CREATING A CULTURE OF WATER AND ENERGY EFFICIENCY IN NOVA SCOTIA COMMUNITIES

Recommendations on water efficiency and energy efficiency for municipal water

Ecology Action Centre

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JANUARY 2015

"While there is no single path to success in water management — and the path will look different for each jurisdiction and each community — there is much to be gained by framing approaches to common problems, pooling expertise, and collaborating to address key questions."

Canadian Municipal Water

Rural communities now understand that the environment is itself a valuable resource for tourism and for attracting people to live and locate businesses"

Now or Never (Ivany) Report, 2014

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Water and Energy Efficiency: A Report for Community Leaders

Water is directly affected by climate change through droughts, more frequent storms and flooding. Water is also indirectly affected by climate change through increased energy demands –water for hydro-power projects, and for oil and gas development. This relationship between energy and water is referred to as the *water-energy nexus,* and neglect of its many dimensions threatens our sensitive lakes, streams and groundwater. We must become better caretakers of our water, whether it is used for drinking, industry, or agriculture, and we must assess opportunities associated with efficiency *and* conservation. Water efficiency asks *how* we use water and conservation asks *why* we use water.[1]

The water and energy nexus is also adding pressure to rural municipal governments to deliver safe and sufficient water services to a geographically diffuse population on a limited budget. There is currently very little collection, management and sharing of water quality and quantity information within and between all levels of government, leading to further difficulties in management and stewardship. Market-based mechanisms such as water pricing are being discussed by governments and organizations as a means for effective water resource management and allocation.

Governments, businesses and organizations across many sectors are recognizing the sensitivity of our water resources, and are exploring the most significant risks and opportunities from the use of this resource. Unfortunately, there is little up-to-date information collected on multi-sectoral water use nationally or provincially. This lack of data makes it difficult to plan for future challenges and opportunities associated with climate change. Nova Scotia, like all other provinces, does not collect sufficient data on its water resources. Nationally, Nova Scotia ranks strongly for implementing policies that support source water protection and water treatment[2]. Unfortunately, The Auditor General has shown that the provincial government is not sufficiently enforcing regulations that support these policies, or monitoring of water use[3]. Lack of enforcement and monitoring can lead to slow leaks and undetected contaminations which go unnoticed until exposed by a larger crisis.

In 2014, the release of the *Now or Never* report[4] and the *Municipal Water Priorities Report*[5] prompted discussions about exploring the water-energy nexus and improving water management and water stewardship in Nova Scotia. By assessing water within the context of the water-energy nexus, it is possible to be highly efficient with both of these resources. For example, the POLIS Project on Ecological Governance completed a report for water use in Ontario, and applied energy *intensities* to assess how much energy was used to deliver each

[1] Brooks, D.B. "Water Use Efficiency and Water Use Conservation". Canadian Water Resources Journal. 2005. Volume 30, issue 3, 263-264.
[2] Canada's Drinking Water Report Card. Ecojustice. 2011. Available online.
[3] Nova Scotia Office of the Auditor General. 2014. Available online.
[4] Nova Scotia Commission on Building Our New Economy. 2014. Available online.
[5] Municipal Water Priorities Report. Canadian Water Network. 2014. Available online.

of their water services[6]. The POLIS report was the first in Canada to demonstrate the impact of coupling water and energy efficiency at a provincial scale, with quantifiable economic benefits to local communities.

In an effort to understand how efficiently Nova Scotia communities are delivering water services (pumping, treatment, and transport), the methodology from the Ontario POLIS report was applied to Nova Scotia. The intent is to (a) quantify all water used in the province of Nova Scotia; and (b) calculate all energy used in the pumping, treatment, delivery, and heating of this water. After a scan of the available data, it was determined that water use data is not collected in sufficient detail to accurately calculate water or energy use for water services on a provincial scale. However we were able to calculate limited water use and energy for water services for residential, manufacturing and industrial sectors, in seven communities. We broadened this information by contacting water leaders in these and other communities to discuss specific issues around water services in their communities.

Through discussions with water leaders across the province, we learned that every community in Nova Scotia deals with unique challenges and opportunities around its water and water services that reflect landscape, economy, socioeconomics and other factors. Communities that show leadership and innovation in implementing conservation and efficiency initiatives can effectively address unique conditions, and reduce demand on water resources and on the provincial energy grid. Despite developing these effective and innovative solutions, many of our communities have water consumptions and leakage rates that exceed Canadian averages.

The stories in this report are shared to ask provincial and municipal governments to expand water metering across the province in order to better assess and manage water resources. By expanding metering, we would be able to (i) Recognize the many paths toward progress in water management across the province; (ii) Explore effective solutions used across the province; and (iii) Reward communities for measurable reductions in energy use for services, and increased water conservation.

[6] Maas, C. "Ontario's Water Energy Nexus." The POLIS Water Sustainability Project. 2010. Available online.

THE WATER-ENERGY NEXUS IN NOVA SCOTIA

Energy production relies heavily on water: cooling in electric thermal plants, extraction, refining and processing of fuels, irrigation to grow biomass crops, and hydropower production[7],[8]. Energy is also required to extract, treat, transport and heat water for drinking, irrigation and industrial purposes. Any change in the water cycle impacts energy systems because of the dependence on water for cooling, cycling and other processes, and will result in higher energy rates and higher demand for water. Climate change is likely to have the greatest impact on the water-energy nexus, since water can be negatively impacted by so many diverse factors:

"Climate change is expected to exacerbate current stresses on water resources from population growth and economic and land-use change, including urbanisation.[7]"

It is in the context of the present-day climate change threat that stewardship of our water resources takes on more urgency.

The monitoring of water use in Canada varies by sector and by province. In the past, the most rigorous water use data was collected in the Environment Canada Municipal Water Use Survey. This survey showed trends of water use in residential, manufacturing and industrial activities, with detailed information given where possible. In 2011, the final Environment Canada survey was published, with subsequent surveys reduced in scope and detail, being collected instead by Statistics Canada. From the 2011 survey, we have a sense of the state of Canada's water use: The Canadian average daily consumption of water per capita was 274 litres, with Nova Scotia's consumption calculated at 292 litres[9]. Compare these statistics to that of other countries, and we find Nova Scotia water consumption is much higher than that of other countries:

Region	Consumption (per person, per day)
United States	382 Litres
Canada	274 Litres
Sweden	200 Litres
Nova Scotia	292 Litres

Some energy data is also collected by Statistics Canada and is publicly available. Several provinces have general sectoral information because industries are not well-monitored. In Alberta the Pembina Institute estimates that every 1 m^3 of synthetic crude oil produced requires 2 - 4.5 m^3 (4000 litres) of water[10]. Energy is also required for providing water services –

[7] The Water-Energy Nexus. Grace Communications Foundation. Available online.
[8] Water for Energy. International Energy Agency. Available online.
[9] Environment Canada. 2011 Municipal Water Use Report. Available online.
[10] Troubled Waters, Troubling Trends: Technology and Policy Options to reduce Water Use in Oil and Oil Sands Development in Alberta. Pembina Institute. 2006

The POLIS Project on Ecological Governance calculates that 976 TJ of energy are required to deliver water services (pumping, treatment and transport of water) in Ontario[11]. This is equivalent to the energy required for a Boeing 747 to cross the Atlantic Ocean 976 times, or the energy produced at Point Aconi for 3 months[12].

The Canadian Water Network recognizes that municipal water management has serious challenges to overcome. In 2014, they released Canadian Municipalities Water Priorities Report, which described common challenges and opportunities in delivering water services, including aging infrastructure, energy upgrades and declining populations. This report also showed that the assessment of water issues in rural communities that have not implemented water metering is extremely difficult.

Water quality issues in some Nova Scotia communities are severe and urgent. First Nations communities such as Pictou Landing are coming to terms with a legacy of industrial waste from the local pulp mill. Boil water orders are common in many First Nation communities, and the solutions to improve water quality issues are complex and long-term. Arsenic and uranium, common natural contaminants in drinking water across the province, have been linked to several cancers. Despite links to health concerns, private well owners are rarely encouraged to test their water or explore treatment options to remove arsenic and other contaminants. These and other water quality issues across the province are significant, and often have layers of social, economic and racial barriers associated with them. *Creating a Culture of Water and Energy Efficiency in Nova Scotia Communities* focusses on water services and not on these complex issues.

This report is intended to quantify the energy used to provide water services in Nova Scotia, based on the model for Ontario by the 2010 POLIS report. In the absence of detailed water and energy data in Nova Scotia, we present a more anecdotal assessment through surveys to discuss water and energy challenges at the municipal level.

To understand the water-energy nexus in Nova Scotia, this report uses the best available data, with direct accounts from communities across the province. *Creating a Culture of Water and Energy Efficiency in Nova Scotia Communities* paints the picture of challenges that exist, and the broad array of innovative solutions that can be replicated to improve stewardship of our water resources.

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[11] Maas, C. "Ontario's Water-Energy Nexus: Will We Find Ourselves in Hot Water, or Tap into Opportunity?" 2010. The POLIS Water Sustainability Project. Available Online.

[12] NSPI Point Aconi = 1098.5 GWh/yr = 3954.6 TJ/yr = 10TJ/day, 976 TJ = 90.4 days. Available online. Page 12, Table 1.

CASE STUDY COMMUNITIES

During the development of this report, it became clear that the available water use data present a very limited picture of water and energy use in the province. In an effort to learn more about water and energy use in Nova Scotia, case study communities were first identified in the Environment Canada Municipal Water Use dataset. Communities with the most comprehensive and up-to-date data were selected and explored for more in-depth analysis. Energy use for water services was calculated based on the POLIS report, and used published values for *energy intensities*[13,14], or *the amount of energy used for a particular water service process (e.g. pumping, transport, treatment, delivery and heating)*. In our model, energy use for water services is the sum of energy used in successive processes such as pumping, transport, treatment, delivery, heating. Data presented in this report include:

- the distribution of water used for residential, commercial/institutional and municipal and industrial/agricultural purposes (pie charts);
- population;
- proportion of population connected to municipal system;
- per capita annual water use;
- percent of water leakage in cubic metres and equivalent Olympic swimming pool volumes;
- energy used for water services; and
- per capita annual energy used for water services and energy for average Canadian homes.

Please refer to Appendix A for full calculations.

Water utility employees are aware of many challenges facing their utility and community, and have a good understanding of the mechanisms that exist to overcome them. A rich description of each case study community emerged from verbal accounts. In speaking with utility operators, managers, mayors and public works engineers about their work, it was clear that each community is seeking to improve water services for its community while facing struggles of varying urgency, and accessing limited resources.

Some communities in Nova Scotia do not meter their water and thus cannot submit water use information to the Environment Canada survey; however their water stories provide another perspective on water and energy. Their stories are included in the *Other Communities* section.

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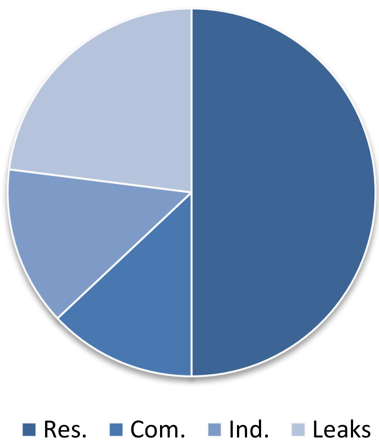
[13] Maas, C. 2009. Greenhouse Gas and Energy Co-Benefits of Water Conservation. POLIS Research Report 09-01. Available online.
[14] Griffiths-Sattenspeil, B. and Wilson, W. The Carbon Footprint of Water. 2009. The River Network. Available Online.

TOWN OF AMHERST



Population	
9 499 people 100% on municipal system	
Water use per person	
237.2 m^3/year 2.4 times Canadian average[15]	
Leakage from water system	
23%, 518618 m^3 207 Olympic-sized swimming pools[16]	
Energy use for providing water services	
6.1 TJ/year, or 639.5 MJ/yr/capita Energy for 57 average Canadian homes[17]	

The Town of Amherst provides water services to approximately 10 000 people, and to an additional 200 residents beyond the Town limits. The well field includes four wells, and the treatment plant uses chlorination (primary treatment), and moves the water through the entire system using a gravity-fed model.

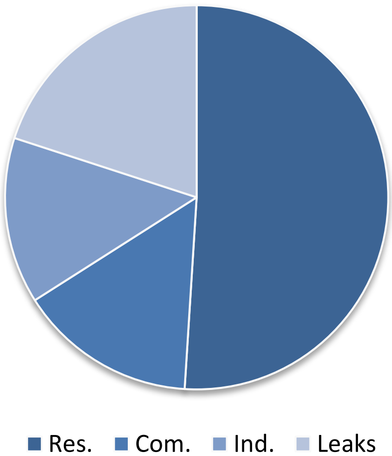
Energy efficiency was addressed during the development of this well field 20 years ago, and most of the system has components that make it reasonably energy efficient. Shortly after this well field was developed, water meters were installed in homes in order to bill residents for the water they actually use, as opposed to the standard model of paying for average use. This resulted in a 25 per cent decrease in residential consumption within the first year of installation. Employees believe that the 1 per cent decrease every year since the installation can be attributed to the popularity and availability of low-flow fixtures such as toilets, faucets and shower heads.

"I would love to see anything on energy efficiency such as more efficient pumps – if they exist – and other system resources that would improve water and energy efficiency."

- Town of Amherst Public Works

[15] The Canadian average consumption of water per year per person is 99.3 m^3. Link.
[16] The volume of an Olympic-sized swimming pool is 2500 m^3. Link.
[17] The Canadian annual average consumption of energy per home is 106 GJ (0.106 TJ) Link.

TOWN OF BRIDGEWATER



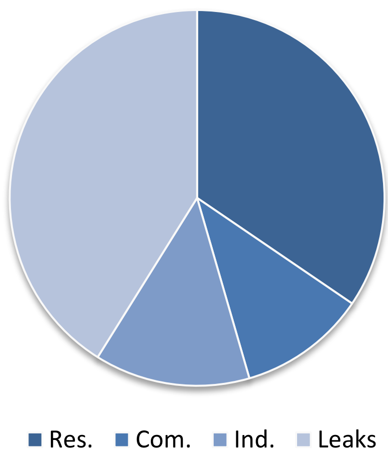
Population	
7 993 people 100% on municipal system	
Water use per person	
333.5 m^3/year 3.4 times Canadian average	
Leakage from water system	
20%, 533 204 m^3 213 Olympic-sized swimming pools	
Energy use for providing water services	
7.5 TJ/year, or 940.4 MJ/yr/capita Energy for 71 average Canadian homes	

The Town of Bridgewater has a water treatment plant (tertiary treatment) which uses gravity to move water through the system; however there are two booster stations to pump water uphill to reach all residences. Because water flows constantly through the system, it would be difficult to retrofit any more systems in the treatment plant without shutting down the water supply for the Town and causing major disruption. The Town has a goal to assess a set number of pipes each year, both through complaints and through assessments. All broken pipes are assessed immediately, and fire hydrants are assessed every five years. A 2010 assessment of efficiency provided some reasonable suggestions which were implemented shortly after. In 2011 pumps with higher efficiency were installed, and boilers were retrofitted from oil to propane.

> *"There's not a whole lot else we can do for energy savings without shutting the system down for major changes."*
>
> *-Bridgewater, Water Utility, Distribution*

Major water users in the area include the Michelin plant – which uses 1/3 of total water produced by the Town – a hospital and a golf course. The golf course is provided potable water for their irrigation pond. It is thought that they are currently not recycling their water and would save resources by receiving untreated water. The Town is informed when Michelin plans to shut down or increase production, or when the golf course makes a withdrawal from the municipal reservoir, so that the utility maintains a steady flow to its customers.

MUNICIPALITY OF CAPE BRETON



Population
101 355 people
69% on municipal system

Water use per person
250.5 m³/year
2.5 times Canadian average

Leakage from water system
41%, 7 218 863 m³
2888 Olympic-sized swimming pools

Energy use for providing water services
30.9 TJ/year, or 441.8 MJ/yr/capita
Energy for 291 average Canadian homes

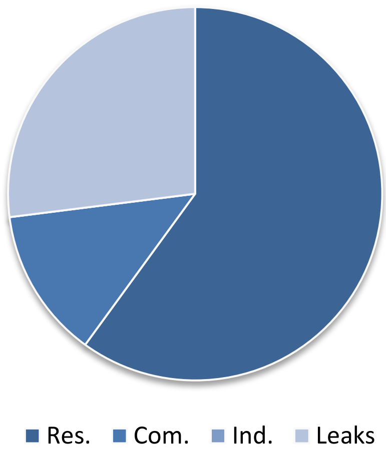
This utility is the second largest in the province and is based on eight systems: Three large systems with more than 20 000 m³ per day, one with 10 000 m³ per day, and four with less than 2 000 m³ per day. The water distribution system was first developed in 1892 and has subsequently evolved to incorporate new standards and technologies, and expanded to cover a larger area. The biggest issue for the municipality of Cape Breton is the loss of treated water through leaks in infrastructure caused in part by acidic water which for many decades before treatment, caused pipes to corrode. Although many pipes in the system have been replaced with non-corrosive piping, the remaining older infrastructure has been exposed to acidic water for a longer period of time, and consequently has a higher incidence of leakage. The CBRM utility has loss rates of 30-40%, far above the national average of 14%, and it is a challenge each year to obtain results from leak-reduction initiatives. Infrastructure includes 750 kilometres of pipes in the system, and the utility replaces 5km of pipe each year. The leak detection system is not sufficiently developed to identify leaks quickly.

"The biggest thing with us, is the pumping of water that you don't sell."

- Cape Breton Regional Municipality Public Works

Water utility employees feel that efficiency is a very effective way to reduce costs, and strive to lower rates of leakage every year. In their experience, improving efficiency by reducing leakages is the first order of business for the utility to maintain low costs for their customers.

MUNICIPALITY OF EAST HANTS



Population
21 556 people
27% on municipal system

Water use per person
158.7 m³/year
1.6 times Canadian average

Leakage from water system
27%, 249 316 m³
99 Olympic-sized swimming pools

Energy use for providing water services
2.52 TJ/year, or 432.5 MJ/yr/capita
Energy for 24 average Canadian homes

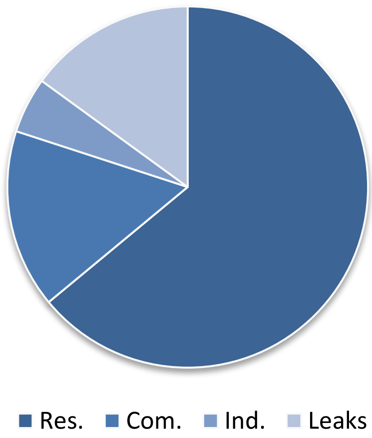
East Hants tracks their energy and water consumption on a quarterly basis, and has been carefully implementing efficiency programs across the municipality since 2011. At the water utility, the aging water system was identified as a barrier to efficiency, and was replaced with a system of groundwater wells in 2012. Currently, there are large distances between existing and proposed communities, and the infrastructure to provide these spread-out communities with the services at the same cost is a real challenge. Planning and development of water service areas in East Hants is being discussed because it is more efficient to service new communities around a loop rather than in separate disconnected service areas.

"The strongest win on efficiency is long term planning, but it is slower to implement."

- East Hants Municipality, Infrastructure and Operational Services

Council is very engaged on improving efficiency – they track changes and have seen improvements and shifts in efficiency and consumption. The biggest barriers for efficiency are economic. East Hants has a predominantly residential tax base and limited commercial and industrial activities; therefore it is difficult to find money implement capital or infrastructure changes. Employees believe that energy and water efficiency are important topics of discussion, and want to see them addressed more often at professional development events for municipalities and water service providers.

HALIFAX



Population
397 866 people
82% on municipal system

Water use per person
151.6 m^3/year
1.5 times Canadian average

Leakage from water system
15%[18], 7 368 366 m^3
2 947 Olympic-sized swimming pools

Energy use for providing water services
154.2 TJ/year, 472.7MJ/yr/capita
Energy for 1454 average Canadian homes

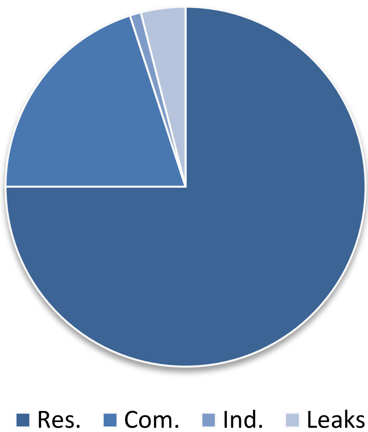
Halifax Water is the largest water utility in the province. Its size and scale has allowed the utility to develop a long-term planning and vision on 25-40-year timelines. This utility follows an annual energy management plan which is connected to recurring 5-year business plans. With energy being the second highest cost to the utility after human resources, the goal of the energy management plans is to continually improve or minimize the energy footprint of the utility. Expanding services into new communities is a constant and expensive concern. Although growth is difficult to predict, setting goals for infrastructure upgrades allows for some degree of planning and fund allocation.

In addition to assessment and planning tools, the utility is continually looking for opportunities to generate energy from renewable resources within its asset base. Two examples are the new wind farm recently completed a t the JD Kline Water Supply Plant in Pockwock, NS, and a small energy recovery turbine installed in Bedford, NS. At the Pockwock site, a 10 MW wind farm consisting of 5MW turbines is helping to offset energy costs. In the Bedford and Sackville area, a 40kW in-line energy recovery turbine has been installed in one water main alongside existing pressure reduction valves which are normally used to keep water pressure in the water supply system at a safe level. This turbine is essentially a reverse acting pump connected to an electrical generator - it reduces the pressure of the water as it flows through the turbine, and in the process drives the generator to produce power. These types of turbines are useful where significant pressure reduction requirements exist, and where water is flowing at a more or less constant rate.

As with many other utilities, Halifax Water strives to control costs and energy use, and leaks in the water system, while planning for expansion.

[18] Current rates may be lower.

TOWN OF NEW GLASGOW



Population

9 360 people, 15000 served beyond Town
100% on municipal system

Water use per person

354.8 m³/year
3.6 times Canadian average

Leakage from water system[19]

4%, 123 530 m³
49 Olympic-sized swimming pools

Energy use for providing water services

12 TJ/year, or 1281.2 MJ/yr/capita
Energy for 113 average Canadian homes

The New Glasgow water utility provides water for town residents, commercial and industrial customers as well as for two adjacent municipalities. Employees are proud of the leadership around water conservation and efficiency. They have a highly responsive system for fixing leaks when they are identified on a complaint-basis, and using their SCADA (Supervisory Control and Data Acquisition) system.

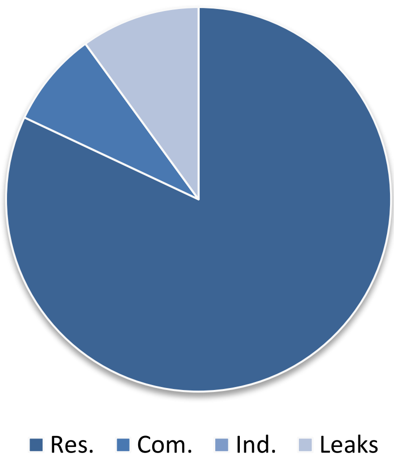
Exceptional leadership within the water utility has helped foster a culture of efficiency. A new treatment plant built in 2000 included many upgrades to efficiency components, and the utility also installed a wind turbine to generate its own power and thereby add energy into the grid, lowering energy costs.

"When we see ways to improve, we do our best."

- Town of New Glasgow Water Utility

[19] The 4% leakage value comes from the Environment Canada dataset which used the population of New Glasgow only (9360 people) and not entire serviced area (approx. 15000 people). The true leakage value may be closer to 6%, 197648 m^3 and 78 Olympic-sized swimming pools.

MUNICIPALITY OF QUEENS



Population
11 212 people
27% on municipal system

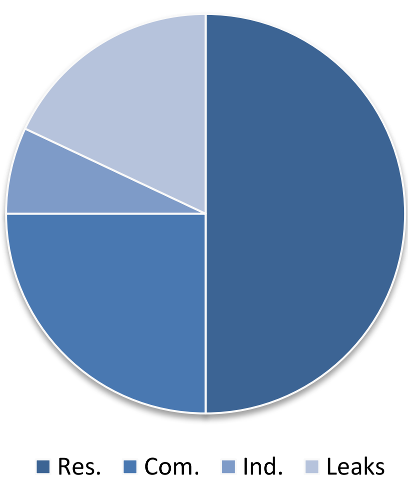
Water use per person
338.9 m³/year
3.4 times Canadian average

Leakage from water system
10%, 102 585 m³
41 Olympic-sized swimming pools

Energy use for providing water services
3.79 TJ/year, 1253.1 MJ/yr/capita
Energy for 36 average Canadian homes

[no interview from this community]

TOWN OF WOLFVILLE



Population
3 867 people
100% on municipal system

Water use per person
234.6 m³/year
2.4 times Canadian average

Leakage from water system
18%, 163 318 m³
65 Olympic-sized swimming pools

Energy use for providing water services
2.7 TJ/year, or 716.1 MJ/yr/capita
Energy for 26 average Canadian homes

[no interview from this community]

OTHER COMMUNITIES

The following communities did not have data available through the Environment Canada Dataset, but provided context of local water and energy issues.

MUNICIPALITY OF ARGYLE

Lower East Pubnico has no residential water services; however it supplies water to three industrial fish processing plants, and these are the economic drivers for this community. During a period of provincial divestment of water utilities across the province, in 2012 the government released the industrial water utility in Argyle. To maintain support for the local fishing industry, the municipality received (bought) the water infrastructure and created an industrial municipal water utility. The system is comprised of three groundwater wells which pump groundwater to plants where water is treated to site-specific requirements for volume and quality, dependent on fisheries catches. Employees are not aware of energy efficiency or water conservation programs for the system at this time.

"If we didn't have the water plant in Lower East Pubnico, the fish plan operators would face additional hardships."
- Argyle Public Works

TOWN OF BERWICK

Water in Berwick is supplied to residents by private wells. After the Walkerton tragedy in 2000, residents and developers expressed concern about water quality and quantity because Walkerton and Berwick both have strong agricultural industries, and residents rely on wells, which are vulnerable to contamination. This concern prompted the Town to fund a hydrogeological study of the quality and quantity of the local water source. This study outlined an aquifer recharge area to the south of the Town, and identified risks to groundwater, and allowed the Town to make more informed decisions around development and water services.

"Berwick residents appreciate having their own wells instead of being on a public system."
- Mayor of Berwick

There is a general sense from many citizens that they prefer private well water to centralized water because of perceived lower costs. Residents generally test their water for bacteria when they purchase their home, and don't follow up with regular bacterial or chemical testing. The Town has explored a grant program and sample delivery initiative to promote testing of private wells, but it has not been implemented. There is a single large water user in the community – Eden Valley Foods, which has a larger well to accommodate their processing plant. The Town is not aware of complaints regarding water quality or quantity in the area surrounding the poultry plant.

INDUSTRIAL PARKS

There are roughly 60 industrial parks around the province, with a wide range of businesses activities and water needs (for example floor washing, processing water or cooling baths), each using different water systems. Each of these parks is supplied water from different water systems. Some are municipally serviced and others have independent sources. Many use water treated to drinking water quality standards for industrial activities, leading to unnecessary energy usage and cost. Industrial parks can consider alternative energy efficient options, such as cistern water collection systems, and constructed wetlands and holding ponds, which would collect local water for specialized treatment for industrial purposes.

> *"We were able to find efficiencies – in energy, water and materials – in every business that we reviewed"*
>
> *- Eco-Efficiency Centre*

Against these challenges, some industrial parks struggle with the choice to sell property lots to businesses or use available land for ecological water treatment services such as constructed wetlands and innovative stormwater management. Some communities like Chester and Debert have explored innovative and ecological water systems in industrial parks; however other communities lack the leadership, awareness and resources to implement efficiency improvements.

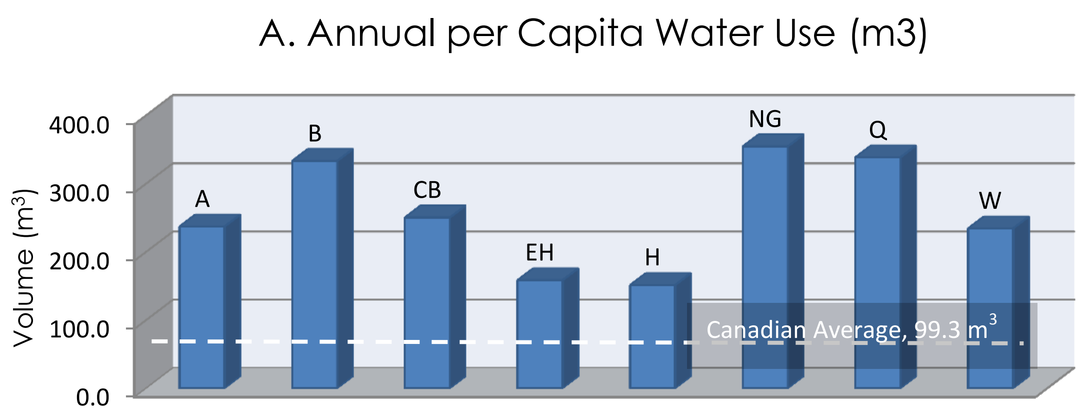
CASE STUDIES SUMMARY

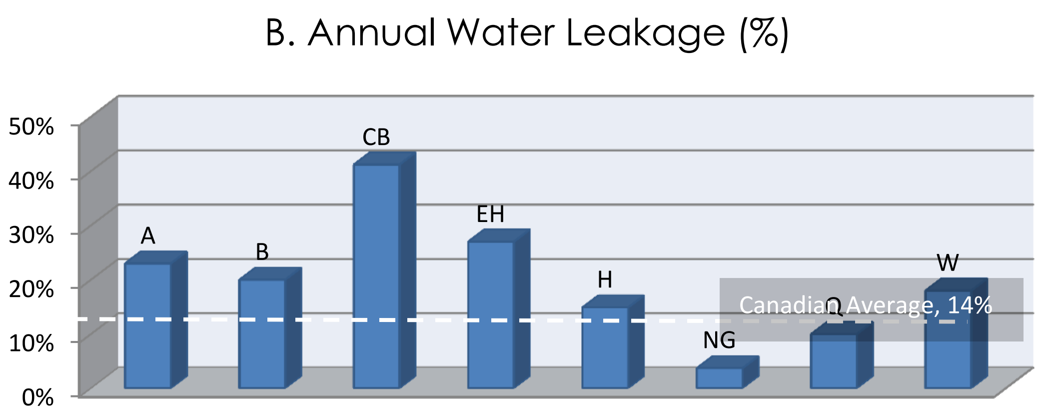
Environment Canada Dataset Calculations

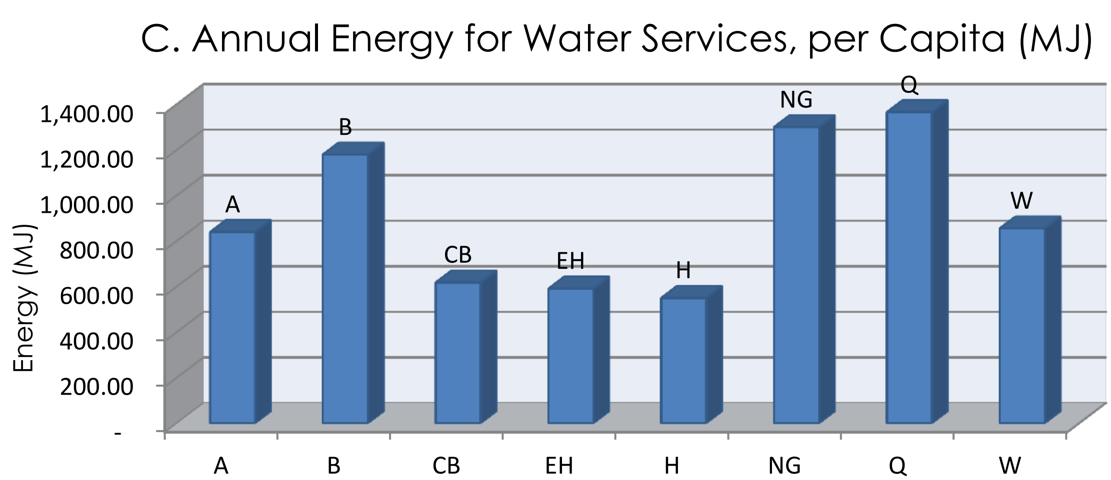
All case studies demonstrate that the average water use per person above the Canadian average of 99.3 m^3 per year (Graph A), with a minimum of 151.6 m^3 in Halifax, and maximum of 354.8 m^3 in New Glasgow. According to the Environment Canada dataset, the national average for water leakage in registered water utilities is 9%. New Glasgow is the only community to fall below this average (at 4%), and Queens with an average of 10%, is the next closest (Graph B). Cape Breton's high leakage rates (40%) may be caused by the combination of infrastructure age and water quality conditions (e.g. increased corrosion by acidic groundwater). Although there are no national averages for per capita energy use for water services (Graph C), these are somewhat consistent with per capita water use (Graph A). It is notable that three communities with energy use between 400-500 MJ/yr are also the most populated regions.

Case Study Community Discussions

Communities across the province are aware of their own unique challenges and strive to addresses them using innovative solutions. Leadership within the water management organization is a key factor of success in many communities. For example- leadership to take on upgrades, address leaks, and make systems more efficient and effective. Although in-line energy capture turbines seem to be used only in large municipalities, in some cases smaller municipalities might be able to adopt these technologies. Metering of water consumption is a powerful tool for management of water services, but is often not incorporated into systems or homes. Without a thorough understanding of water consumption through tracking or metering, we cannot take steps to improve our stewardship or planning around water resources. Some communities have shown that metering decreases leakage and also consumption. The motivation for utilities to save energy and money is clear. The motivation to save water is more complex: Less water use results in fewer revenues and resources for the utility. The balance of saving money through efficiencies and making money through consumption can be difficult to address in municipalities of all sizes. With strong leadership and long term planning, a balance can be achieved that results in sustainable stewardship of water resources. An independent water efficiency organization, equivalent to the role played by Efficiency Nova Scotia in the realm of energy, could be a leader in water efficiency and conservation improvements at residential, commercial and industrial scales.







***A**mherst, **B**ridgewater, **C**ape **B**reton, **E**ast **H**ants, **H**alifax, **N**ew **G**lasgow, **Q**ueens, **W**olfville*

CONCLUSIONS AND RECOMMENDATIONS

It is clear that many water leaders are using their resources to address wasted water. There is still a large gap between Nova Scotia communities and Canadian averages. Based on our findings we present a number of recommendations that can help communities reach and exceed national averages:

- **Install water meters and charge customers for what they use.** Tracking water use results in household conservation and lower costs to utilities and municipalities. Energy metering of specific water service system components would be useful in tracking and ultimately reducing energy use.
- **Expand residential and utility water conservation programs.** Conservation at the household level results in measurable reductions in water use. A balance between revenue and conservation can be obtained through leadership and long term planning, and by new sorts of utility financial systems that separate revenue from deliveries of water.
- **Lower bills by creating on-site power.** Solar, wind and water main energy recovery technologies create offset energy.
- **Reduce leaks in the water system.** Losses through leaky infrastructure are losses to utilities, and also to water conservation.
- **Build communities where water services can support them.** Add developments along planned water service loops where water systems can support them more efficiently.
- **Promote efficiency and conservation among large water users** in the community. Partner with golf courses, hospitals and industry in achieving efficiency goals.
- **Don't treat water to drinking water standards if it is not being consumed.** Water for golf course irrigation, fish plant treatment, and industrial purposes shouldn't be treated unnecessarily.

The Canadian Rural Municipalities report states that much can be gained by sharing information and successes so that all communities can benefit from all water management innovations. Sharing success stories is a powerful way to grow knowledge and experiences, and can result in innovations being adopted across the province.

Communities around Nova Scotia are finding effective ways to manage their drinking water resources in the face of unique and challenging obstacles and limitations. They must go further in order to reach national averages in consumption and leakage rates. Governments must support them to promote efficiency in water services, and also for water conservation.

The greatest impacts from climate change are already being felt by our water resources: more frequent and severe storms, flooding, and drought, and stresses on municipalities are ever-increasing. It is imperative that Nova Scotia strive to better understand our water resources, and use less water and energy in our communities.

APPENDICES: CALCULATIONS AND ASSUMPTIONS

Dataset

"The Municipal Water and Wastewater Survey (MWWS) was a survey of all Canadian municipalities with population over 1000 and a sample of those with population under 1000 (excluding First Nations communities), which was conducted every two or three years since the early 1980s. The survey collected data on water sources, water use, water conservation, wastewater treatment level and water and wastewater pricing at the municipal level. The ongoing trend-line analyses and extensive data made available provide information that supports water management decisions in the broader context of ecosystem management. Environment Canada has ended the Municipal Water and Wastewater Survey. Data from past surveys remains available." The original data is available online here.

Excerpt from this database:

E	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL	BM	BN	BO	BP	BQ	
strMunicipality	TotalAnnualVol_M3	ResidentialWaterUse_AnnualM3	WaterUsePerCapita_Total_lcd	RespondingPop_WaterUsePerCapita_Total	WaterUsePerCapita_Total_Resp_2009	WaterUsePerCapita_Res_lcd	RespondingPop_WaterUsePerCapita_Res	WaterUsePerCapita_Res_p_2009	TotADF_PSW_Overall_2006	TotADF_PSW_Overall_2004	TotADF_Domestic_2006	TotADF_Domestic_2004	TotADF_Domestic_2001	TotADF_Domestic_1999	PctPopServedSFMeters	RespondingPop_PopServedSFMeters	P
Berwick																	
Bridgetown									351.67	351.67	211.00	211.00	211.00	211.00	100.00	991	M
Bridgewater	2666021	1365003	913.82	7993	MWWS20	467.88	7993	MWWS20	692.64	692.64	415.58	415.58	415.58	415.58	100.00	7993	M
Canso	09	68447	1372.31	911	MWWS20	205.85	911	MWWS20	1372.31	1320.14	205.85	198.02	3641.36	130.29	100.00	885	M
Cape Breton	17521512	6047605	623.19	77030	MWWS20	215.10	77030	MWWS20	746.75	746.75	418.18	418.18	425.37	257.31	99.86	77030	M
Chester	21000	13650	885.14	65	MWWS20	575.34	65	MWWS2009							10.00	65	M
Clare																	
Clark's Harbour																	
Colchester County Municipalit	268016	63750	657.50	1117	MWWS20	156.39	1117	MWWS2009							100.00	1117	M
Cumberland County Municipalit	45733		259.95	482	MWWS2009												
Digby																	
Digby									932.24	932.24	745.79	745.79	745.79	745.79			
East Hants	923394	594743	417.33	6062	MWWS20	268.79	6062	MWWS2009							100.00	6062	M
Guysborough																	
Halifax	49452123	31903597	446.39	301080	MWWS20	290.31	301080	MWWS20	437.88	455.31	286.27	295.95	320.07	246.55	99.95	301080	M
Hantsport									897.60	897.60	359.04	359.04	352.00	352.00			
Inverness County Municipality	844465	336179	1258.13	1839	MWWS20	630.88	1460	MWWS2009							45.04	1839	M
Kentville	06								622.00	622.00	242.58	242.58	240.15	362.52	100.00	5757	M
Kings County Municipality	06	130571	461.83	1291	MWWS20	277.10	1291	MWWS20	461.83		277.10				100.00	1291	M
Lockeport																	
Lunenburg																	
Lunenburg									1398.85	1398.85	279.62	279.62	279.62	279.62			
Mahone Bay	215409	75393	648.53	910	MWWS20	226.99	910	MWWS20	400.00	400.00	260.00	260.00	260.00	260.00	100.00	910	M
Middleton									703.42	703.42	246.23	246.23	246.23	218.80			
Mulgrave	465582	204856	1462.80	872	MWWS20	643.63	872	MWWS2009							8.00	872	M
New Glasgow	3320687	2477750	675.61	13466	MWWS20	504.11	13466	MWWS20	0.00	0.00			203.32	203.32	100.00	13466	M
Oxford									1035.82	1035.82	258.96	258.96	258.96	258.96			
Parrsboro									568.13	568.13	454.38	454.38	454.38	454.38			
Pictou									452.01	452.01	334.41	334.41	334.41	334.41			
Pictou County Municipality																	
Port Hawkesbury									787.61	787.61	315.04	315.04	315.04	315.04			
Queens	1025847								1581.43	1581.43	284.66	284.66	1363.67	1363.67	100.00	3027	M
Richmond County Municipality																	
Shelburne																	
Shelburne	188452								382.74	382.74	267.82	267.82	267.82	267.82			
Springhill	06	913860	747.41	3941	MWWS20	635.30	3941	MWWS20	747.41	860.47	635.30	774.42	774.42	774.42	0.00	3941	M
St. Mary's																	
Stellarton									617.10	617.10	394.96	394.96	394.96	349.20			
Stewiacke									379.63	379.63	212.59	212.59	290.91	290.91			
Trenton									338.75	338.75	118.56	118.56	118.56	118.56			

Nova Scotia Data | Nova Scotia Data (2) | Column headings explanation | 2009 MWWS summary database

Model Used

The following calculations were developed using the above dataset for Nova Scotia municipalities.

Energy Intensity of Water Services:

WD = Energy intensity of water distribution = 0.17 kWh/m^3

SW = Energy intensity of small water treatment, from surface water = 0.92 kWh/m^3

$SW_{\%}$ = Proportion of water treatment from surface water (0-100%)

GW = Energy intensity of small water treatment, from surface water = 0.85 kWh/m^3

$GW_{\%}$ = Proportion of water treatment from surface water (0-100%)

EI_{WS} = Energy Intensity of Water Services = $WD + SW*SW_{\%} + GW*GW_{\%}$

Ex. Amherst: $SW_{\%}$ = 100%, $GW_{\%}$ = 0%

$EI_{WS} = 0.17 + 0\ kWh/m^3 * 0\% + 0.92\ kWh/m^3 * 100\% = 1.09\ kWh/m^3$

Total Embedded Energy, Residential

W_R = Total supplied water for residential/domestic purposes

E_{ER} = Total embedded energy, residential = $W_R * EI_{WS}$

Ex. Amherst: $W_R = 1127430\ m^3/yr$

$E_{ER} = 1127430\ m^3/yr * 1.09\ kWh/m^3 = 1228899\ kWh/yr = 4.06 \times 10^{-3}\ PJ/yr$

Total Embedded Energy, Commercial/Institutional

W_C = Total supplied water for commercial/institutional purposes

E_{EC} = Total embedded energy, commercial/institutional = $W_C * EI_{WS}$

Ex. Amherst: $W_C = 293132\ m^3/yr$

$E_{EC} = 293132\ m^3/yr * 1.09\ kWh/m^3 = 319514\ kWh/yr = 1.15 \times 10^{-3}\ PJ/yr$

Total Embedded Energy, Industrial

W_I = Total supplied water for industrial purposes

E_{EI} = Total embedded energy, industrial = W_I * EI_{WS}

Ex. Amherst: W_I = 315681 m^3/yr

E_{EI} = 315681 m^3/yr * 1.09 kWh/m^3 = 344092 kWh/yr = 7.39 x 10^{-4} PJ/yr

Total Embedded Energy, Water Loss

W_L = Total supplied water, lost through leaks, etc

E_{EL} = Total embedded energy, industrial = W_L * EI_{WS}

Ex. Amherst: W_L = 518618 m^3/yr

E_{EL} = 518618 m^3/yr * 1.09 kWh/m^3 = 565294 kWh/yr = 2.04 x 10^{-3} PJ/yr

Total Embedded Energy for Water Services

$E_{ET} = E_{ER} + E_{EC} + E_{EI} + E_{EL}$

Ex. Amherst: E_{ET} = 4.06 x 10^{-3} PJ/yr + 1.15 x 10^{-3} PJ/yr + 7.39 x 10^{-4} PJ/yr + 2.04 x 10^{-3} PJ/yr = 7.98 x 10^{-3} PJ/yr