

City of Prince George Water Conservation Plan

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CITY OF PRINCE GEORGE
**WATER CONSERVATION
PROGRAM**

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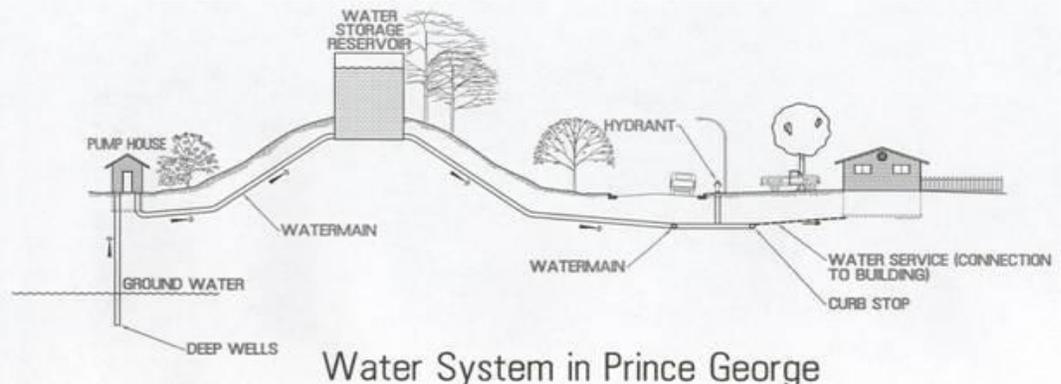
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Executive Summary

The goal of a City of Prince George Water Conservation Plan (WCP) is to set out a framework for the next 10 years that allows a water utility to influence demands. In the short term, benefits may include cost savings due to reducing demands on the infrastructure; in the long term, a WCP will be a useful tool in developing adaptive strategies to mitigate effects of climate change and growing populations.

The City of Prince George is located near the geographical centre of British Columbia, at the confluence of the Fraser and Nechako Rivers. The City experiences a climate with typically cold winters and warm summers, and approximately 400-600 mm of annual precipitation on average, with 2/3 being rainfall and 1/3 being snowfall. Potable water is supplied to the City's industrial, commercial, and institutional (ICI) customers and residential population of over 61,000 through a network consisting of six collector groundwater wells, 15 reservoirs, and over 550 km of watermains. Figure 1 demonstrates the setup of the underground water system. The groundwater wells are predominantly located within the Lower Nechako River Valley Aquifer which produces safe and reliable drinking water. Two other groundwater wells are located within College Heights and the Western Acres subdivision.

Figure 1: The Underground Water System in Prince George

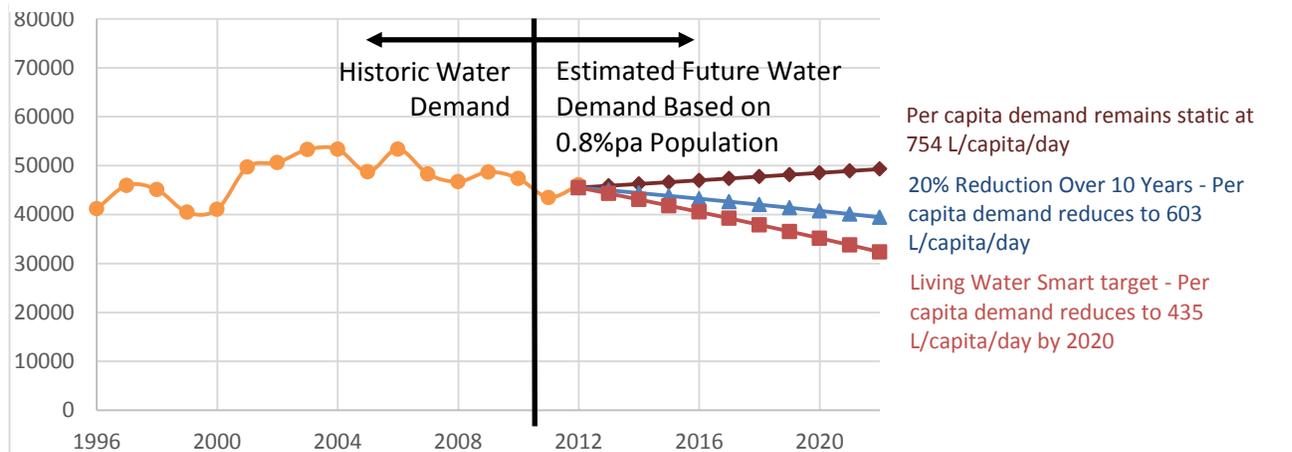


Historical water use in the City was studied, and through analysis of the average day and maximum day demands, it was found that the average day demand has trended slightly downwards by 4-5%, while summertime maximum day demands over the past 10 years have continued to increase by 9-20% depending on the year. Residential average day demand has decreased by 4-10% since 2004. In addition, average day per capita demands are significantly above national averages for water consumption. In 2009, the Government of Canada reported the national residential per capita water use to be 274 litres per capita per day (L/c/d) while residential water usage in Prince George was 611 L/c/d.

Encouraging a focus on reducing summertime maximum day demands through water conservation practices will alleviate stress on the drinking water infrastructure. A baseline to use for water conservation target setting is the 2015 average day demand (ADD) of 754 litres per capita per day (L/c/d), residential ADD of 611 L/c/d and maximum day demand of 1136 L/c/d.

The goal of the 2016 Water Conservation Plan is the attainable water conservation target of a 20% reduction in water demand over 10 years. This would result in an average day demand of **603 L/c/d** and maximum day demand of **908 L/c/d** in 2026. The results of the conservation measures recommended in this plan can be seen in Figure 2 below which compares future water demand with conservation efforts to future water demand without these measures.

Figure 2: Projected Future Water Demand in Prince George with Water Conservation Targets



Based on this information, a number of water conservation strategies were assessed and evaluated with respect to the needs of the City, targeting maximum day demands, the benefit they would bring, and ease of implementation. The following table summarises the Water Conservation Plan Strategies.

Table 1-0: 2016 Water Conservation Plan Strategies

Action	Implementation	Timeline
Strategy 1: Sprinkling Restrictions		
Impose mandatory sprinkling restrictions, and introduce staged sprinkling restrictions (Stage 1, 2, 3) based on dry summer conditions (Section 5.1.1.1).	Amend Schedule C of Water Regulations and Rates Bylaw No. 7479 to include staged water-use restrictions.	2018
Increase water-use violation fines in accordance with staged sprinkling restrictions (Section 5.1.1.1).	Amend Schedule C of Water Regulations and Rates Bylaw No. 7479 to include staged water-use violation fines.	2018
Enforce sprinkling restrictions (Section 5.1.1.2).	Train additional staff.	2018/2019
Strategy 2: Water Metering		
Continue volunteer water meter program (Section 5.2.1).	Promote volunteer water meter program through Media, and at Environmental Events such as Earth Day. Distribute 50 free water meters to volunteer homeowners each year.	Ongoing
Meter 100% of Industrial, Commercial and Institutional (ICI) water accounts (Section 5.2.2).	Change 165 ICI accounts from flat billing to metered water billing.	2017-2022
Obtain water consumption data for different areas of the City (Section 5.2.3).	Install flow meters in different pressure zones to obtain more water consumption data.	2017-2022
Determine City corporate water usage (Section 5.2.4).	Install water meters in all City buildings, arenas, parks and fire halls to determine corporate water usage.	2017-2022

Confirm accuracy of City water production volumes and distribution network (Section 5.2.4.1)	Calibrate water meters at all City wells and pump stations.	2017
Obtain water consumption data from bulk water users (Section 5.2.5).	Four additional water customer filling stations with water meters for use by Hydrant Use Permit holders. Two filling stations will be developed in 2017, and two in 2018. Hydrant Use Permit holders will be able to fill up at these stations, and eventually will no longer be able to obtain water from fire hydrants.	2017 – 2 filling stations 2018 – 2 filling stations
Increase permit fees for Hydrant Use permits, or charge users volumetrically for the water they draw (section 5.2.5.1).	Amend Water Regulation and Rates Bylaw No. 7479 to include.	2018
Enforce strict fines for water theft at non-metered hydrants (Section 5.2.5.1).	Amend Water Regulation and Rates Bylaw No. 7479 to include.	2018
Strategy 3: Water Loss Management Program – Leak Detection and Repair Program		
Perform regional flow rate analysis in each pressure zone to determine if there are areas of the City that are losing water within the system (Section 5.3.1).	Assess data obtained from installed flow meters over in pressure zones.	2017-2026
Partner with UNBC to implement ICI Water Audit Program (Section 5.3.1.2)	Partner with UNBC to develop a Water Audit Program for ICI customers connected to the City Water infrastructure. It is proposed that the audits will be performed by UNBC students.	2018-2023
Invest in leak detection and repair program (Section 5.3.2).	Purchase a second Echologics Leakfinder RT and train two additional utility staff members to use it.	2016-2026
Strategy 4: Educational and Outreach Programs		
Promote water conservation education to the public (Section 5.4.1).	Work together with the City's External Relations team to promote the importance of water conservation and provide water conservation tips.	Ongoing
Continue to distribute educational pamphlets and brochures and advertise water conservation tips on the City's website and other media outlets (Section 5.4.1).	City Staff will hand out brochures and educational pamphlets at Community Events and promote water conservation tips on the City website and other media outlets.	Ongoing
Continue poster contest for Drinking Water Week (Section 5.4.1).	City Staff will put on BC Water Week poster contest yearly in collaboration with SD57.	Ongoing
Continue to promote Earth Day and Drinking Water Week events (Section 5.4.1).	City Staff will set up a booth at Earth Day and Drinking Water Week events.	2017
Restart "Wacky Wet Water" School Programs (Section 5.4.1).	Use Environmental Staff to update Wacky Wet Water Public Education Program.	2017-2026
Restart Water Wise Workers bicycle team to travel around the City to remind homeowners about summer water restrictions and distribute educational materials (Section 5.4.1).	Hire summer students to communicate information on water restrictions and water conservation tips.	2017-2026
Provide a free residential water use audit on the City's website (Section 5.4.1).	Develop, upload and advertise free water use audit to City's website.	2017
Provide regular insert with utility bills on water conservation tips (Section 5.4.1).	Develop and distribute water conservation insert.	2017-2026
Provide regular insert in the Community Active Living Guide on water conservation tips (Section 5.4.1).	Develop and distribute water conservation insert.	2017-2026
Strategy 5: City Leadership in Advancing Water-Use Efficiency		
Continue expansion of the Sentinel Centralized Computer Irrigation System to all Level A Parks (Section 5.5.1.1).	Install irrigation systems in Level A Parks (Rainbow Park, Connaught Hill Park) and connect to Sentinel Centralized Computer Irrigation System.	2017-2026

Install wireless rain sensors on battery-operated irrigation systems on boulevards (Section 5.5.1.1).	Purchase and install wireless rain sensors.	2017-2026
Upgrade connection for Sentinel Centralized Computer Irrigation system (Section 5.5.1.1).	Upgrade connection between Sentinel computer systems from dial-up connection to wireless cell phone connection.	2017-2026
Re-use water from Lheidli T'enneh Memorial Water Spray Park for irrigation (Section 5.5.1.2).	Apply for grants to fund Lheidli T'enneh Memorial Park Spray Water Re-use project.	2017-2022
Develop a water-efficient landscaping and xeriscaping strategy for City operations, developers and landscapers (Section 5.5.2).	Create a strategy that encourages City operations, developers and landscapers to incorporate xeriscaping and water efficient landscaping into landscape projects.	2020
Provide adult seminars on how to create a sustainable lawn and garden (Section 5.5.2.1).	Work in partnership with REAPs to design and implement seminars to public.	2021
Apply for grants to continue to retrofit all City offices, arenas and other facilities to low flow fixtures and other water saving devices (Section 5.5.3).	Continue to retrofit civic facilities with low flow fixtures and other water saving devices (including but not limited to low-flow shower heads, faucet aerators and low flow toilets).	Ongoing
Upgrade Harkins Library server room cooling system to eliminate use of 100,000 L of water per year (Section 5.5.3.1).	Facilities refrigeration upgrade.	2016
Upgrade City Hall server room cooling system to eliminate use of 100,000 L of water per year (Section 5.5.3.1).	Facilities refrigeration upgrade.	2017
Retrofit flush tank urinals at the Elksentre Arena (Section 5.5.3.1).	Upgrade urinals at Elksentre Arena to include flush controls.	2017-2022
Conduct a public survey to better understand water use, water conservation, perception on water sources and reception of water meters (Section 5.5.4).	Develop and promote water conservation survey to Public. Include survey with utility bill cycle.	2017
Initiate a water conservation education program for all city employees (Section 5.5.5).	Develop and implement water conservation education program for City Staff.	2017
Implement a water rate structure that encourages water conservation on all residential accounts (Section 5.5.6).	Develop an inclining tiered block rates structure that charges higher rates for high water users.	2021

1 Introduction

The City of Prince George (the City) has a sustainable year round source of drinking water. The City obtains most of its potable water from groundwater collector wells located within the Lower Nechako River Valley Aquifer which provides safe and reliable drinking water. Due to the proximity of the Nechako and Fraser Rivers to the community, attitudes and habits have formulated to trust there is a limitless abundance of water in Prince George. As our community continues to grow, a greater stress has been applied on the City's water source and the ability to deliver water through the network infrastructure. Sustainable water usage practices and ethics will need to be applied to preserve our drinking water quality and quantity.

Water conservation programs have the ability to defer, reduce, and/or eliminate the need for water supply and/or wastewater facilities upgrades. A reduction in wastewater flows can reduce treatment

costs and provide environmental benefits in terms of reduced discharges. Water conservation can extend water supplies and reduce operating costs and energy use. By reducing water use and, therefore, water withdrawals, water quality can be improved, ecosystems maintained, and water resources will be protected. As a result, even water systems with an abundant supply of water can benefit from a conservation plan by using existing resources more efficiently and saving resources over the long term.

Grant programs are made available from time to time from the federal and provincial governments to assist local governments in funding water and sewer servicing infrastructure. A significant requirement for receiving funding for water and wastewater infrastructure projects is to have a conservation plan in place. These requirements align with the Living Water Smart program established in British Columbia. Living Water Smart establishes water management and water use directives to adapt to climate change impacts and the pressures placed on water resources from a growing population and economy. The development of a new water conservation plan has been approved and supported by City Council through the Capital Expenditure planning process.

1.1 Water Conservation and Prince George

Historically, water supply in Prince George has been ample, and there has been little community pressure to conserve water for environmental or economic reasons. Compared to the rest of the Province, potable water availability is still currently abundant all year round in Prince George. However, increasing Maximum Day Per Capita Demands (MDD) placed on the water infrastructure has put pressure on the City to reduce these demands on the system in order to avoid huge financial investment costs where possible. Despite Prince George having a reliable source of water, there are still benefits that can be realized by implementing a water conservation plan. These benefits include:

- Reduced operation and maintenance (O&M) costs for power, chemicals, and general maintenance for the water supply and treatment systems;
- Reduced demands on the Nechako River Valley aquifer;
- Reduced flows to the City's wastewater treatment centre, and ultimately the Fraser River;
- Reduced or delayed capital expansion costs for the water system and the wastewater system; and,
- Reduced rate of demand increase.

In the future, climate change and increased environmental awareness may change the community concerning its water supply. This Water Conservation Plan (WCP) is prepared to lay out a path to promote and enable this change.

The purpose of this Water Conservation Plan is to set out a framework for the next 10 years that allows the City's Water Utility to influence demands. In the short term, water conservation measures can decrease operation and maintenance costs associated with supplying water and delaying spending on infrastructure upgrades. In the longer term, providing education to the community will increase awareness about the other benefits of water conservation, and increasing the knowledge about the nature of Prince George's water demand will enable future decision makers to make informed choices regarding infrastructure replacement and renewal, and future water conservation initiatives.

1.1.1 Water Conservation and the City of Prince George Official Community Plan (OCP)

The goal of water conservation planning is to achieve more efficient water-use by residential, industrial, commercial and institutional consumers in the City of Prince George. The impetus for moving toward water conservation is both economic and environmental. Economic concerns include a desire to alleviate capacity constraints, defer infrastructure renewal and replacement costs, and reduce operational costs. Environmental considerations involve minimizing the impact of both extracting and subsequently releasing treated City water to the natural environment.

Water conservation is often perceived to be restrictive and associated with personal inconvenience and rationing. Water conservation is, however; not only a matter of using less water through use-limits such as sprinkling regulations, but also involves careful management of water resources using a wide variety of methods. Mechanisms to assure and maintain water quality, repair leaks, use water saving technology (such as low-flow-toilets), and xeriscape (low water-use landscaping) all reduce excessive demand and contribute to water conservation.

The conservation of water is identified in the City of Prince George’s OCP 2011 through the following policies and objectives:

Objectives:

Objective 6.2.7	Use all feasible water-use efficiency tools to reduce residential water consumption.
Objective 6.2.8	Operate sustainably to reduce water demand which should reduce operational costs and should help defer future capital investments for additional storage, pumping and distribution capacity.
Objective 6.2.9	Increase public awareness on the value of aquifers and reduce their vulnerability.
Objective 6.2.10	Protect groundwater resources and the Nechako River and Fraser River as the receiving environment for the City’s wastewater.

Policies:

Policy 5.1.3	Encourage business competitiveness through the efficient use of resources and energy (e.g., water conservation and GHG emission reductions).
Policy 6.2.13	To adapt for climate change, water supply (both quantity and quality) should be protected and conserved to the greatest extent possible by: protecting aquifers and recharge zones; concentrating development near existing sources; and encouraging household and industry water conservation.
Policy 6.2.16	Encourage developers and landscapers to incorporate xeriscaping (drought resistant, low water requirement) concepts into development of landscape projects.
Policy 6.2.17	The City should work with all government forms and agencies to demonstrate leadership in advancing water use efficiency.
Policy 6.2.18	Develop water efficient landscaping through a partnership between the City and community members/organizations.
Policy 6.2.19	The City should consider integrating rain collection and reuse in all City and private developments and renovations.
Policy 6.2.20	The City and Regional District of Fraser-Fort George should continue to exchange information regarding Foothills Landfill groundwater monitoring results and the Nechako Aquifer water quality.

1.1.2 Water Conservation Plan 2005

The overall goal of the 2005 Water Conservation Plan was “to use all feasible water-use efficiency tools to reduce residential water consumption by 20% and overall water consumption by 15% in the next 10 years (relative to 2004 water-consumption levels).” In order to ensure a groundwater supply that remains reliable and healthy, and continues to meet the needs of future community demand, the City of Prince George has implemented a number of water conservation initiatives.

The 2005 Water Conservation Plan projected a savings of \$139,209 for water and wastewater operating expenses per year with a 15% reduction in water use. To determine if expenses had decreased, the costs from 2004 were multiplied by 19.79% for inflation, as per the Bank of Canada, and compared to the total water and wastewater operations and maintenance expenses in 2014. As shown in Table 1-1, water and wastewater operations and maintenance expenses have not decreased but instead have increased by 25%.

Table 1-1: Water and Wastewater Operating and Maintenance Costs – 2004 vs 2014

Expense Category	2004 Costs (\$)	2004 costs adjusted for inflation to 2014 (\$)	2014 Cost	% Change
<i>Water Operations and Maintenance</i>				
<i>Electricity</i>	584,817.43	700,556.75	921,305.09	
<i>Fuels and Oils</i>	3,036.87	3,638.01	4,411.41	
<i>Water Treatment</i>	69,791.12	83,603.25	91,617.72	
<i>Chemicals</i>	1,884.74	2,257.74	1,373.46	
<i>Total Water</i>	659,530.16	790,055.75	1,018,707.68	+22.4%
<i>Wastewater Operations and Maintenance</i>				
<i>Electricity</i>	210,113.93	251,696.90	403,902.32	
<i>Fuels and Oils</i>	4335.37	5193.37	3915.72	
<i>Chemicals</i>	67,736.19	81,141.64	76992.8	
<i>Parts</i>	35,602.31	42,648.25	67799.6	
<i>Total Wastewater</i>	317,787.80	380,680.16	552,610.44	+31.1%
<i>Total Water and Wastewater</i>	977,317.96	1,170,735.91	1,571,318.12	+25.5%

The following milestones highlight the history of water conservation in the City of Prince George since 1996.

Table 1-2: Historical Water Conservation Measures

Year	Milestones
1996	Implementation of Industrial Commercial and Industrial (ICI) metering
1998	First study focused on cost-benefit analysis of universal metering
1998-2001	Summertime watering restrictions in the Hart area
2000-current	Initiated “Wacky Wet Water” School Education programs
2001	Incorporated water quality issues into the Official Community Plan
2001-current	Initiated Summer Public Education programs, ran water conservation poster contests during Drinking Water Week and distributed Wise Water Use conservation kits in 2006 & 2007
2001-current	Water conservation tips highlighted on the City’s website
2001-current	Implemented advertising for indoor and outdoor water conservation during the summer months
2001-current	Participation in Rivers Day to provide educational materials
2002-2003	Provided a regular insert into the Leisure Services Guide on water conservation alternatives
2003	Water Regulation and Rates Bylaw amended to include Water Sprinkling Restrictions
2004	Comprehensive Fees and Charges Bylaw amended to revise water rates from a declining rate structure to a capacity charge rate and flat rate for consumption
2005	First Water Conservation Plan completed
2005	Implementation of a voluntary residential metering program
2005	REAPS and City of Prince George Rain Barrel program
2005	Implementation of the Centralized Irrigation Initiative in Carrie Jane Park
2007	Water Regulation and Rates Bylaw amended to require the installation of water meters for all new single family and multi-family developments
2008	Approved a list of CSA approved and independently tested low flow toilets for new construction
2008	B.C. Building Code change to require low flow (6L) toilets in all new development
2008	Implementation of volumetric pricing to equalize the cost of water across all ICI users
2012	B.C. Building Code change to require high efficiency (dual flush) toilets in all new development

The City of Prince George 2005 Water Conservation Plan recommended three strategies under the water conservation program. These three strategies are:

- Water metering
- Volumetric pricing
- Information and education

Table 1-3: 2005 Water Conservation Plan Recommendations

Strategy 1: Water Metering	
Install water meters in all industrial, commercial and institutional customers that were allowed in previous years to be unmetered.	Ongoing - working towards 100%. 165 accounts still on flat rate.
Installation of metered filling stations for private use.	For inclusion in future capital expenditure plans.
Recommend the installation and use of water meters on a voluntary basis in 25-250 homes per annum for 5 years.	Ongoing.
Recommend amendment to the Water Bylaw to implement mandatory water metering in all new building construction.	Complete.
Mandatory installation of water meters in all new buildings, including residential.	Complete.
Mandatory installation of water meters in all houses sold and all home renovations.	Future consideration.
Retrofit all existing commercial, industrial and institutional meters to the RF AMR system, finance over two years, to gain greater meter efficiency. All new residential meters should be compatible with RF AMR technology.	Ongoing.
Strategy 2: Volumetric Pricing	
A system of volumetric pricing is recommended to equalize the cost of water across all users.	Complete.
The City of Prince George recommends implementing a water rate structure that encourages water conservation on all residential accounts.	Future consideration.
Strategy 3: Information and Education	
It is recommended that the City of Prince George establish a bicycle team to travel around the City to remind homeowners about summer water restrictions, provide tips on reducing water use in the home, and distribute information on how to volunteer to have a water meter installed in their home.	Concluded in 2006 - recommend reactivating this program.
Create a Guide to Wise Water Use – a 10 page brochure to highlight tips on how to decrease residential indoor and outdoor water consumption.	Complete.
Distribute Wise Water Use Door Hangers by a bicycle team over the summer, handed out to interested residents at community events and included as part of the Water Works Wonders Conservation Kits.	Complete - recommend reactivating this program.
In association with other community groups, the City of Prince George proposes to facilitate a program to encourage the use of rain barrels.	Complete – facilitated by REAPS.
In cooperation with REAPS and the Community Garden, the City of Prince George recommends providing adult seminars on how to create a sustainable lawn and garden.	Future partnership.
The City of Prince George will continue to participate in the Sustainable Landscapes Program to promote natural landscaping of public areas.	Ongoing.
The City of Prince George will continue with Drinking Water Week Activities.	Ongoing.
Increase the number of Wacky Wet Water education programs to reach more school aged children.	Ongoing.
Tailor a high-school education program to meet high-school curricula (IRP requirements). This education program would be prepared and handed over to high-school teachers for delivery.	Future consideration.
Provide a free water use audit both on paper and on the website. This will ask specific questions about water use and provide a calculated total of your daily water consumption. It will also include tips for saving water.	Complete – part of the Guide to Water Use booklet.
Recommend providing incentives for residential retrofitting to 6L toilets from current 13L toilets.	Complete – Building Code revisions
Recommend following up with the Ministry of Community, Aboriginal and Women’s Services to make low flow toilets mandatory in all new building starts and with all plumbing renovations.	Complete – Building Code revisions 2008.

Design landscapes to minimize the effect they will have on the surrounding area by giving preference to regionally native plant species and the use of water conserving landscape techniques.	Complete – 2008.
Expansion of the Centralized Irrigation Initiative of The City of Prince George Environmental Services to all parks and boulevards.	Phase I and II – rain sensors for irrigation at playing fields and manual shut offs at parks. Phase III – 2008. Phase IV – 2009 Blvds (existing irrigation).
Support for the development of changes to fertilizer and grass seeding regimes.	Future consideration.
Initiate a water conservation education program for all city employees.	Future consideration.
Promote a program to retrofit all city offices, arenas and other facilities to low flow fixtures and other water saving devices (including but not limited to low-flow shower heads, faucet aerators, and low flow toilets).	Ongoing.

2 Community Water System Profile:

2.1 Background and Summary

The City of Prince George is located near the geographical centre of British Columbia. The climate in Prince George is typically summers that are short but warm, and winters that are long and cold with snow cover present between November and March of each year. The region has, however, been seeing increased rainfall in the winter due to changing weather patterns. The City is located at the confluence of the Nechako and Fraser Rivers, making it susceptible to flooding and ice jams.

The City’s water system consists of 19 pressure zones, 15 storage reservoirs, over 30 pumping stations and pressure reducing stations, and includes over 550 km of watermain. The City is supplied through six groundwater collector wells, one north of the Nechako River, and five south of the river. There are groundwater wells which have been taken out of operation in recent years that are maintained in a standby capacity. They can provide emergency and backup water supply to the City of Prince George if needed.

The City currently serves a population of over 71,000, and a variety of commercial and industrial enterprises on its water system and provides over 16 million cubic metres of potable water for consumption per year.

2.2 Climate Profile

Prince George generally experiences short, relatively hot summers with long, cold winters. Maximum day water demands are closely linked with climate factors, particularly hot periods with low rainfall. Climate records from Environment Canada for 2008 – 2015 were reviewed and are summarised in Table 2-1. Total summer rainfall, maximum summer temperature and number of days in summer without rainfall have been included in our analysis these have the greatest influence on MDD. For the purposes of this analysis, summer is defined as May – September and winter is defined as October-April.

Table 2-1: Summary of Climate Data for Prince George

Year	Average Maximum Temperature (°C)		Total Precipitation (mm)		Maximum Summer Temperature (°C)	Summer – Number of Days Without Rain
	Summer	Winter	Summer	Winter		
2008	20	3	311	359	33	12
2009	22	2	228	403	33	20
2010	20	5	224	226	32	14
2011	19	3	371	370	27	8
2012	21	3	198	321	32	11
2013	22	2	221	210	34	16
2014	21	1	163	257	34	12
2015	21	4	246	306	32	21

From the data presented in Table 2-1 it is evident that:

- The summer of 2011 was wetter than usual, with above average rainfall.
- There was a 20 day period without rainfall in the summer of 2009, from July 19th to August 7th. Over this drought period there were 10 days during which the maximum temperature exceeded 30 degrees Celsius.
- The summer of 2014 had very little precipitation, however looking at the daily precipitation records the maximum number of days without rain was 12 days.
- There was a 9 day period without rainfall in the summer of 2015, which resulted in the 2015 water restrictions. Over the 9 day period there were 5 days in which the temperature exceed 30 degrees Celsius

2.3 Community Profile

According to recent B.C. Stats data the 2015 population of the City of Prince George was approximately 71,400 people; this source of data was used for population estimates applied to various calculations in this study. The major ICI water users in Prince George include the hospital, the university, a chemical processing plant and the wastewater treatment plant. Change in population over the last 10 years in the City of Prince George is shown in Table 2-2.

Table 2-2: Prince George Population

Year	Population	Annual Change in Population
2004	74,792	-
2005	73,350	-2%
2006	72,961	-0.7%
2007	72,756	+0.6%
2008	73,815	+0.8%
2009	73,114	+1
2010	73,574	+1.2
2011	73,803	+0.5

2012	73,509	-0.4
2013	73,850	+0.5
2014	73,321	-0.7
2015	71,363	-2.7

2.4 Watershed Profile

Prince George has an ideal raw water source which provides potable groundwater that requires no treatment (however water is disinfected to provide protection in the distribution network). This type of situation is increasingly rare, but leads to water treatment cost savings that accumulate through the careful protection of water sources and upland watersheds. The groundwater aquifer is recharged from the Nechako and Fraser Rivers.

2.5 Infrastructure Profile

2.5.1 Groundwater Wells

The City of Prince George receives potable water from six groundwater collector wells adjacent to the Nechako and Fraser Rivers across the City.

Table 2-3 summarizes the well capacities for the south and north water systems. The north system is supplied solely by the newly (2006) constructed Fishtrap Collector Well and pumping system.

Table 2-3: Existing Supply Wells

System	Well	Pump Station	Abstraction Volume Limit (m ³ pd)	Rate of Abstraction Limit (L/s)
South	Wilson Park East	PW 601, PW 602	109,106	1,052
	Wilson Park West	PW 605	81,830	789
	College	PW 621, PW 624	22,776	220*
	Corral	PW 625	191	1.8*
	Willow Cale	PW 627	9,456	90.9*
North	Fishtrap Island	PW 660	111,834	1,078

*indicates pump capacity rather than abstraction limit

The combined abstraction limit (assuming that pump capacity is less than abstraction limit) for the six wells is Prince George is 28,000 m³/day or 280 million litres/day.

2.5.2 Distribution and Treatment Systems

A disinfectant (sodium hypochlorite) is added to the raw water to provide residual disinfection in the network. Chlorine analysers were added to the water system in 2011 to monitor and ensure

appropriate levels of disinfection are occurring at wells and re-chlorination booster stations. A summary of the distribution system is provided in Table 2.4.

Table 2-4: Water System Summary

Water System Component	Quantity
Pressure Zones	19
Supply Wells	6
Storage reservoirs	15
Pump Stations	17
Pressure Reducing Valves	17
Length of watermains (km)	553.6
Service connections	25,268
Fire Hydrants (Owned by City)	2,057

2.5.3 Planned Water System Upgrades

The Water Master Plan that was prepared by Opus Dayton Knight Ltd. in 2014 recommends upgrades to the City of Prince George water supply system. The majority of the upgrades are required to provide adequate fire flows in the network. The justification for most of these upgrades will not vary with reduced water consumption. However, there are a number of reservoirs that require upgrades to provide sufficient storage for fire, emergency and flow balancing requirements. The volume required for emergency storage and equalisation is dependent on maximum day water demands (MDD). This means that a reduction in water demand may reduce the size, and therefore cost, of any new reservoirs required, or alternatively may delay the need for a new reservoir at all.

2.5.4 Wastewater Treatment and Infrastructure

The City’s 555 km of sanitary sewer line and 31 lift stations channel the wastewater to the Lansdowne Wastewater Treatment Centre and 5 treatment lagoons. A reduction of water usage can result in decreased flows to the sanitary sewer, which results predominantly from efficiency in indoor water use that creates wastewater.

Reduced sewer flows result in lower wastewater treatment operating and maintenance costs and system capacity requirements. This can correspond to a reduction in capital costs for treatment plant and network expansions. The impact of water conservation initiatives on the capacity of the wastewater infrastructure was not analysed over the course of this study.

2.6 Current and Historic Water Demand

Water consumption data for the City of Prince George’s water utility has been reviewed and assessed for the period from 1985 to 2015. Sectoral water demands for Industrial, Commercial, and Institutional (ICI) and residential users were evaluated.

Gross water use data from 2004 to 2015 was analysed to determine current annual average day demand (ADD) and maximum daily demand (MDD) on a per capita basis.

2.6.1 Average Day Demand

2.6.1.1 Total Average Day Demand (ADD)

The Average Day Demand (ADD) is the total volume of water entering the distribution system averaged over the 365 days of the year. The ADD is used to determine the overall source capacity required to service the City's entire water system. It is also useful in analysing historic demands and in estimating future demands. The City's pump station data was used to calculate the total withdrawal of raw water from 2007 to 2015 and written records were used to determine total system water usage for the period between 2004 and 2006.

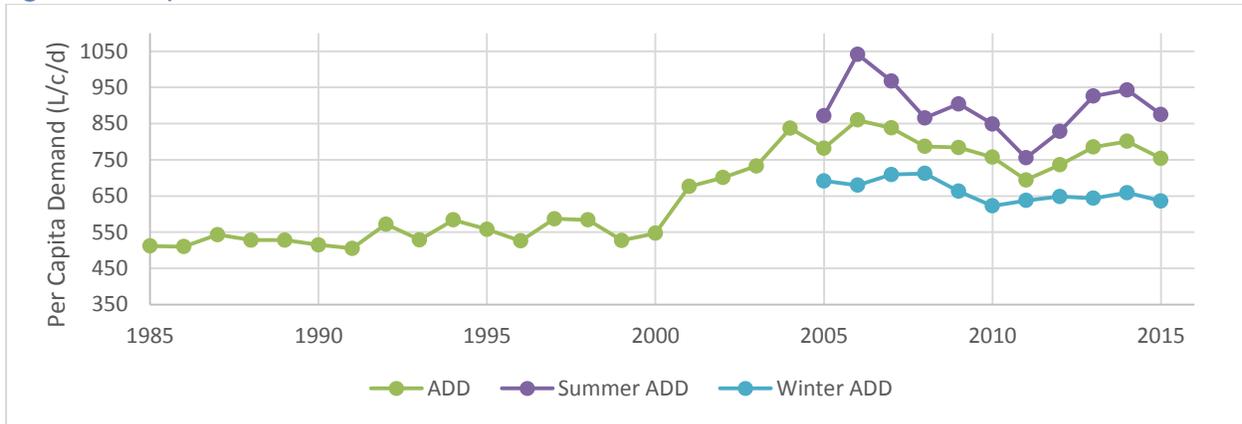
The per capita demand, expressed in litres per capita per day (L/c/d), is the average daily total water entering the system divided by the number of inhabitants served by the utility (85% of the City's population are connected to the City's water). This value is a general performance measure of water consumption since its calculation does not consider population equivalents for ICI customers. The calculated total, average, and per capita demands for the last eleven years are listed in Table 2-5.

Table 2-5: Average Day Demand

Year	City Water Utility Customers	Total System Demand (m ³)	Average Day Demand (m ³ /day)	Estimated Average Per Capita Demand (L/c/d)
2004	63,573	19,472,790	53,204	837
2005	62,348	17,788,644	48,736	782
2006	62,017	19,476,928	53,361	860
2007	61,877	18,935,674	51,879	838
2008	61,893	17,823,187	48,697	787
2009	62,147	17,776,692	48,703	784
2010	62,538	17,287,575	47,363	757
2011	62,733	15,882,068	43,513	694
2012	62,483	16,841,159	46,014	736
2013	62,773	17,979,237	49,258	785
2014	62,323	18,220,375	49,782	801
2015	60,659	16,694,885	45,614	754

Water consumption patterns in the summer and in the winter differ significantly. Figure 3 illustrates the per capita demand in Prince George from 1985 to 2015 along with the average daily summer and winter demands for each year between 2005 and 2015. This additional detail in the figure depicts that the winter demands are less influenced by weather from year to year and so have less variance. The large increase in per capita demand recorded in 2001 is likely due to inaccuracy of the flowmeters that were replaced that year. The peaks in summer demand need to be managed the most and should therefore be targeted by water conservation practices.

Figure 3: Per Capita Demand 1985 – 2015



Average Day Demand (ADD) based on per capita water use in the City of Prince George has varied over the last 30 years, with a minimum of 512 L/capita/day in 1985 to a peak of 860 L/capita/day in 2006. Authors of the 2005 Prince George Water Conservation Plan used the 2004 water demand as the planning base year. Water conservation strategies outlined in the plan were implemented that same year. Between 2004 and 2015 there is a slight decreasing trend in per capita demand; it is possible that per capita demand has effectively been reduced by 10% in this period. It should be noted that between 2006 and 2011, ADD decreased consistently by 0.5-8% each year from 860 L/capita/day to 694 L/capita/day – an overall 19% decrease in water consumption in 5 years. This could be attributed to the water conservation efforts imposed by the 2005 Water Conservation Plan, and the City of Prince George Water Conservation Public Education Program as well as populations changes, varying summer weather conditions, large local fires (ie. Lakeland Mills in 2012) and changes to the building code. It is not possible to accurately quantify the impact of the water conservation programs with the information available.

In addition, between 2011 and 2014, ADD increased by 15% from 694 L/capita/day to 801 L/capita/day. The increase may be due to the reduction of the City of Prince George Water Conservation Public Education Program in 2012, as well as several other factors. ADD decreased again by 6% between 2014 and 2015 from 801 L/capita/day to 754 L/capita/day which may be linked to the water ban in July 2015 during the hottest part of the summer. During the water ban in 2015, daily water consumption decreased from 61,000 m³ to 29,000 m³ city-wide in a few days. ADD seems to be affected by summer rainfall, as ADD was lowest in 2011 and 2015 when summer rainfall levels were higher (371 mm in 2011 and 246 mm in 2015) while ADD was highest in 2006 and 2014 when summer rainfall was lower (164 mm in 2005 and 163 mm in 2014).

The variable changes in ADD in the City of Prince George between 1985 and 2015 may also be attributed to population changes, higher than estimated losses due to leaks, unauthorized consumption, data errors, and inaccurate meters. Climatic factors or changes in the Utility’s ICI customer base or consumption volumes may also have influenced per capita demand in this time period.

For the purposes of setting water conservation targets, the 2015 per capita Total Average Day Demand of 754 L/c/d will be used.

2.6.2 Sectoral Water Demands

2.6.2.1 Industrial, Commercial, and Institutional (ICI) Water Demands

As of 2014, the City of Prince George has 2072 industrial, commercial or institutional (ICI) water service connections, of which 1863, 90%, are metered. This does not include the metered residential/multi-family properties. The major ICI water users in Prince George include the hospital, the university, a chemical processing plant, and the City's wastewater treatment plant.

Table 2-6: ICI Water Demand

Year	Total # of Metered ICI Connections	Metered ICI Demand (m ³)	Total # of ICI Connections	Estimated Total ICI Demand (m ³)	Total System Demand (m ³)	Estimated Per Connection Demand (L/connection/day)
2013	1,700	3,403,417	1,909	3,743,759	17,979,237	5,372
2014	1,863	3,333,441	2,072	3,666,785	18,220,375	4,848

As 10%, 165 accounts, of ICI connections are currently unmetered; it is assumed that an additional 10% of water demand may be added to the metered water consumption for total ICI water consumption which amounts to 3,743,759 m³ L in 2013 and 3,666,785 m³ in 2014. According to these calculations ICI water usage accounts for approximately 20-21% of the total water system demand per year. The estimated per connection demand for ICI connections in 2013 and 2014 was 5372 L/connection/day and 4848 L/connection/day respectively.

According to the 2009 Environment Canada water usage reports, the City of Prince George's residential customers use on average 73% of the total volume of water entering the distribution system and Commercial and Industrial customers use approximately 22% of it. The remaining 5% of the gross water use is considered to consist of system losses such as non-revenue water and leakage. For the purpose of this study, 20.5% of Total Water Consumption was attributed to Industrial, Commercial, and Institutional (ICI) water demands.

2.6.2.2 Residential Water Demands

2.6.2.3 Metered Residential Use

Due to the requirement of the installation of a water meter in newly built single family and multi-family dwellings and the volunteer water meter program, the City of Prince George has 691 residential water meter connections as of 2014. Of these connections, 22 are in multi-family dwellings and 669 are in single-family dwellings. The connections in multi-family dwellings measure the total building's water consumption and are not broken down by suite. Metered residential water consumption is broken down in Table 2-7 and 2.8.

Table 2-7: Metered Residential Daily Connection Demand – Single Family

Year	Total # of Single Family Connections	Sector System Demand (m ³)	Per Connection Demand (L/connection/day)	Per Capita Demand (L/c/d)
2013	712	153,581,368	591	236.4
2014	669	179,151,446	734	293.6

Per capita demand for single family metered accounts was determined by dividing daily connection demand by 2.5, the average persons per home. The daily demand for residential metered properties was 236 L/c/d and 293 L/c/d in 2013 and 2014.

According to a study performed by the American Water Works Association, multi-family residential uses 14.2% less water than single family residential. This was assumed to calculate the per capita demand for metered multi-family connections, as the population for each connection is highly variable.

Table 2-8: Metered Residential Daily Connection Demand – Multi-Family

Year	# of Multi-family connections	Sector System Demand	Per Connection Demand (L/connection/day)	Per Capita Demand (L/c/d)
2013	24	48,048,216	5,485	202.8
2014	22	39,364,292	4,902	251.9

2.6.2.4 Unmetered Residential Use

Unmetered Residential Use was calculated by subtracting metered residential water use and ICI water use from the total system demand, and accounts for approximately 78% of total water usage. Since most of residential water use is not measured, it also includes any system losses. Approximately 85% of the City’s population is served by the City’s water utility, while the remaining population is served by private or community wells.

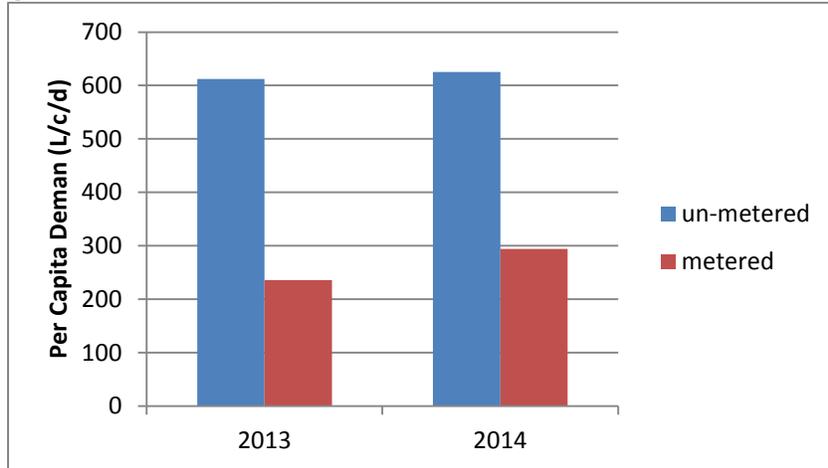
Residential per capita demand was calculated by using 85% of the City’s population. For the purposes of setting water conservation targets, 2015 residential ADD of 588 L/capita/day will be used.

Table 2-9: Residential Average Day Demand

Year	City Water Utility Customers	Total System Demand (m³)	Estimated Residential Water Usage (m³/day)	Estimated Residential Per Capita Demand (L/c/d)
2004	63,573	19,472,790	41,613	653
2005	62,348	17,788,644	38,014	610
2006	62,017	19,476,928	41,622	671
2007	61,877	18,935,674	31,563	654
2008	61,893	17,823,187	38,088	614
2009	62,147	17,776,692	37,989	611
2010	62,538	17,287,575	36,943	591
2011	62,733	15,882,068	33,940	541
2012	62,483	16,841,159	35,989	574
2013	62,773	17,979,237	38,421	612
2014	62,323	18,220,375	38,937	625
2015	60,659	16,694,885	35,678	588

The average day demand (ADD) for unmetered residential properties is double the ADD for metered residential properties. In 2014, metered residential per capita water consumption was 293 L/c/d while unmetered residential per capita water consumption was approximately 625 L/c/d as shown in Figure 4.

Figure 4: Residential Per Capita Demand - Un-metered vs Metered



2.6.3 Maximum Day Demand per Capita

The Maximum Day Demand (MDD) is the average per capita demand on the day with maximum water consumption. The MDD defines the required treatment capacity of the City’s water system and is critical in the sizing of network water mains and system reservoirs for provision of flow equalisation and emergency storage volumes.

The City’s pump station data was used to estimate the 2007 to 2015 MDD values. Written pumping records were used to estimate the 2005 and 2006 MDD values. A summary of the MDD to ADD peaking factors for the last 11 years is shown in Table 2-10.

Table 2-10: Per Capita Demands and Peaking Factors

Year	City Water Utility Customers	Average Day Per Capita Demand (L/c/d)	Maximum Day Per Capita Demand (L/c/d)	Peaking Factor
2004	65,573	837	-	-
2005	62,348	782	1038	1.2
2006	62,017	860	1495	1.9
2007	61,877	838	1352	2.1
2008	61,893	787	1156	1.6
2009	62,147	784	1089	1.8
2010	62,538	757	1165	1.4
2011	62,733	694	928	1.2

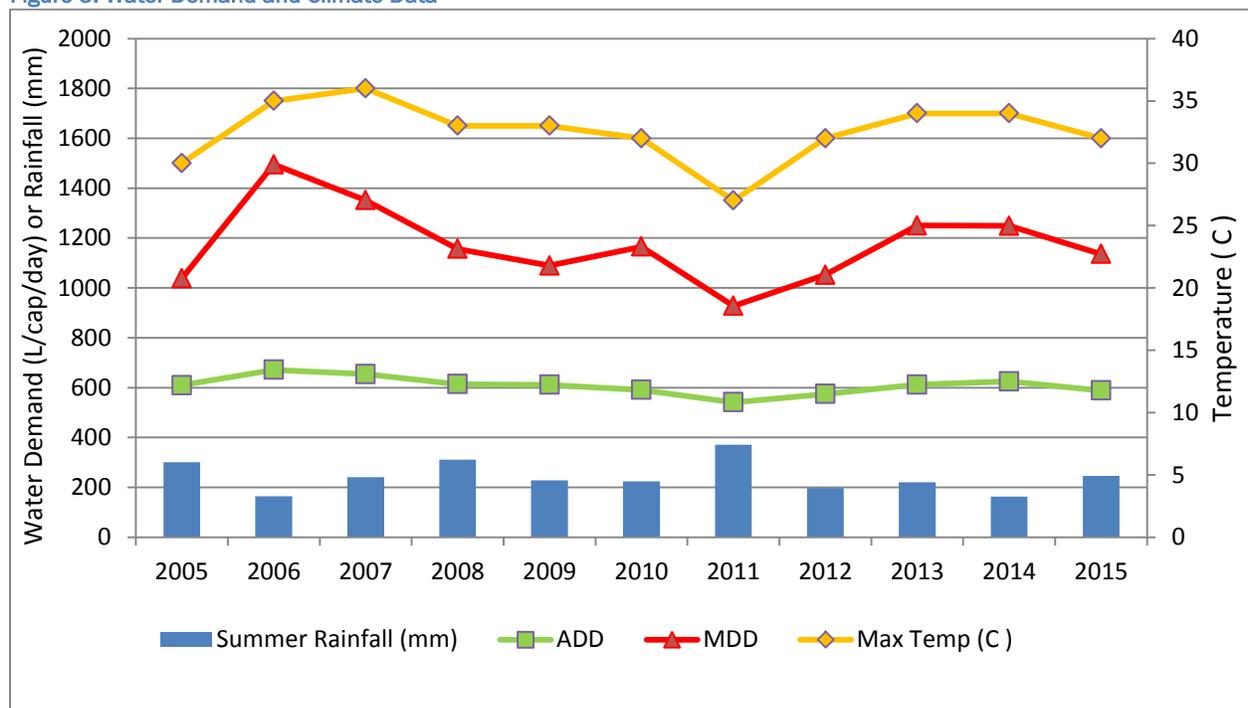
2012	62,483	736	1052	1.5
2013	62,773	785	1250	1.7
2014	62,323	801	1249	1.6
2015	60,659	754	1136	1.4

The average MDD per capita peaking factor over the last 11 years is 1.6.

The MDD, ADD, total summer rainfall and maximum temperature for the period 2005 to 2015 are shown graphically in Figure 2. It is clear from this graph that MDD is heavily influenced by climatic factors such as temperature and rainfall. During hot, dry weather, outdoor water use for irrigation, car washing and other water intense activities increases. It is likely that the peak in MDD in 2009 is due to the hot, dry period experienced during the summer that year. The MDD for 2015 occurred on July 7, 2015 which was the day that prompted the 2015 water ban. Likewise the low MDD in 2011 is likely due to the overall lower temperatures and higher rainfall (particularly during summer) experienced that year.

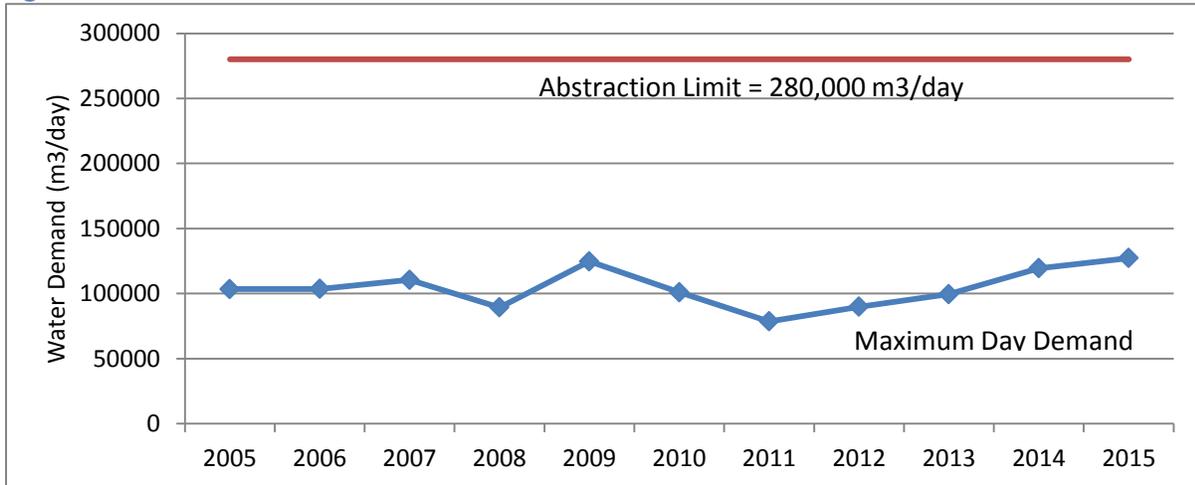
An MDD of 1,200 L/capita/day, based on the average of the 2014 and 2015 MDD, will be used as the baseline for the purpose of setting water conservation targets.

Figure 5: Water Demand and Climate Data



The historical MDD is less than the abstraction limit in Prince George as shown in Figure 6. Rather than putting pressure on the water supply, the MDD has put pressure on the distribution infrastructure in meeting the required system performance measures.

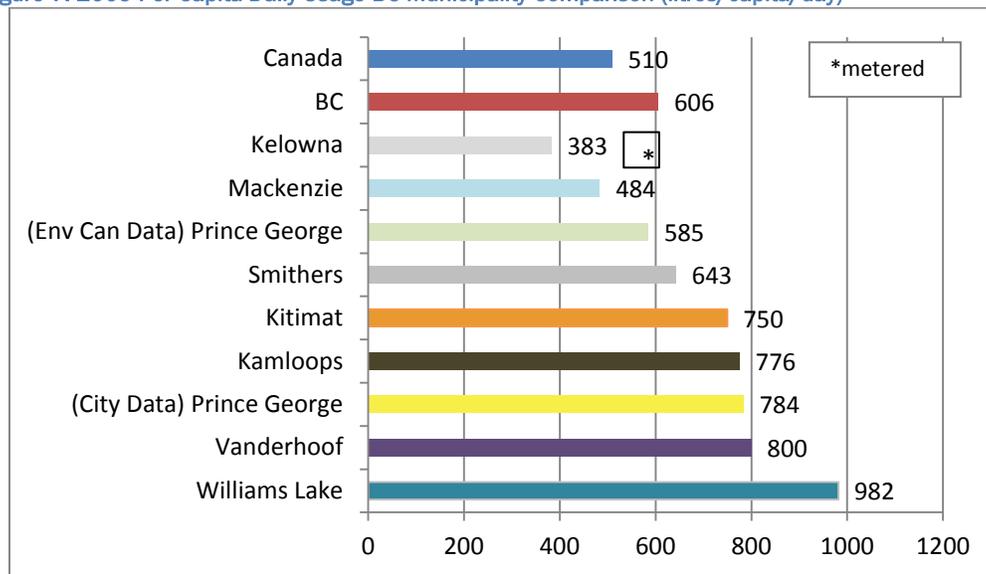
Figure 6: Abstraction Limit and MDD



2.6.4 Comparison with Other Municipalities in B.C.

Per capita water use using the corrected populations for “City data” for Prince George was compared to the consumption data of B.C. municipalities using Environment Canada data which is illustrated in Figures 7 and 8.

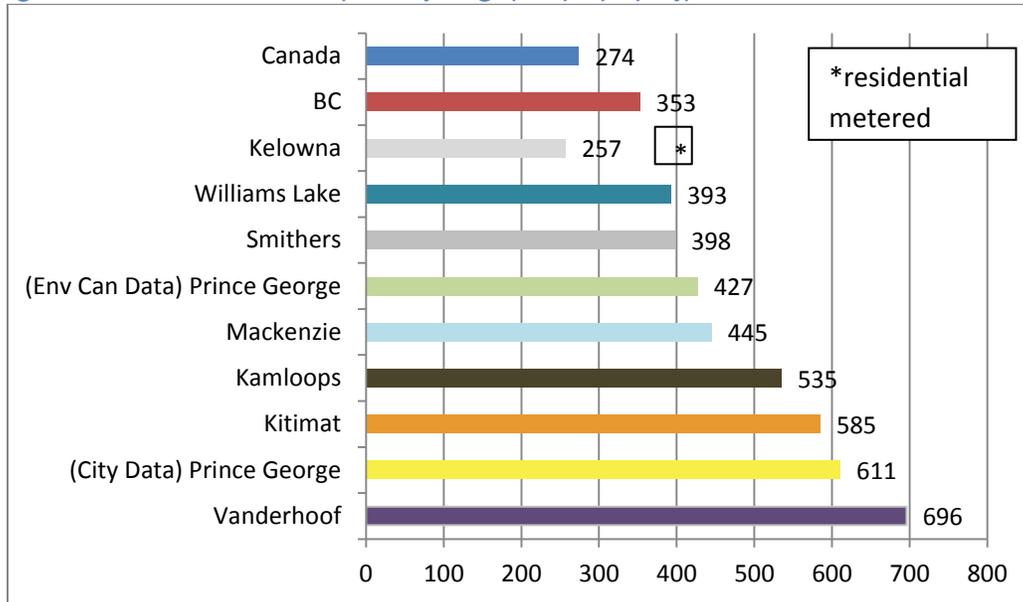
Figure 7: 2009 Per Capita Daily Usage BC Municipality Comparison (litres/capita/day)



Note that “City data” values above were calculated from the City’s flowmeter totals divided by 85% of the B.C. Stats population. The per capita water usage was therefore 784 L/c/d in 2009 and significantly higher than 585 L/c/d reported by Environment Canada and calculated using a population value which included residents that are not served by the utility.

Assuming that 78% of Prince George’s water demand is residential, and using other assumed breakdowns for other B.C. municipalities, the residential water usage per capita was calculated and compared in Figure 8.

Figure 8: 2009 Residential Per Capita Daily Usage (litres/capita/day)



The City residential per capita water usage was 611 L/c/d for 2009 (B.C. Stats population: 73,114*.85% served by the utility = 62,147) compared to 427 L/c/d (population: 74,119) from Environment Canada data.

Both the average and residential per capita daily usage in Prince George in 2009 of 784 L/c/d and 611 L/c/d are greatly above the B.C. averages of 606 L/c/d and 353 L/c/d respectively. Prince George's residential water usage is lower when compared to Vanderhoof. However, municipalities such as Kamloops, Kelowna, Mackenzie, Williams Lake, Kitimat and Smithers have lower residential water usage rates than Prince George. It is noted that the assumptions made to determine residential water use for the other B.C. municipalities are unknown unless otherwise indicated.

3 Future Water Demand

3.1 Population and Economic Growth

Future water use in the City of Prince George is aligned with population and ICI growth over time. A growth rate of 0.8% has been used for future demand projections (as per the Prince George OCP middle growth rate). Assuming that per capita water demand remains static at 754 L/capita/day, the ADD can be expected to increase by 8% (3,800 m³/day) every year to 49,712 m³/day in 2022 from population growth alone. Water demand will continue to increase over time due to increases in population.

3.2 Climate Change

Climate change is increasingly affecting British Columbia's landscapes, communities, and economic activities. Climate change will become more pervasive and many regions of B.C. will experience increasing water shortages. By anticipating the effects of climate change, municipalities can take action before major impacts occur to reduce a community's vulnerability.

In order to adapt to climate change, many municipalities are therefore incorporating climate change impacts to their water management plans, upgrading their reservoir capacity, and incorporating various demand management initiatives. Adaptation activities include using new technologies, adjusting planning and investment practices, and revising regulations. Adaptation measures have the benefit of achieving sustainability goals and should not be considered as only having the capacity to address climate change. Both adaptation and mitigation are required in addressing climate change.

The gradual shift in average climate conditions will be accompanied by changes in climate variability and the frequency and extent of extreme weather events. These impacts will affect municipalities across Canada, and have impacts on infrastructure, social and economic systems, and the natural environment. Local governments have a critical role to play in managing climate change risks by implementing adaptive measures to enhance the community's resilience to climate change.

3.2.1 Climate-Related Impacts

The City of Prince George has considered climate change impacts in the Official Community Plan. It is expected that average temperatures in Prince George will rise in the future, and precipitation will increase. A rise in the average temperature may cause changes in runoff by increasing the frequency of melt events. The sensitivity of water storage in snowpack and glaciers to increased temperatures will be greater in the south and at lower elevations. However, the effect of warmer temperatures will also shift the timing of the runoff freshet to earlier in the spring, thus depleting the storage capacity that would have been available for the later summer season. The consequences of these changes in water source, water storage, and runoff timing will have consequences for the competing demands of water resources.

Although the effects of climate change cannot be predicted precisely, Prince George is likely to experience variations in weather resulting in both flooding and drought conditions. The City of Prince George water supply is from groundwater wells; the majority of which are located along, and therefore recharged by, the Nechako River. Even though the City of Prince George has a very small demand compared to the available water resources, there should still be careful management of the supply if it is to remain a sustainable supply of water for the future as pressures from climate change mount. By monitoring the water supply and the recharge of the aquifer, the City will be able to mitigate its impact on the supply.

With average temperatures continuing to increase due to climate change, the likelihood of Prince George residents' instinctive desire to consume more water will correspondingly increase. Additionally, the increased water use may be coupled with drought conditions, which could create the need for severe water restrictions. The citizens' regard for the changeable availability of water is foundational to water conservation measures.

The realization that water supply is limited needs to be addressed. By persistently and effectively reaching out to the public, the myth of limitless abundance of clean, fresh water can be dispelled. By educating the public on this matter, a conservation ethic can be instilled that will ensure that water availability and quality issues do not limit future social and economic gains.

3.3 2016 Water Sustainability Act

The new *Water Sustainability Act (WSA)* came into effect, replacing the former Water Act, on February 29, 2016 and introduced important changes to regulate water users. The new Act includes improved protection of groundwater and aquatic ecosystems, and new licensing requirements for non-domestic groundwater users (ie. Industrial, agriculture).

Groundwater use is now managed and regulated under the new *Water Sustainability Act*, and groundwater users are required to obtain a license and pay annual water rental fees based on water consumption. The City of Prince George will be required to pay for water usage under its water license. Based on current water consumption rates, it is expected the City will pay approximately \$40,000 annually for water rental fees under the new regulations.

4 Water Conservation Target

The determination of a water conservation target will enable the City of Prince George to focus its efforts within and document the appropriate plan to achieve that target.

4.1 2005 Water Conservation Plan Target

The overall goal of the 2005 water conservation plan was “to use all feasible water-use efficiency tools to reduce residential water consumption by 20% and overall water consumption by 15% in the next 10 years (relative to 2004 water-consumption levels).”

From the data analysed in this report, average day residential per capita water demand has marginally declined in the 2004 to 2014 period. The overall water usage trend for the City of Prince George has trended downwards by 4-5%. The targets of the 2005 water conservation plan were not achieved by 2014, as shown in Table 4-1.

Table 4-1: Progress against 2005 WCP Goals

Water Use (L/c/d)	Base year 2004	2014 Target	Actual 2014	Actual % Reduction
Residential ADD	653	522	625	4%
Total ADD	837	670	801	5%

Water conservation measures implemented and carried forth in the last ten years may have contributed to a slight decrease in water consumption in Prince George, but this cannot be confirmed with the data available (refer to Section 1 for further information on previous water conservation measures). Varying climate conditions or changes in the Utility’s ICI customer base may also have influenced per capita demand in this time period.

4.2 Water Conservation Goals and Targets

In general, reduction of Average Daily Demand (ADD) is important to alleviate stress on source supply capacity to ensure longevity of the resource. With the source capacity in Prince George

governed by groundwater supplies, which are replenished through the sand/gravel layer from the Fraser and Nechako rivers, there is minimal concern for source capacity.

Alternatively, reduction of Maximum Day Demand (MDD) is important to alleviate stresses within the operation of the water system infrastructure. Treatment, pump, pipe network and storage capacities are all designed to handle the MDD in the water system. The City finalized a Water Master Plan Update in 2014, which assessed the capacity of the water distribution network and recommended necessary upgrades. Reducing water demand will have an effect on reservoir upgrades in particular. Reduction in MDD should therefore be a higher priority.

Water conservation targets needs to align with the proposed goals of this water conservation plan which are to:

- In the short term: Reduce costs associated with O&M of the water distribution system and delay capital expenditure on infrastructure upgrading projects; and,
- In the long term: Increase operational knowledge about the water distribution network and water demand. Increase awareness amongst Prince George residents of the benefits of water conservation.

The B.C. MoE Living Water Smart Campaign set a target for 33% reduction in water use between 2008 and 2020. If Prince George was able to adhere to this target, it would correspond to a 20% reduction from current (2015) water demand in 5 years. This would be an ambitious target to achieve that would likely require significant investment from the City and potentially universal water metering.

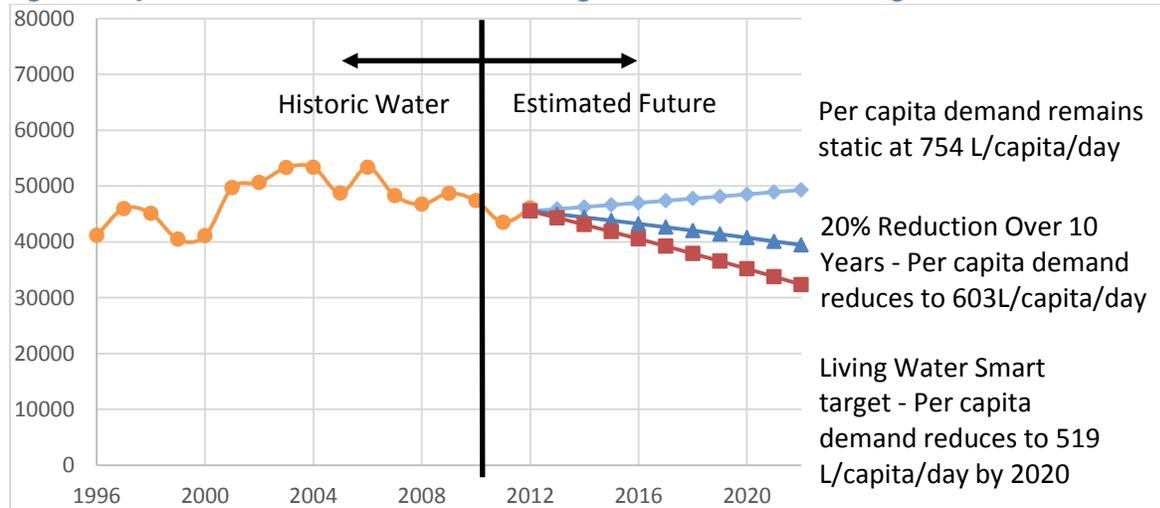
A more attainable target would be a 20% reduction in water demand over ten years. This target would be more in line with the City’s goals to reduce operational costs in the short term. A comparison of the two targets is given in Table 4-2.

Table 4-2: Water Conservation Target

	Living Water Smart Target 33% Reduction		20% Reduction in 10 years	
	Base year 2008	End year 2020	Base year 2015	End year 2025
Total ADD (L/capita/day)	787	519	754	603
Residential ADD (L/capita/day)	614	405	588	470
MDD (L/capita/day)	1156	763	1136	909

Figure 9 shows the impact of reducing per capita demand over 10 years to 519 L/capita per day or 603 L/capita/day over 10 years versus maintaining the status quo.

Figure 9: Projected Future Water Demand in Prince George with Water Conservation Targets



5 Identify Water Conservation Measures:

The City of Prince George has made some progress in water conservation over the past 20 years. However, further water management practices and tools must be applied in order for the City of Prince George to adhere to water conservation targets set by the province, delay and minimize infrastructure operational and maintenance costs and uphold a safe and reliable supply of drinking water for the community and its watersheds. Water conservation programs are beneficial to a municipality that is unmetered, as leaks or other forms of wasting water can be substantial and remain unaccounted for. Reducing water demand will also help to:

- Ensure the future reliability of drinking water supplies;
- Protect water resources and be responsible environmental stewards; and,
- Use water resources efficiently

The following strategies will be implemented under the City of Prince George Water Conservation Program to meet water conservation targets:

1. Water-Use Restrictions
2. Water Metering – Encourage Additional Participation
3. Water Loss Management Program – Leak Detection
4. Continue Public Education Program
5. Continue City Leadership in Advancing Water-Use Efficiency

Each water conservation measure has been assessed in order to identify the strategies that would best meet the City’s goals with regard to water conservation (summarised in Section 4, Table 4-2).

The criteria for evaluation were:

- Targets maximum day demand;
- Achieves reliable reductions in water demands;
- Reduces outdoor water usage;
- Low implementation costs; and,
- Improves knowledge and management of infrastructure

5.1 Strategy 1: Water-Use Restrictions

Currently the City regulates water restrictions through Schedule C of the City of Prince George Water Regulations and Rates Bylaw No. 7479, 2003, which is in effect all year round and limits the days and hours during which residents may use sprinklers.

No sprinkling is allowed daily between 8:00 a.m. and 5:00 p.m. in the Western Acres area of the City. This is applicable to the properties adjacent to Cinch Loop, Hartman Road, Cattle Drive, Corral Road, and Western Road. This is also applicable to the properties abutting the frontage road north of Highway 16 west from the 8100 block of Highway 16 west to the City's western boundary. In all other areas of the City, sprinkling is not allowed between 12:00 noon and 5:00 p.m. daily. Outside these hours even numbered houses are allowed to sprinkle lawns on even numbered days, and odd numbered houses are allowed to sprinkle lawns on odd numbered days.

The fine for violation of the rules is \$50 per day; however no tickets have been issued to date. Enforcement of mandatory water restrictions is fundamental to their success. Water restrictions target maximum day demand, but are only effective if they are adhered to by the community. This requires community support and strict enforcement. Maintaining the current regime of water restrictions is inexpensive but does not yield the outcome sought.

5.1.1 Impose Mandatory Water Restrictions

Maximum day demands (MDD) can be reduced by imposing mandatory watering restrictions such as limiting outdoor sprinkling, imposing staged water restrictions and prohibiting tasks that require unnecessary or excessive water-use.

Currently, most of the City of Prince George is not allowed to sprinkle between 12:00 noon and 5:00pm daily. Mandatory Sprinkling Restrictions will be further limited to no sprinkling or irrigation between 8:00am and 5:00pm City-Wide to minimize the waste of water caused by evaporation. Sprinkling during the hottest part of the day is wasteful due to increased evapotranspiration rates.

Changes in weather patterns have become prevalent in Northern BC, which may result in hotter and drier summers. In July 2015, it was noted that during hot, dry weather sprinkling activities greatly increased maximum water demands which in turn greatly stressed the infrastructure as the pumps were not able to keep up. The introduction of staged water restrictions will manage maximum day demand in instances of particularly hot and dry summers. Staged water restrictions are recommended as follows in preparation of these events:

- **Stage 1** – Sprinkling is **only permitted** at even house numbers on even numbered days. Sprinkling is **only permitted** at odd house numbers on odd numbered days. No sprinkling permitted between **8:00am and 5:00pm** daily City-wide.
- **Stage 2** – Sprinkling is **only permitted** at even house numbers on Tuesdays and Saturdays. Sprinkling is **only permitted** at odd house number on Wednesdays and Sundays. No sprinkling permitted between 8:00am and 5:00pm daily City-wide. Watering by hand-held hose with a spring-loaded shut-off nozzle or hand held container (watering can) is permitted during sprinkling restrictions.
- **Stage 3** – Sprinkling is **not permitted until further notice** City-wide. Watering by hand-held hose with a spring-loaded shut-off device or hand held container (watering can) is permitted during sprinkling restrictions.

The following water-use limitations should also be included in Schedule “C” Water Restriction of the Water Regulations and Rates Bylaw and enforced at all times of the year:

No person shall allow water to be wasted by using more water than is required for commercial, industrial, residential and recreational purposes, including but not limited to:

- (1) Allowing a tap, or hose to run unnecessarily;
- (2) Irrigating plants or lawns within same vicinity for longer than 1 hour;
- (3) Watering or irrigating impervious surfaces (for purposes other than dust suppression); and,
- (4) Washing a vehicle with a running hose without a spring-loaded shut-off nozzle.

Applications for an exemption from the water restrictions will be reviewed by the Authorized Person for reasons such as new sod and lawn seeding that will allow water-use outside of the water-use restrictions. The length of time allowed for the water-use exemption will be reviewed by the Authorized Person.

5.1.1.1 Increase Water Restriction Violation Fines

Currently the City of Prince George imposes a \$50 fine per day for water restriction violations. To address maximum day demand and minimize stress on the pumping infrastructure, the Water Conservation Plan 2016 implements a three stage water restriction violation matrix that includes higher fines that coincide with staged watering restrictions. The three fine rates are as follows:

Table 5-1: Tiered Water Restriction Violation Fines

Water Restriction Violations	
Stage 1 Offence	\$100.00 fine per day
Stage 2 Offence	\$250.00 fine per day
Stage 3 Offence	\$500.00 fine per day

5.1.1.2 Enforce Water Restrictions

To target maximum day demand and achieve reliable reductions in water demands, it is compulsory that the water-use restrictions be enforced by the City of Prince George. Resources must be dedicated to this initiative in order to make it effective.

City of Prince George Utilities Staff are granted authority to issue violation tickets should they witness these offences. By imposing mandatory sprinkling restrictions during working hours, between 8:00am and 5:00pm, enforcement will be more attainable.

It is also recommended that the Water Wise Workers program be reinstated which will involve staff being hired for the summer months to distribute public education materials on water restrictions and conservation. Having these resources solely dedicated to this program will contribute to better tracking of water use offenders, and will offset the workload from Bylaw Services and the Utilities Division. The Water Wise Workers program has been beneficial in maintaining water conservation goals in the past through one-on-one interactions throughout the community. The addition of 2 summer staff who work full time for 4 months will have the approximate cost of \$25,000.

5.1.1.3 Additional Voluntary Irrigation Restrictions

Peak outdoor water use is greatest between 7 to 9 am and 5 to 9 pm, while water consumption is typically lowest overnight. Residents should be encouraged to use sprinkling timers and stagger their outdoor water use to lower peak hour demands through the summer, and alleviate the stress of irrigation on the water distribution system. Large strata users should be encouraged to implement additional irrigation restrictions. Voluntary Irrigation Restrictions may be as follows:

Table 5-2: Voluntary Irrigation Restrictions

Last Digits of Street Address	Hour to Turn on Sprinkler System
00-20	11:00 pm - Midnight
21-40	Midnight - 1:00am
41-60	1:00am - 2:00am
61-80	2:00am - 3:00am
81-99	3:00am - 4:00am

5.2 Strategy 2: Water Metering

Water metering has been identified as one of the most effective tools for increasing awareness of water conservation and inefficient water usage. When households pay for the amount of water they use rather than a flat rate, there is incentive to decrease water consumption in order to decrease their utility bill. In a community like Prince George, where the general perception of quality water resources is plentiful and replenishing, there is no incentive to reduce lawn sprinkling times or identifying leaks. When combined with public education and volumetric pricing, water meters can produce dramatic reductions in water consumption. Water meters assist with increasing awareness of household water consumption and allow users to detect leaks when they see water consumption reflected in their utility bill.

The 2005 City of Prince George Water Conservation Plan recommended universal water metering for Industrial, Commercial and Institutional customers (ICI) as well as all multiple family dwellings which is now required under the Water Bylaw. The installation of a water meter is also mandatory under the Water Bylaw in all new building construction, including residential.

The implementation of universal water metering for all residential properties in Prince George is not being recommended as a part of the 2016 Water Conservation Plan; due to the high cost associated with purchasing and installing the water meters for each residence in the City of Prince George. The reduced water usage offsets associated with universal water metering cannot justify the high implementation costs at this time. In the 2005 Water Conservation Plan, the introduction of voluntary residential water metering was recommended and has been implemented. Since 2005, approximately 75 water meters have been installed in residential properties in Prince George through the voluntary residential water meter program.

5.2.1 Continue Volunteer Water Meter Program

The current volunteer water meter program will be continued with the offering of 50 water meters a year for property owners. As a part of this program, the cost of the meter and plumbing permit are covered by the City of Prince George. The volunteer property owner is responsible for the installation of the water meter by a certified plumber. In 2016, the City had 100 water meters available for the volunteer water meter program, and approximately 20 had been redeemed as of June 2016.

Public education and promotion of the benefits associated with the volunteer water meter program will be increased, and directed at demographics that will benefit from the programs.

5.2.2 Meter 100% of Industrial, Commercial and Institutional (ICI) Accounts

The 2005 Water Conservation Plan aimed to “Install water meters in all industrial, commercial and institutional (ICI) customers that were allowed in previous years to be unmetered.” As of 2016, 165 ICI connections remain unmetered and on flat rate billing. The City will continue to mandate the metering 100% of ICI accounts and work to move the flat rate accounts to metered billing.

5.2.3 Pressure Zone Water Meters

The installation of water meters to all single family residential properties in Prince George is not currently feasible. Without universal water metering it is difficult to accurately determine the breakdown of water use by sector, such as residential, commercial, and industrial usage as well as system water loss. To compensate for this data gap, water meters will be installed in different pressure zones of the City to obtain regional baseline water consumption data throughout the City of Prince George. This data can be compared with theoretical flows and will further assist with determining how much treated water is lost from the system.

5.2.4 Determine City of Prince George Corporate Water Usage

Currently the City of Prince George does not have the ability to determine total corporate water usage because of a lack of water meters within municipal operations. To measure yearly total water consumption, water meters will be installed in all municipal buildings, fire halls, arenas, parks and utility operations. This data will assist with tracking corporate water usage, provide water consumption data and identify municipal operations that may benefit from additional water conservation initiatives.

Fire suppression flows required for fire events per year will also be investigated. Calculations can be performed to estimate the water volumes used over a period of time during the fire event. Evaluating fire suppression volumes, and metering bulk water users, will assist in determining how much water is lost to leaks and/or water theft.

5.2.4.1 Calibrate City Meters

As water meters age they can become less accurate and produce incorrect water consumption data. To ensure accuracy of City water production volumes and network distribution, water meters will be calibrated at all City wells and pump stations in 2017.

5.2.5 Bulk Water Metering

There is currently one metered public water filling station in the City of Prince George that is located at Fire Hall #2 on 5th and Ospika Blvd. There are three permit holders that use this filling station for the sale of consumable water. The users are charged a start-up fee of \$15, a monthly rental fee of \$50 and invoiced at \$0.00219 per m³.

Hydrant Use Permit holders are able to use a fire hydrant for purposes other than fire protection, and are charged a permit fee of \$200 and a \$25 daily charge. Water consumption from fire hydrants is currently not metered and is therefore unmeasured and unregulated.

Under the Water Conservation Plan 2016, four more metered public water filling stations will be installed between 2017 and 2019, two per year. Hydrant Use Permit holders will be required to use the bulk stations rather than the hydrants to measure and regulate water consumption. Over time the Hydrant Use Permits will be phased out and fall under Bulk Water User permits, and no one will be able to use a fire hydrant for purposes other than fire protection or with a Hydrant-Use Exemption.

A Hydrant-Use Exemption will be reviewed by the Authorized Person and may include the rental of a City-owned backflow prevention device and water meter. Hydrant-Use exemptions will be provided for City operations and maintenance activities, and reviewed for private construction projects and community water association ice rink maintenance.

Locations for metered public filling stations will be spread out through the City, and will be selected to allow for easy access for all potential users. This will allow the City to better account for water usage, protect water quality and ensure that hydrants are only used for approved purposes.

5.2.5.1 Increase Hydrant Use/Bulk Water Use Permit Fees and Infraction Fines

Permit fees for Hydrant Use/Bulk-Water permits should be increased to \$500 a year, or users should be billed volumetrically for the water they draw.

It will also be necessary to prevent water theft from fire hydrants by enforcing strict fines. A minimum of \$2,500 will be fined to those that decide to steal water rather than use the metered filling stations. Water theft fines may be enforced on an escalating scale based on staged water restrictions. Water theft may also result in the loss of the violating company's business license.

To prevent water theft, hydrant locks may be installed on problem hydrants.

5.3 Strategy 3: Water Loss Management Program

The water in the distribution system can be classified into two categories: authorized consumption or water loss. Authorized consumption can be either metered or unmetered water use that may or may not be billed. Water loss can be either the apparent losses due to meter inaccuracies or unauthorized consumption, or real losses due to water leaks/breaks.

Every water system loses water through leaks and breaks and maintenance activities. Even newly constructed water lines are allowed a certain minimum leakage rate depending on system pressure, pipe size, number of joints and water services, and type of pipe. Most water systems experience breaks or leaks in watermains, service lines, hydrants, tanks, valves, and appurtenances that occur

due to a variety of causes. The problems associated with ageing facilities and deteriorating system components are part of the growing infrastructure problem faced by most utilities.

In all water distribution systems, a significant amount of water and money can be wasted through leakage. Large volumes of water can escape a distribution system, and whatever surrounds that system may ultimately find its way into it. Negative pressure in water pipelines can draw pathogens into the system through leakage areas.

Water loss carries a significant price tag, both economic and environmental. It is not cost effective to have a product that does not reach its consumer. Nor is it a good use of resources to treat a raw product only to have it lost in the distribution system. Proper accounting of water used and lost, with corrective measures, will help reduce the costs associated with potable water and lead to a more sustainable product.

There are three general components to a Water Loss Control Program:

- Water audits;
- Leak detection; and,
- Repair programs.

5.3.1 System Water Audits

A water audit is a process to measure consumption and losses in a system. A water audit enables the City to determine the water supplied, consumed, and lost in the distribution system. It also allows the City to quantify the cost of that lost water.

Water losses comprise of real (leakage) and apparent (paper losses) losses. These include:

- Meter Error and Inaccuracies;
- Unauthorized Consumption;
- Distribution System Leaks;
- Storage Reservoir Leakage; and,
- Storage Reservoir Overflows.

5.3.1.1 Regional Flow Analysis

Performing a system water audit is difficult without the use of water meters to determine water consumption. Therefore, a base level of information about the system will be required to carry out a water audit which will be achieved by analysing and evaluating the data obtained through the installation of water meters in each pressure zone throughout the City. Two years after the installation of the pressure zone water meters, the data will be used to perform a regional flow rate analysis in each pressure zone to determine which areas of the City may be losing water to leakage.

5.3.1.2 Industrial, Commercial and Institutional (ICI) Water Audits

Large water users are typically part of the Industrial, Commercial and Institutional (ICI) sector. A water audit is a visual inspection of the water use systems within the business while it is operating to determine existing water uses, losses, and appropriate conservation practices, and to offer water use improvement recommendations.

According to USEPA Water Conservation Plan Guidelines (August 1998), general industrial water use audits can result in water use reductions of 10 to 20%. Most of the City of Prince George's largest water users are the ICI connections which make up 20.5% of City water consumption. Since most ICI connections have a water meter, base data will be available to assist with the audit. This water conservation measure may potentially produce a significant effect on water conservation, and can be accomplished with minimal financial investment by using students.

It is recommended that an ICI Water Audit Program be implemented similar to the Prince George Chamber of Commerce Carbon Reduction program which allowed for local businesses to have a complimentary carbon footprint audit be performed on their business by UNBC students. The students then provided tips on energy conservation and reduction initiatives. The ICI Water Audit Program would collaborate with UNBC to perform water usage audits on industrial, commercial and institutional facilities that are connected to the City water infrastructure to determine existing water uses, losses and conservation methods.

To promote the program and reward companies that participated in the audit, it may be worthwhile to advertise that the company has participated in a water audit and has received "Water-Wise" certification through the City of Prince George and UNBC. This could be achieved by putting a sign out front of the business and advertising the company's reductions in water usage through the City's website and Facebook page.

5.3.2 Leak Detection and Repair Program

In combination with a system water audit, a leak detection and repair program should be implemented to reduce the volume of non-revenue water related to system losses. Initial steps are to review leak, break, and maintenance data to identify areas of historical pipe problems, review reservoir overflow levels.

The City currently does not have a leak detection program and is mostly reliant on service requests to identify and repair leaks. Two utilities staff members are currently trained on the Echologics Leakfinder RT which is used to detect leaks. This device was purchased in 2004 for approximately \$30,000. The purchase of a second leak detector and the addition of two more staff members to be trained on its use are recommended to detect and repair leaks and reduce water loss from City infrastructure.

In addition to the above, an external consultant can perform an infrastructure analysis which includes executing nightflow analysis to determine unreported leakages.

5.4 Strategy 4: Educational and Outreach Programs

The City of Prince George Water Conservation Program will utilize its current environmental, utilities and park staff to reinstate the distribution of educational opportunities on water conservation by:

- Working together with the City's External Relations Team to promote the importance of water conservation and provide water conservation methods to the public;
- Promoting and attending community events, such as Earth Day and Drinking Water Week, to distribute brochures and educational pamphlets on water conservation; and,
- Distributing information on Water Conservation to City Utility users.

Since 2012, the Water Conservation Public Education Program has had reduced staffing which has resulted in decreased public education distribution on water conservation. It has been noted that since 2012, per capita water usage has increased in the City of Prince George. Therefore, it is important that all of the below mentioned Water Conservation Public Education Programs be reinstated as soon as possible.

5.4.1 Continue Public Education Programming

Information and education tools are used to encourage water conservation. Information and education strategies are based on an assumption that personal actions are influenced by awareness and understanding. An essential part of any water conservation strategy is a good public education program to make consumers aware of the reasons for water conservation. The goal of the program should be to develop a conservation ethic among water users, since rate and regulatory incentives have different effects on different consumer groups. The public must understand why water conservation is important. The costs associated with the construction of new or expanded water and wastewater facilities should be compared to the benefits that can be derived from conserving water.

This strategy has been implemented by all municipalities interested in water conservation throughout B.C. and Canada as a typical part of a water conservation program. According to USEPA Water Conservation Plan Guidelines (August 1998), public education measures can result in water use reductions of 2 to 5%.

The City's Water Conservation Public Education Program that was utilized from 2000 to 2012 includes a number of measures to promote responsible use of water within the community. The following previously utilized tools will continue to be used by the City of Prince George including:

- **Distribution of Guide to Wise Water Use, Wise Water Door Hangers and Wise Water Use Conservation Kits** – The City distributes brochures and door hangers to highlight tips on how to decrease residential indoor and outdoor water consumption and communicate water use restrictions. These educational materials will be given out under the voluntary metering program, provided to interested residents at community events, and distributed to residents for water conservation awareness. The Wise Water Use Conservation Kits are given out under the voluntary metering program. The conservation kits include soil moisture meters, hose nozzles and lawn measuring cups amongst others.
- **Drinking Water Week Poster Contest** – The City holds a water conservation poster competition during Drinking Water Week for students in School District 57. Prizes included water bottles, Frisbees and a trip to the Aquatic Centre.
- **Wacky Wet Water** – The City of Prince George (City) partnered with School District 57 to provide water conservation and drinking water issues education including hands-on activities and field trips.
- **Water Wise Workers** - The City established a team of Water Wise Workers to visit neighbourhoods and retail outlets, and to attend public activities and community events. The Water Wise Workers provided information on the City's water system, reminded homeowners about summer water restrictions, provided water conservation tips, demonstrated water-saving tools and distributed information on how to volunteer to have a water meter installed in homes.
- **Free Water Use Audit** – The free water use audit will be promoted and shared on the City's new website for residents to calculate their daily water consumption.

- **Regular Insert** – An insert on water conservation and sustainable lawn care tips will be developed and included with utility bills and the Leisure Services Guide. For residential customers with water meters, bill inserts may be created specific to their water usage and their water meter.

The most effective way to address maximum day demands is by reducing irrigation demands. Public education programs that are geared towards reducing lawn watering times and utilizing rain barrels for watering gardens may prove to alleviate these stresses on the water system.

5.5 Strategy 5: City Leadership in Advancing Water-Use Efficiency

Municipal leadership in advancing water-use efficiency can have a significant impact on water conservation. The City of Prince George has a belief in the utilization of water conservation practices and has integrated irrigation water-use efficiency projects throughout City parks and low-flow fixtures in municipal buildings.

5.5.1 Continue Park Operations Water-Use Efficiency Projects

The City of Prince George's Park operations have implemented water saving measures through a centralized irrigation system and water-efficient landscaping designs.

The City currently has an ongoing strategy to use landscape design to minimize the effect on surrounding areas by giving preference to regionally native plant species, using water conserving landscape techniques including alternative turf and landscape management on all parks, field, boulevards and school yards, the installation of high efficiency irrigation systems for flower beds, and installation of sensors to turn sprinklers off with rain or high winds.

5.5.1.1 Upgrade and Expand Sentinel Centralized Computer System

The Sentinel Centralized Computer System controls 40 irrigation systems at most of the City sports fields, the cemetery and mausoleum, several municipal buildings and arenas, and a few boulevards and intersections. The Sentinel system controls and adjusts irrigation runtimes based on the weather conditions over the past 24 hours. The system collects weather information at two locations, the 18th Ave Yard and in the Hart. Irrigation limits are calculated based on evapotranspiration rates, and sprinklers are shut off once limits have been met. This also proves to be effective for managing leaks and preventing excessive water loss. The Sentinel system advertises that it may lead to a 25-35% decrease in City irrigation water consumption.

Currently there are 14 stand-alone irrigation systems that are not controlled by the centralized Sentinel system that include Level A locations: Rainbow Park, Connaught Hill Park and the majority of Lheidli T'enneh Park. These sites are watered manually by City Staff. Installing irrigation systems and connecting these Level A locations to the Sentinel Centralized Computer may contribute to water savings and allow Parks Staff to focus on their other duties.

The remaining systems that are not connected to the Sentinel system are Level B boulevards, which are currently maintained manually by Parks Staff who adjust or turn off the system during rain events. These sites do not necessarily need to be connected to the centralized system, but would

benefit from the installation of wireless rain sensors. The sensors could result in significant water savings and prevent the need for City Staff needing to manually turn them off during rain events.

The Sentinel Centralized Computer System is located in the Park Operations trailer at the 18th Ave yard, and communicates with the weather station in the Hart and Sentinel nodes of the irrigation system at Carrie Jane Grey Park, Volunteer Park and Balsam Park through dial-up radio connection. The dial-up radio connection experiences communication issues and has resulted in stalls. The Sentinel system cannot receive weather and irrigation updates when the connection is down which affects its ability to calculate evapotranspiration rates and irrigation times and can lead to over-watering. The connection for the Sentinel Centralized Computer System to the weather stations and 3 sentinel nodes should be upgraded to cell phone connection to ensure irrigation efficiency.

5.5.1.2 Lheidli T’enneh Memorial Spray Park Water Re-Use

The water spray park in Lheidli T’enneh Memorial Park (LTMP) is a popular attraction for children of all ages during the heat of the summer. On average the spray park uses approximately 3.8 million litres of potable water per year.

The south end of Lheidli T’enneh Memorial Park is currently watered by City Staff and is not connected to an irrigation system. The water from the spray park could be captured and stored in an underground cistern, and re-pressurized to irrigate this part of the park. Re-using the water from the LTMP spray park would result in significant water-savings and could likely be funded by grants.

5.5.2 Water Efficient Landscaping Strategy

Lawn care and landscaping can require extensive amounts of water, and attribute to high Maximum Day Demands in the summer months. However, landscaping doesn’t need to require heavy watering with the use of xeriscaping. Xeriscaping means “water conservation through creative landscaping” and uses native and adapted plants that will grow and sustain themselves with low water requirements.

The City of Prince George should implement a “Water Efficient Landscaping Strategy” for municipal gardens and parks that involves transforming high water usage landscapes to xeriscaping.

In addition, the “Water Efficient Landscaping Strategy” should encourage developers and landscapers to incorporate xeriscaping and water efficient landscaping into landscape projects.

5.5.2.1 Sustainable Lawn and Garden Adult Seminars with REAPS

In support of a “Water Efficient Landscaping Strategy”, the City of Prince George can work together with REAPs to design and implement adult seminars on sustainable lawn and garden care.

5.5.3 Retrofit City Operations to Low-Flow Fixtures and Water-Efficiency Devices

The City of Prince George currently has a program to retrofit city offices, arenas, and other facilities to low-flow fixtures and other water saving devices when appropriate. The new Administration building at the 18th Ave Yard has been equipped with dual flush toilets, and hand-sensor sinks. As plumbing devices and appliances need to be replaced in municipal buildings they are updated to low-flow fixtures.

5.5.3.1 Bob Harkins Library and City Hall Server Room Upgrades

Currently, both the Bob Harkins Library and City Hall use water to cool the building's server rooms which use 100,000 L/year of water in each facility. The server room cooling systems in both of these buildings will be retrofitted to reduce water consumption. The Harkins Library server room system will be upgraded in 2016, while City Hall's server room will be retrofitted in 2017.

5.5.3.2 Elksentre Arena Urinal Retrofit

The Elksentre Arena is currently equipped with flush tank urinals that are continually running water, and flushing unnecessarily. Retrofitting the urinals with water-efficient flush controls would result in significant water savings and eliminate unnecessary water waste.

5.5.3.3 Water Pump Station Upgrades

Currently, some of the water pump stations use production water to cool the buildings. Upgrading these facilities with a water reuse system or air-conditioning and heat pump system will assist in water conservation.

5.5.4 Conduct a Public Survey on Water Conservation

The City of Prince George Water Conservation Program has prepared a public survey to better understand the public's water use, water conservation, perception on water sources, need for metering and reception to metering. The survey asks for feedback from community members about water conservation tactics they support. The survey has been taken approximately 25 times, but the survey needs to be further distributed to obtain more data as the results will be used to facilitate greater public understanding of water resources.

The Water Conservation Survey may be included with the next cycle of utility bills and may also be promoted on the City's website.

5.5.5 Water Conservation Education Program for City Employees

Municipal Leadership in advancing water-efficiency at the City of Prince George begins with City employees. A Water Conservation Education Program will be implemented to provide City employees with knowledge on the importance of water conservation, and how to incorporate water efficiency into daily work duties.

5.5.6 Volumetric Pricing for Residential Users

As recommended in the 2005 Water Conservation Plan, the City of Prince George should implement a water rate structure that encourages water conservation on all metered residential accounts. As a financial incentive to reduce water consumption, the City of Prince George would develop an inclining tier block rate structure that charges higher rates for high water consumption. The metered water users would pay a capacity charge based on the connection size and a consumption charge that is based on usage on a tiered block scale. As an example, the City of Kelowna tiered scale is shown below:

Table 5-3: Volumetric Pricing for Residential Users

Increasing Tiered Block Rates Scale	Consumption Charge (per m ³)
First 60 cubic metres	\$0.420
Next 100 cubic metres	\$0.565
Next 90 cubic metres	\$0.857
Balance of cubic metres	\$1.715

6 Conclusion

The City of Prince George Water Conservation Program and Opus DaytonKnight Consultants Ltd. evaluated several water conservation methods to assist the City in achieving water-use reduction targets. The strategies were assessed to ensure that in the short term, costs associated with operations and maintenance of the water distribution system would be reduced and capital expenditure on infrastructure upgrading projects would be delayed and in the long term, operational knowledge about the water distribution network and water demand, as well as awareness amongst Prince George residents of the benefits of water conservation would be increased. The strategies that were identified to achieve these requirements are the following:

1. Water-Use Restrictions
2. Water Metering – Encourage Additional Participation
3. Water Loss Management Program – Leak Detection
4. Continue Public Education Program
5. Continue City Leadership in Advancing Water-Use Efficiency

Once implemented, it is expected that these water conservation strategies will assist in alleviating stress on water infrastructure by reducing maximum day demands, and address water system wastage. Both of which are necessary to properly preserve the quality and quantity of our community’s water resources. Only through a continuous focus on education and awareness of water conservation, can the program be successful.

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