benefits associated with the purchase of the Leech River watershed lands include control over watershed land use, potential avoidance of building and operating a $150 million water treatment plant, and long-term protection of ecological values in the watershed.[108]

⓾ CASE STUDY: ATLIN HYDRO PROJECT, ATLIN

The 2.1 megawatt Atlin Hydro Project is a small run-of-river hydro project that has allowed the isolated community of 400 people in Atlin, BC, to end their reliance on diesel fuel to power and heat their homes. Atlin remains an "off-grid" community, meaning that it is not linked to the provincial hydro grid. Because of this, the community had previously relied on a diesel-fired electrical generating station for all of its power. Its annual diesel usage was upwards of one million litres. The estimated productive life span of the Atlin Hydro Project is 25 years — though it is believed the lifetime of the project will far exceed this.[109] Over that time period, upwards of 150,000 tonnes of greenhouse gases from the diesel generators will be prevented from entering the atmosphere.[110] Because a corporation owned by the Taku River Tlingit First Nation developed the project, the project's hydro sales revenues remain with the local economy and create employment and contracting opportunities.[111] This project illustrates the potential for successful community involvement in the development of water into an energy resource for the local community. The added benefit is a reduction in greenhouse gas emissions and particulate matter, such as black carbon, leading to a healthier environment for the community.

The Negative

The following case studies provide on-the-ground examples of instances where the recommended action items identified in the report could, if implemented, provide beneficial input and have a positive impact on achieving the core principle of improved governance and policy coherence of water and energy resources in the years ahead. The case studies are divided into five categories, drawing on the overarching core principle of the report and the four recommended actions.

- Core Principle: Policy Coherence and Improved Governance
- Action 1: Publish Accurate and Timely Reports on All Provincial Water Use
- Action 2: Appropriately Price Water and Energy Resources
- Action 3: Promote Resource Recovery to Conserve Water and Energy Resources
- Action 4: Prioritize Watershed Health and Function

Each case study is placed in the category where the most improvement could be made.

108 Capital Regional District, 2007b. *Backgrounder: Creating a Legacy.* Retrieved from www.crd.bc.ca/water/timberwest/background.htm

109 Simpson, 2012.

110 BC Hydro, 2012b.

111 Taylor, 2009.

11 CASE STUDY: PROPOSED SITE C HYDROELECTRIC DAM, PEACE RIVER SYSTEM

Water used in the production of energy has location-specific benefits and drawbacks. Throughout BC, there are a number of projects that raise questions about the suitability of proposed hydroelectric projects. One such project — Site C — is a third dam proposed for the Peace River system. It would cost nearly $8 billion to build and would produce about 5,100 gigawatt hours of electricity per year, enough power to light and heat 450,000 homes.[112] The powerhouse at the proposed dam would generate approximately 35 per cent of the energy produced at the W.A.C. Bennett Dam (BC's largest body of fresh water, and the seventh largest reservoir by volume on earth), but with just five per cent of the larger dam's reservoir area. The reservoir created by the dam would flood approximately 5,000 hectares of productive farmland and rise 60 metres above the current river bed. Though located in the north of the province, the valley's microclimate makes it an agriculturally productive region, comparable to the richly fertile lower Fraser River region of BC's southern mainland.[113] This is especially important if the valley is lost under the proposed reservoir. As fuel and transportation costs increase, importing food to replace locally grown sources becomes more expensive.

The Site C proposal highlights the inherent tensions between various provincial policies including those designed to:

- protect water resources;
- protect agricultural lands;
- achieve secure, domestic hydroelectric and renewable energy supplies; or
- boost investment and employment in new resource extraction industries, particularly mining and natural gas extraction and processing.

In addition to the Site C application, dozens of smaller run-of-river hydro projects are either underway or are proposed in BC. Each of these could have significant ecological impacts and each serves to highlight governance challenges. For example, a proposed 45-megawatt run-of-river hydropower project on the Kokish River of northeastern Vancouver Island would result in the damming and diversion of an 11-kilometre stretch of river, endangering summer- and winter-run fish populations. Operation of the 45-megawatt project would require diverting water from an area of documented salmonid spawning and rearing habitat — representing the first time an independent power producer would be allowed to do so in BC.

Trade-offs are almost certain to result when land-use decisions are made. But trade-offs can be mitigated if conflicts between various policy initiatives are addressed. Aligning policies as much as possible before new energy projects are reviewed and considered for approval helps to ensure more effective governance.

12 CASE STUDY: PROPOSED LIQUEFIED NATURAL GAS PLANT, KITIMAT

A proposed liquefied natural gas (LNG) plant near Kitimat — the third such proposed project in the area — could add immensely to strains on BC's hydroelectric network, while simultaneously increasing water-intensive gas extraction activities. A Shell-led consortium aims to build the $12.35 billion plant[114], which, if built, would have an annual production rate of 12 million tons of natural gas and would be

112 BC Hydro, 2012c.
113 Fawcett, 2010.
114 Vancouver Sun, 2012.

among the first LNG export facilities in western North America.[115] The plant is one of several under consideration and would consume the equivalent of between eight per cent and 10 per cent of the province's current hydroelectric production.

If all three of the proposed LNG export terminals were to be built, the combined demand on provincial power resources would approach one-quarter of the province's projected hydroelectric power production as of 2016.

If such an expansion occurred, it would result in provincially significant increases in the consumption of water and power resources. Like the proposed Site C dam, proposals for a number of new LNG projects underscore the importance of reconciling the contradictions between government policies before major projects are reviewed and considered for approval.

At present, there are obvious tensions between provincial government policies aimed at conserving water resources and having secure domestic hydroelectric and renewable energy supplies, and those aimed at heightened investment, employment, and revenues from an expanded natural gas sector. A dramatic expansion of the natural gas sector would also undermine provincial government objectives to lower greenhouse gas emissions in BC. As such emissions climb, moreover, there are likely to be impacts on water resources which could negatively affect hydroelectric production in the province.

Good governance would also ensure that the cumulative environmental impacts of the natural gas sector's operations are more fully understood and addressed, with the specific objective of ensuring that the healthy ecological functioning of watersheds is maintained. This is especially true when the natural gas well "stimulation" method known as hydraulic fracturing (fracking) is considered. The harmful impacts that fracking operations have on groundwater resources have been extensively documented, as have the massive amounts of surface water required in the fracking process.[116]

13 CASE STUDY: BC JOBS PLAN

A key component of the provincial government's BC Jobs Plan, released February 2012, is its emphasis on an expanded mining sector in the province. The government has set as a target the development of at least eight new mines by 2015. Each mine will require substantial amounts of electricity infrastructure to power its operations, as well as large amounts of water. Included in the list of new mines is the proposed Red Chris gold-copper mine, an open-pit mine located 80 kilometres south of Dease Lake that would threaten water resources in the traditional territory of the Tahltan Nation in northwest BC. Members of the Tahltan Nation believe the mine will contaminate and significantly transform the landscape of the Klappan Valley, resulting in a "vast tailings pond near the headwaters of three of BC's biggest rivers — the Stikine, the Nass, and the Skeena."[117] The region is known as the Sacred Headwaters. Under the BC Jobs Plan, another nine existing mines are also scheduled for expansion.[118]

To facilitate such an expansion, the government further announced that it is "committed to reducing the turnaround time for permits by reducing the 'notice of work' backlog for mining by 80 per cent by August 31, 2012 and for water and land act tenures by 50 per cent by December 31, 2012."[119]

Like the proposed Site C dam and several proposed liquefied natural gas plants, the provincial government's attempts to foster a new mining boom in BC raises questions about the inherent tensions be-

115 ibid.
116 Parfitt, 2011.
117 Pollon, 2012.
118 Government of British Columbia, 2012.
119 ibid.

tween various government policies, in particular how the heavy emphasis on expanded natural resource industry activities squares with efforts to protect water and domestic energy resources.

As the water-energy nexus emerges as more of a provincial priority, there needs to be a greater emphasis placed on policy coherence, such that policies are linked and driven by common principles. Otherwise, pursuit of certain policy objectives may partly or completely undermine other policies.

ACTION 1: PUBLISH ACCURATE AND TIMELY REPORTS ON ALL PROVINCIAL WATER USE

14 CASE STUDY: HYDRAULIC FRACTURING, HUDSON'S HOPE

British Columbia is providing the natural gas industry with access to increased volumes of water, including water from hydroelectric reservoirs, to assist companies in extracting gas from deep shale formations.[120] This raises a number of concerns, including:

- an absence of transparency into how decisions are made about the use of water resources in hydraulic fracturing operations in BC;
- uncoordinated approaches to the issuance of water use permits and water licences to various natural gas companies (permits are issued by the provincial Oil and Gas Commission, while licences are issued by the Ministry of Forests, Lands and Natural Resource Operations);
- tracking the total volume of water used by the industry from under all permits and licences;
- accounting for the cumulative impacts associated with industry water use and wastewater handling; and
- a lack of publicly available and easily navigable information on water use.

Surface water is often used by the industry in the extraction process known as hydraulic fracturing (fracking). According to a report by the Pembina Institute (2011), some fracking operations use up to 90 million litres of water per well.[121] Two recent water withdrawal licences issued to Calgary-based Canbriam Energy Inc. and Talisman Energy would allow the companies to withdraw 7.3 billion litres of water annually out of the Williston Reservoir—equivalent to draining 2,920 Olympic-sized swimming pools per year. This is a relatively tiny amount when viewed against all the water in the reservoir, but enough that it has required the natural gas sector to negotiate directly with BC Hydro to compensate the power utility for the lost power potential associated with the water withdrawn from the reservoir.[122]

Increased reliance on water from the Williston Reservoir for fracking operations would pit oil and gas company water needs against the water requirements for energy production at BC Hydro's W.A.C. Bennett and Peace Canyon Dams, which supply the majority of electricity to the BC grid. In 2010, BC Hydro's Williston Reservoir sat at 77 per cent of normal inflows, due to low snowpack and drought. This was on top of a dry 2009 in which BC imported 10,801,679 megawatt hours of electricity from the United States.[123] In 2010, the result was the importation of electricity into BC from western U.S. at an estimated cost of $220 million. This is equivalent to a one-year hydro rate increase of seven per cent.[124]

120 CBC News, 2011.
121 Campbell and Horne, 2011.
122 Parfitt, 2011.
123 BC Stats, (n/d).
124 Vancouver Sun, 2010.

Ensuring that information on how water is used, where it is withdrawn from, and any associated trade-offs in the use of that water over other uses is necessary for effective management of both water and energy resources. As this report argues, making data on the quantities of water withdrawn from water sources, water users, and water rental fees publicly available is the first step to establishing baseline information for water resources in BC, and measuring cumulative impacts on watersheds. This, in turn, will assist in the sustainable management of water resources, and how they are used in the creation of water-derived energy sources.

ACTION 2: APPROPRIATELY PRICE WATER AND ENERGY RESOURCES

⓯ CASE STUDY: STAVE LAKE WATER SUPPLY AND TREATMENT PROJECT, ABBOTSFORD AND MISSION

The Abbotsford/Mission Water and Sewer Commission (AMWSC) is a joint water system that serves the residents of both the City of Abbotsford and District of Mission. Currently, it supplies potable water to 135,000 users, with an estimated doubling of water users in the next 20 years.[125] However, projected water demand could exceed current supply capacity from the existing three sources by as early as 2015.[126] To meet the projected increase in water demand, AMWSC may be forced to develop access to a new water supply at Stave Lake—a move that would require significant increases in water pumping and treatment costs. To meet immediate needs, AMWSC is increasing groundwater pumping and implementing demand management measures.[127] The total estimated cost for the Stave Lake Water Supply and Treatment Project is almost $300 million.

By charging a volumetric rate for water use, Mission has the potential to reduce per capita water use and consumption. Abbotsford already charges water users on a volumetric basis. Together, through various options such as the use of pricing signals to reduce per capita water use, aggressive conservation efforts, replacement of outdated toilets and fixtures, installing smart meters, landscape and irrigation audits, lawn sprinkler restrictions, and two-tiered water pricing in the high-use summer months, Abbotsford and Mission could achieve water neutrality. Conservation and efficiency, rather than increasing supply, could meet all new demands for water and avoid a multi-million-dollar investment in a new municipal water supply. This has corresponding energy savings as well. Treating and moving water and wastewater represents a significant energy cost to municipal governments and agencies. Reductions in per capita water use have the potential to lower the energy required for pumping and treating of both water and wastewater.

ACTION 3: PROMOTE RESOURCE RECOVERY TO CONSERVE WATER AND ENERGY RESOURCES

Although a case study is not included to illustrate a "missed opportunity" for promoting resource recovery to conserve water and energy resources, it should be noted that efforts must be made to incorporate technologies that reduce the demand for both water and energy into new developments at the residential, commercial, and industrial levels. Provincial policies, municipal by-laws, and building

125 Abbotsford Mission Water & Sewer Services, (n.d.).
126 Deloitte, 2011.
127 ibid.

codes can act as the driving force behind promoting such technologies, ensuring a higher degree of conservation of our water and energy resources.

ACTION 4: PRIORITIZE WATERSHED HEALTH AND FUNCTION

16 CASE STUDY: TOWN CREEK WATERSHED, LILLOOET

Generally, communities in BC do not have control over land-use decisions on their watershed lands. Rather, this responsibility is largely in the hands of the provincial government. For example, decisions involving whether or not to permit activities such as logging and cattle grazing on Crown lands and in most watersheds are the responsibility of BC's Ministry of Forests, Lands and Natural Resource Operations. The same ministry also has authority to issue water licences (rights of access) to surface waters on Crown lands. Traditionally, the value associated with forests on such lands has been as a source of timber for logging companies, without concern for watershed protection.

Lillooet is a small community on the Fraser River about 240 kilometres inland from Vancouver. In 2004 and again in 2009 forest fires destroyed up to 70 per cent of the trees that stood in the Town Creek watershed, a main water source for the District of Lillooet. It is estimated that the fires impacted the district's water source so severely that water withdrawals may have to be discontinued or drastically curtailed for up to seven years (as of 2009).[128] Bringing online alternative water sources for the municipality could cost upwards of between $8 million to $12 million,[129] with a projected water user rate increase of $200 to $250 per year depending on the proposal.[130]

Control over watershed lands is critical for source water protection, as well as for conserving water and energy resources. The fires in the Town Creek watershed highlight the difficulties communities can confront when lands are damaged and new water sources must be found. Community control over management of lands in a watershed may be one means of ensuring a higher level of control and protection of key community water resources. For example, if the highest and best use of Crown timberlands was protecting water quality as opposed to providing a supply of raw materials to the logging industry, then "forestry" operations could be reconfigured to focus on reducing the risks of wildfire in proximity to communities and community water supplies.

Through long-term planning with integrated land and watershed decision-making, community water sources would have a greater degree of oversight and protection afforded to them. This, in turn, could lead to potential downstream savings in terms of avoiding having to further treat water, with all the embedded energy costs associated with such treatment.

Though it is difficult to say for certain whether the 2004 or 2009 forest fires in Lillooet could have been avoided had land management decisions been made by the community with watershed protection as a central focus, it could be stipulated that greater integration of land- and water-use decisions and source protection would have long-term benefits for community watersheds and water and energy security generally.

128 True Consulting Group, 2009.
129 ibid.
130 True Consulting Group, 2011.

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POLIS Project on Ecological Governance, University of Victoria

Created in 2000, the POLIS Project on Ecological Governance is a research-based organization housed at the University of Victoria, British Columbia. Researchers who are also community activists work to make ecological thinking and practice a core value in all aspects of society and dismantle the notion that the environment is merely another sector. Among the many research centres investigating and promoting sustainability worldwide, POLIS represents a unique blend of multidisciplinary academic research and community action.

www.polisproject.org

POLIS Project on Ecological Governance

watersustainabilityproject

The POLIS Water Sustainability Project (WSP) is an action-based group that recognizes water scarcity is a social dilemma that cannot be addressed by technical solutions alone. The project focuses on four themes crucial to a sustainable water future:

- Water Conservation and the Water Soft Path;
- The Water-Energy Nexus;
- Watershed Governance; and
- Water Law and Policy.

The WSP works with industry, government, civil society, environmental not-for-profits, and individuals to develop and embed water conservation strategies that benefit the economy, communities, and the environment. The WSP is an initiative of the POLIS Project on Ecological Governance at the University of Victoria.

www.poliswaterproject.org

THE CLIMATE JUSTICE PROJECT

The Climate Justice Project is a multi-year initiative led by CCPA and the University of British Columbia in collaboration with a large team of academics and community groups from across BC. The project connects the two great "inconvenient truths" of our time: climate change and rising inequality. Its overarching aim is to develop a concrete policy strategy that would see BC meet its targets for reducing greenhouse gas emissions, while simultaneously ensuring that inequality is reduced, and that societal and industrial transitions are just and equitable.

www.climatejustice.ca

CCPA
CANADIAN CENTRE for POLICY ALTERNATIVES
BC Office

The Canadian Centre for Policy Alternatives is an independent, non-partisan research institute concerned with issues of social and economic justice. Founded in 1980, it is one of Canada's leading progressive voices in public policy debates. The CCPA is a registered non-profit charity and depends on the support of its more than 10,000 members across Canada.

www.policyalternatives.ca

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