OPUS DAYTONKNIGHT

SQUAMISH

District of Squamish

Water Conservation Plan

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Water Conservation Plan

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Contents

Executive Summary

The District of Squamish (District) is located in southwest British Columbia at the confluence of the Squamish River into Howe Sound. This Water Conservation Plan (WCP) was developed to be complementary to other planning and policy documents guiding the District, such as the Official Community Plan (OCP), the Water Loss Management Program, the Water Master Plan (WMP), the Asset Management Plan, and the Water Regulations and Rates Bylaw No. 676. The *"Water Conservation Planning Guide for British Columbia's Communities*[1]*"* and the Ministry Of Environment's *Living Water Smart: British Columbia's Water Plan* (2008) were also used to guide WCP development.

Water System Profile

The District's water system currently serves a residential population of over 18,000, and approximately 270 Institutional, Commercial, and Industrial customers (ICI). The major ICI water users in the District include a brewery, a hospital, a municipal pool, and a wastewater treatment plant. A high rate of growth is expected to persist over the coming years in the District of Squamish leading to an estimated population of 31,525 for the year 2031, as identified in the OCP, from the 2013 census count of 18,319.

The District's water system consists of 14 pressure zones, seven storage reservoirs, and includes over 130 km of watermain. The water system is fed through seven groundwater wells at the Powerhouse Springs well site, located near the confluence of Powerhouse Creek and the Mamquam River. The District also has two surface water supplies at Mashiter Creek and Stawamus River. They provide emergency and backup water supply to the District on an as needed basis, namely in the summer months. The District provides over 3.9 million cubic metres of potable water for consumption per year.

Watershed & Climate Profile

The climate in the District is typically warm and dry in the summer, and cool with significant rainfall in the winter. The District has considered climate change impacts on the community in the OCP, the Well Protection Plan, and this Water Conservation Plan. If the Mamquam glacier retreats, flow may reduce in the Mamquam River, and subsequent recharge to the aquifer may drop as well. This combined with less summer rain could impact the aquifer's capacity to supply the District. Mitigation measures are being investigated and the District is installing apparatus to monitor the aquifer.

Maximum day water demands are closely linked with climate factors, particularly during extended hot and dry summer periods. If average temperatures increase due to climate change, the likelihood of District residents' innate desires to consume more water will correspondingly increase. Additionally, the increase in water use may be coupled with drought conditions.

[1] *Water Conservation Planning Guide for British Columbia's Communities* Version 1.0 March 2009, POLIS Project on Ecological Governance at the University of Victoria with the British Columbia Ministry of Community Development.

History of Water Conservation in Squamish

The following key milestones highlight the progression of water conservation in the District since 1995:

- 1995: Four stages of water restrictions are outlined by the water utility
- 2010: Water Loss Management Program and purchase of leak detection equipment
- 2011: Asset Management Plan by which the need for infrastructure renewal, some of which caused leakage, is identified and funded with rate increase
- 2012: Statements regarding water conservation are included in the OCP
- 2013: Statements regarding water conservation are included in the Annual Report Strategic Initiatives; Outdoor Water Use By-Law amendments; Employ of Water Conservation Officer for Outdoor Water Use By-Law enforcement

Water Conservation Goals

The 2014 data indicates that present water consumption is higher than the national average, with an average consumption per capita of 564 L/c/d and a maximum per capita consumption of 851 L/c/d. For the purposes of setting water conservation targets, the 2014 demand values were used as the basis for all planning. The proposed goals of this water conservation plan are to:

- In the short term: Increase the perceived value of this public service amongst residents and their awareness of the benefits of water conservation; Achieve reliable reductions in water demand.
- In the long term: Delay capital expenditure on infrastructure upgrading projects; Increase operational knowledge about the water distribution network and water demand.

An attainable target of a 15% reduction in water demand (ADD and MDD) over the OCP horizon, to 2031 was selected. This target is supported through the ICI and Multi-Family (MF) customer metering strategy currently proposed in the District's WMP. It is also more in line with the District's goals than an aggressive higher percentage value target would be.

Water Conservation Target

15% Reduction by 2031	Base year 2014	End year 2031
ADD (L/capita/day)	564	479
MDD (L/capita/day)	851	723

Water Conservation Plan Recommendations

This five year plan outlines the short term implementation schedule and budget for the seven Water Conservation Programs selected. These programs will lay the foundation for the District to meet its water conservation target of an average day demand of 479 (L/capita/day) and a maximum day demand of 723 (L/capita/day) by 2031.

Water Conservation Plan Schedule and Budget

Water Conservation Program	Annual Cost	2015	2016	2017	2018	2019
Outdoor Water Use Bylaw Enforcement	$33,000	✓	✓	✓	✓	✓
Customer Water Audits	$16,500		✓	✓	✓	✓
Building Bylaw Amendments (1): Low Flow Fixtures	Nominal	✓				
Building Bylaw Amendments (2): Xeriscaping	Nominal	✓				
Water Loss Management Program Initiatives - Installation of district (zone) meters and completion of network water audits. - Continuation of leak detection program.	 - Utility O&M - Nominal	 ✓ ✓	 ✓	 ✓	 ✓ ✓	 ✓
Public Education Campaigns	$18,500	✓	✓	✓	✓	✓
Endorsement of Local Initiatives	Nominal	✓	✓	✓	✓	✓

The highest impact will be achieved in the short term by the Outdoor Water Use Bylaw enforcement. As this program is rolled out in the summer months and targets irrigation it will influence MDD and consequently the ADD as well. The full impact of the other programs will take longer to be achieved and will be relatively smaller in scale. These programs remain nonetheless important. They develop the conservation ethic which bolsters buy-in for future conservation programs with more bearing.

The majority of the programs will occur on an ongoing basis as they should eventually become an integral part of utility management. Only the Building Bylaw Amendments are a one-time occurrence that will roll into the building inspection program overseen by the Development Services department. The implementation of the Customer Water audits was scheduled to coincide with the ICI and MF customer metering program that will commence in 2016.

The annual costs included in the budget table pertain to the salary of the water conservation officer ($66,000), split between the three most time consuming programs, and an allocation ($2,000) for the cost of producing communication materials and media publishing. Costs that are already incurred by the District such as the Water Loss Management Program, which is covered in utility operations, and the vehicle charges related to the water conservation officer's activities were not included. This schedule of costs was incorporated in the financial analysis completed as part of the WMP.

Measures to Facilitate Water Conservation Plan Update

Activities that do not relate to the current WCP but that will inform revisions of the WCP in years to come were identified in the process of writing this document. These are:

- Improve service connection dataset: This is a task that was previously identified in the District Asset Management Plan. One of the values of an increase in the accuracy of this dataset, as it pertains to the WCP, is that it will improve the quality of future feasibility assessments of universal metering programs.
- Collection and storage of consumption data: This data is necessary to any water rate restructuring analysis which would investigate the possibility of implementing for example inclining or declining block rate structures. The quality of the data produced through the ICI and MF metering program should be verified and assured.

1 Introduction

Freshwater is plentiful in the District of Squamish (District) all year round. The attitudes and habits with respect to the myth of limitless abundance of water are partly rooted in the geography of the land that surrounds the community. They are also rooted in the perceived value of this public service.

Compared to other communities, the rates charged for delivery and treatment of potable water in Squamish had been historically low. The 2010 Public Works Infrastructure Asset Management Plan identified the need to increase user rates by 68%. This has been staged over a five year period with 2015 identified as the last such rate increase period. Despite the increase under the current rate structure, District residents are still not forced to consider how much water they use. Progress toward sustainable water use will in part require a new perspective of the land and an understanding of the services related to potable water.

Water conservation programs have the ability to defer, reduce, and/or eliminate the need for water supply facilities and/or wastewater facilities. Water conservation can extend water supplies and reduce operating costs and energy use. A reduction in wastewater flows can reduce treatment costs and provide environmental benefits in terms of reduced discharges. By reducing water use and, therefore, water withdrawals, water quality can be improved, ecosystems are maintained, and water resources will be protected. 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.

1.1 Water Conservation and the District

For the majority of its history, the freshwater supply and the potable water system has reliably provided the District with an abundance of water that met demands of the community. The community had not been required to conserve water in any significant way. Freshwater is plentiful all year round but community growth, ageing infrastructure, and the current economic context are putting competing pressures on the District to renew and to expand the system yet mitigate cost increases where possible.

The full scope of water conservation strategies used in the industry target the volume of water that enters the distribution system, the system demand. The water that enters the distribution system is in the end either consumed by water users or lost at points of failure across the network. The water conservation strategies the District has undertaken include water loss management, staged water restrictions, and customer education. The purpose of this Water Conservation Plan (WCP) is to set out a course of action for the next 18 years that will allow the District's water utility to influence system demands.

In the future, climate change and increased environmental awareness may change the perception of water within the community. This Water Conservation Plan (WCP) allows for this and lays out a path to promote and enable this change.

1.2 Scope

This report contains a review of the role of water conservation in the District.

- Section 2 presents a profile of the District's water utility including current and historic water use and existing infrastructure.
- Section 3 describes future water demand estimates including the potential effects of climate change on water demand.
- Section 4 looks at goals from previous water conservation initiatives and presents the District's Water Conservation Target for the next 18 years.
- Section 5 reviews water conservation programs previously and currently employed in the District and assesses their successes and shortcomings.
- Section 6 discusses and evaluates potential future water conservation programs in terms of effectiveness, ease of implementation, costs and benefits.
- Section 7 provides a recommendation outline of which water conservation programs should be employed in the District when and at what cost to meet the water conservation target.
- Section 8 provides recommendations on data collection activities that should be undertaken in anticipation of the next water conservation plan.

1.3 Planning Process

This WCP was developed to be complementary to other planning and policy documents guiding the District, such as the Official Community Plan, Water Loss Management Program, Water Master Plan, Asset Management Plan, and Water Regulations and Rates Bylaw No. 676. The *"Water Conservation Planning Guide for British Columbia's Communities*[2]*"* and the Ministry Of Environment's *Living Water Smart: British Columbia's Water Plan* (2008) were also used to guide WCP development.

1.4 Team

Opus DK would like to thank the following District staff for their cooperation and assistance in completing the WCP.

- Mr. David Roulston, P.Eng., Municipal Engineer
- Ms. Meg Toom, Water Conservation Officer

[2] *Water Conservation Planning Guide for British Columbia's Communities* Version 1.0 March 2009, POLIS Project on Ecological Governance at the University of Victoria with the British Columbia Ministry of Community Development.

2 Community Water System Profile

2.1 Background and Summary

The District of Squamish is located in southwest British Columbia. The climate in the District is typically warm and dry in the summer, and cool with significant rainfall in the winter. The District is located at the confluence of the Squamish River into Howe Sound.

The District's water system consists of 14 pressure zones, seven storage reservoirs, and includes over 130 km of watermain. The water system for the District is fed through seven (7) groundwater wells at the Powerhouse Springs well site, located near the confluence of Powerhouse Creek and the Mamquam River. The District also has two surface water supplies at Mashiter Creek and Stawamus River. They provide emergency and backup water supply to the District as needed, namely in the summer months.

The District's water system currently serves a residential population of over 18,000, and approximately 270 commercial, institutional, and industrial customers. It provides over 3.9 million cubic metres of potable water for consumption per year.

2.2 Climate Profile

The District generally experiences warm summers with cool winters. Maximum day water demands are closely linked with climate factors, particularly during extended hot and dry summer periods. Climate records from Environment Canada for 2010 – 2014 were reviewed and are summarised in Table 2.1. The total summer rainfall, maximum summer temperature and number of days in summer without rainfall have been included in our analysis, which confirms the long summer periods without rainfall in Squamish. For the purposes of this analysis, the summer period is defined as May – September and winter is defined as October to April.

Table 2.1: Summary of Climate Data for the District of Squamish

Year	Average Daily Maximum Temperature (°C)		Total Precipitation (mm)		Maximum Daily Summer Temperature (°C)	Summer – Number of Days Without Rain
	Summer	Winter	Summer	Winter		
2010	22	9	360	1,847	37	100
2011	21	8	337	2,015	32	101
2012	22	8	228	1,895	35	108
2013	23	9	575	1,137	35	107
2014	23	9	229	2,061	36	103

From the data presented in Table 2.1 it is evident that:

- Although a similar number of summer days without rain occurred in 2013, that summer was wetter than usual with the highest total precipitation.

- There are extended periods without rainfall in the summer. Looking in detail at the daily temperature records over these five dry periods, there were 34 days during which the maximum daily temperature exceeded 30 degrees Celsius.

2.3 Community Profile

According to recent B.C. Stats data, the 2013 population of the District of Squamish was approximately 18,319 people; this source of data was used for population estimates applied to various calculations in this study. The major ICI water users in the District include the brewery, the hospital, the municipal pool, and a wastewater treatment plant. No population equivalents were calculated to account for these water consumers.

The District has experienced a large amount of growth between the last two national census', as summarised in Table 2.2.

Table 2.2: District of Squamish Population

Census Year	Population	Change in Population (%)
1996	13,994	-
2001	14,248	+1.8%
2006	14,949	+4.7%
2011	17,674	+18.0%

This high rate of growth is expected to persist over the coming years and an estimated population of 31,525 was identified in the OCP for the year 2031.

2.4 Watershed Profile

The District has an ideal raw water source which provides potable groundwater that requires no treatment. 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 aquifer supplying this groundwater is unconfined. It is thought to recharge primarily through seepage from infiltration of direct precipitation and to a larger extent through seepage from the Mamquam River and Mashiter Creek. The latter source allows for year round recharge.

2.5 Infrastructure Profile

2.5.1 Groundwater Wells

The District of Squamish receives potable water from seven groundwater wells located near the confluence of Powerhouse Creek and the Mamquam River. Table 2.3 summarizes the well capacities for the groundwater system.

Table 2.3: Existing Supply Sources

Well	Abstraction Limit (ML/day)	Abstraction Limit (L/s)
Powerhouse Springs Wells	27.8	322
Mashiter Creek*	10.2	118
Stawamus Creek*	11.4	132

* these surface water sources are primarily used as a backup/emergency supply for the system.

The District holds a Project Approval Certificate, granted in 1998 under the Environmental Assessment Act, that allows for a combined instantaneous withdrawal of up to 255 L/s from the well field (based on a maximum of three (3) wells operating at any time, each withdrawing 85 L/s). The combined abstraction limit (assuming that pump capacity is less than abstraction limit) for the three sources is approximately 49.2 ML/day. However, concerns with low flow and high turbidity of the two surface water sources, especially during periods of high demand in the summer, has limited withdrawal by the District to solely the Powerhouse Springs Wells.

It should also be noted that the Powerhouse Springs Wells have a maximum output of 250 L/s, in contrast to the 322 L/s abstraction limit, owing to increases in system pressures as more wells are operated simultaneously.[3] This may limit the actual withdrawal limit for the Powerhouse Springs Wells to 250 L/s or 21.6 ML/day.

2.5.2 Surface Water

Until 2000, the Stawamus River and Mashiter Creek surface water sources were the main supply of potable water to the District. The supply drawn from these two sources under a surface water license from the Ministry of the Environment limits their capacity to 132 L/s for the Stawamus River, and 118 L/s for Mashiter Creek, for a combined capacity of 250 L/s. The District's most recent review lists the capacities of the Stawamus River and Mashiter Creek intakes at 132 L/s and 184 L/s, respectively.

In periods of high demand or under emergency conditions, the surface water sources may be used to supplement water from the Powerhouse Springs supply.

2.5.3 Distribution and Treatment Systems

A disinfectant is added to the raw water to provide residual disinfection in the network. When the surface water sources support the Powerhouse Springs supply, the District must issue a water quality advisory/boil water advisory. The surface water sources are only treated by chlorination, and are subject to periods of high turbidity during heavy rainfall.

A summary of the distribution system is provided in Table 2.4.

[3] *2013 Well Redevelopment Program Powerhouse Springs Well Field* APRIL 2014, Piteau Associates.

Table 2.4: Water System Summary

Water System Component	Quantity
Pressure Zones	14
Supply Wells	7
Storage reservoirs	7
Pump Stations	3
Pressure Reducing Valves	16
Length of watermains (km)	131
Service connections	4,127
Fire Hydrants (Owned by the District)	647

The values included in this table will differ slightly from the data collected for the purposes of the National Water and Wastewater Benchmarking Initiative. The definitions used in the NWWBI, for example to define a pump station, vary slightly from the lens used to define the system in the Water Master Plan and the Water Conservation Plan.

The accuracy of the service connection dataset does not equal that of the other asset groups. This was previously identified in the Squamish Asset Management Plan and is currently being worked on. The utility operators are using a handheld device with the "Collector App" that is ESRI GIS enabled.

2.5.4 Planned Water System Upgrades

The Water Master Plan currently being prepared will recommend upgrades to the District's water supply system. The majority of the upgrades recommended will address fire flows deficiencies and ageing watermains 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, equalization, and emergency requirements. The volume required for emergency storage and equalization 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 defer the need for a new reservoir.

2.5.5 Wastewater Treatment and Infrastructure

The District's 105 km of sanitary sewer and 25 lift stations channel the wastewater to the Mamquam Treatment Plant. A reduction of water usage will correspond to decreased flows to the sanitary sewer. These decreased flows result predominantly from efficiency in indoor water uses that create wastewater.

Reduced sewer flows will also result in lower wastewater treatment O&M costs and system capacity requirements. This may 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 and operating costs was not analysed over the course of this study.

2.6 Current and Historic Water Demand

Water system data for the District's water utility for the period from 2003 to 2014 was reviewed and analyzed to determine current annual average day demand (ADD) and maximum day demand (MDD) on a per capita basis. Yearly resident population totals were estimated by distributing the difference evenly between national census years (2001, 2006, 2011).

The 2014 data indicates that present water consumption is higher than the national average, with an average consumption per capita of 564 L/c/d and a maximum per capita consumption of 851 L/c/d.

2.6.1 System Demands

2.6.1.1 Customer Water Demands

The District of Squamish has just over 65, out of approximately 4,100, service connections with meters. The service connections with meters are predominantly Industrial, Commercial or Institutional (ICI) customers. The major ICI water users in the District include the hospital, a retirement community, the municipal pool, university, a brewery, and a wastewater treatment plant.

Insufficient customer demand data was available for an analysis of water usage trends in each customer group. Estimates of water demand distribution was performed for the purposes of modelling the water network and guiding capital planning decisions; the results of the analysis are included in Table 2.5. It is based on assumptions that network losses by leakage comprise 10-15% of the total system demand and is split within total demands of the utility customer groups.

Table 2.5: Estimated Water Demand Summary

Demand Type	Demand (L/s)		Peaking Factors		Estimated Portion
	ADD	MDD	ADD	MDD	
Single Family	44.5	88.7	1.0	2.0	36%
Multi-Family	29.7	44.5	1.0	1.5	24%
Institutional	11.9	13.1	1.0	1.1	10%
Commercial	16.6	18.2	1.0	1.1	14%
Industrial	19.4	21.3	1.0	1.1	16%
Total	**122.0**	**185.9**	**1.0**	**1.5**	-

2.6.2 Average Day Demand

The 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 District's entire water system. It is also useful in analysing historic demands and in estimating future demands.

The per capita demand, expressed in litres per capita per day (L/c/d), is the average daily total amount of water entering the system divided by the number of inhabitants served by the utility. This value is a general performance measure of water consumption since its calculation does not consider population equivalents for ICI customers nor leakage across the distribution network.

The total system demand values for 2003 to 2007 were taken from a Water Supply Strategy Report produced for the District in 2007. The values for 2008 to 2010 are from the annual reports submitted to Environment Canada. The District's well pump SCADA data was used to calculate the total withdrawal of raw water from 2012 to 2014. No water demand records could be referenced for 2011 therefore the values were interpolated.

The calculated total, average, and per capita demands for the last eleven years are listed in Table 2.6. The 2014 population was interpolated using the 2013 census data with the population projection for 2031 documented in the OCP.

Table 2.6: Average Day Demand

Year	Population	Total System Demand (ML)	Average Day Demand (ML/day)	Per Capita Demand (L/c/d)
2003	14,528	3,965	10.9	748
2004	14,668	3,874	10.6	724
2005	14,809	4,018	11.0	743
2006	14,949	4,077	11.2	747
2007	15,494	4,186	11.5	740
2008	16,039	3,747	10.3	640
2009	16,584	3,628	9.9	599
2010	17,129	3,688	10.1	590
2011	17,674	3,805	10.4	590
2012*	18,117	3,395	9.3	582
2013*	18,319	3,845	10.5	620
2014*	19,053	3,919	10.7	564

* Values for these years stem from SCADA records.

From the data provided, it can be observed that despite an increase in population the District's per capita water consumption has decreased and has stabilised. Water consumption volumes differ significantly in the summer and in the winter. Figure 2.1 illustrates the per capita demand in Squamish

from 2003 to 2014 along with the average daily summer and winter demands between 2011 and 2014 drawn from SCADA records. The calculated variance in water consumption between each period is on average of 125 L/c/d for the last three years.

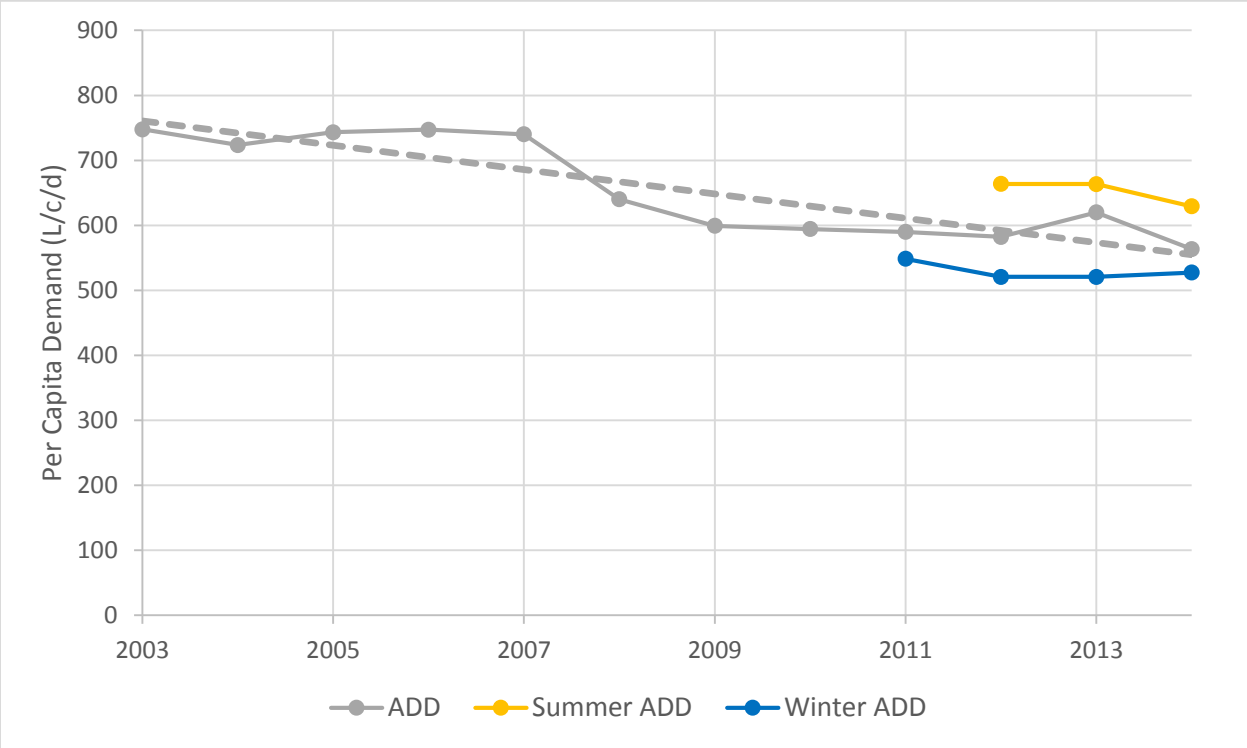

Figure 2.1: Per Capita Demand 2003- 2014

Though the winter ADD values on record are lower than the summer ADD values, being over 500 L/c/d they are nevertheless high. The winter ADD should be managed, partly through a network maintenance and renewal strategy. The higher summer demand should also be managed, it however should be targeted by utility customer water conservation practices.

2.6.3 Maximum Day Demand

The MDD is the average demand on the day with highest water consumption in a given year. The MDD defines the required treatment capacity of the District's water treatment facilities and is critical in the sizing of system reservoirs for provision of fire, equalization, and emergency storage volumes.

The District's well pump SCADA data was used to estimate the 2012 to 2014 MDD values. Written records were used to estimate the 2003 to 2011 MDD values. The 2014 population was interpolated using the 2013 census data with the population projection for 2031 documented in the OCP. A summary of the MDD to ADD peaking factors for the last 11 years is shown on Table 2.7.

Table 2.7: Per Capita Demands and Peaking Factors

Year	Population	Average Day Per Capita Demand (L/c/d)	Maximum Day Per Capita Demand (L/c/d)	Peaking Factor
2003	14,528	748	-	-
2004	14,668	724	1502	2.1
2005	14,809	743	1202	1.6
2006	14,949	747	-	-
2007	15,494	740	1528	2.1
2008	16,039	640	1201	1.9
2009	16,584	599	1115	1.9
2010	17,129	594	1160	2.0
2011	17,674	590	901	1.5
2012*	18,117	582	911	1.6
2013*	18,319	620	878	1.4
2014*	19,053	564	851	1.5
Average	**-**	**657**	**1,125**	**1.8**
Median	**-**	**630**	**1,137**	**1.8**

* Values for these years stem from SCADA records.

The average and median MDD peaking factor over the last 11 years is 1.8. This is more conservative than the average MDD peaking factor of 1.5 from the last three years of SCADA records which have better accuracy than the sources of the data referenced for the 2003 to 2010 values. For the purposes of projecting water demands into the future, an MDD peaking factor of 1.5 will be used.

The MDD, ADD, total summer rainfall and maximum temperatures for the period from 2010 to 2014 are shown graphically in Figure 2.2. The large discrepancies between pre-2011 and post-2011 data (logbook records vs SCADA records) are significant. Due to the discrepancy, the information prior to 2011 could not be used to determine trends in MDD. The parameters included in Figure 2.2 should be measured and compared in the years to come to monitor the effectiveness of the conservation plan programs.

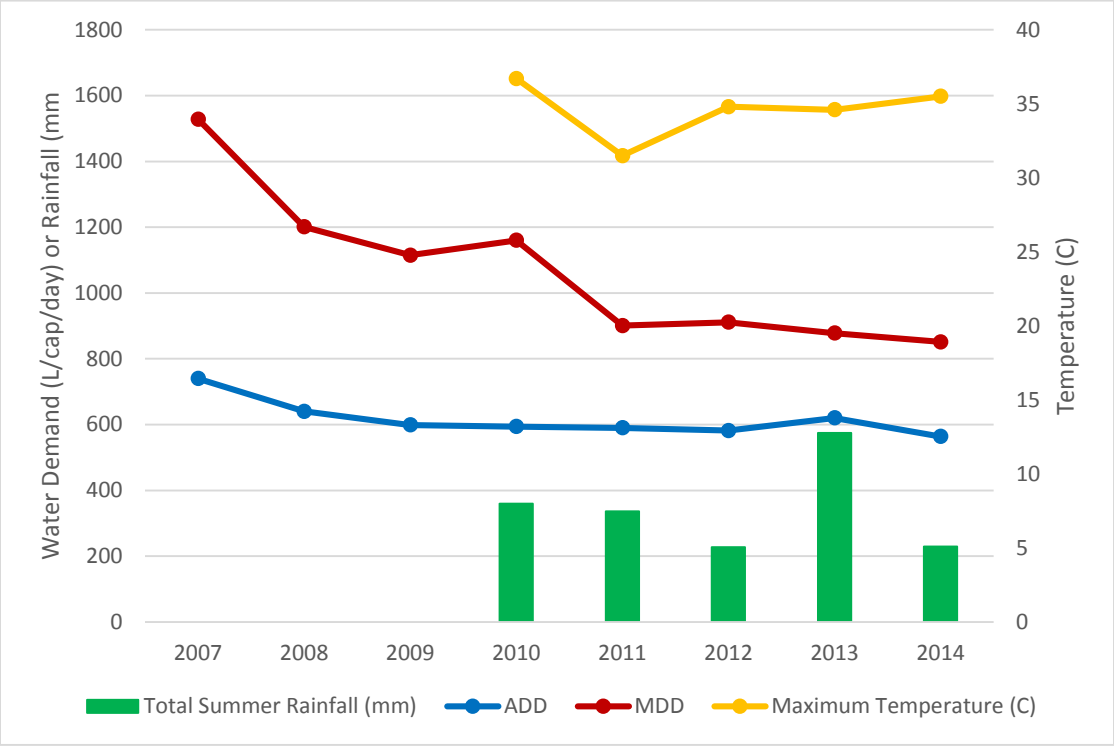

Figure 2.2: Water Demand and Climate Data

The historical MDD is also significantly less than the abstraction limit at Powerhouse Springs as shown in Figure 2.3. Rather than putting pressure on the water supply, the MDD has put pressure on the distribution infrastructure in meeting the required system performance measures.

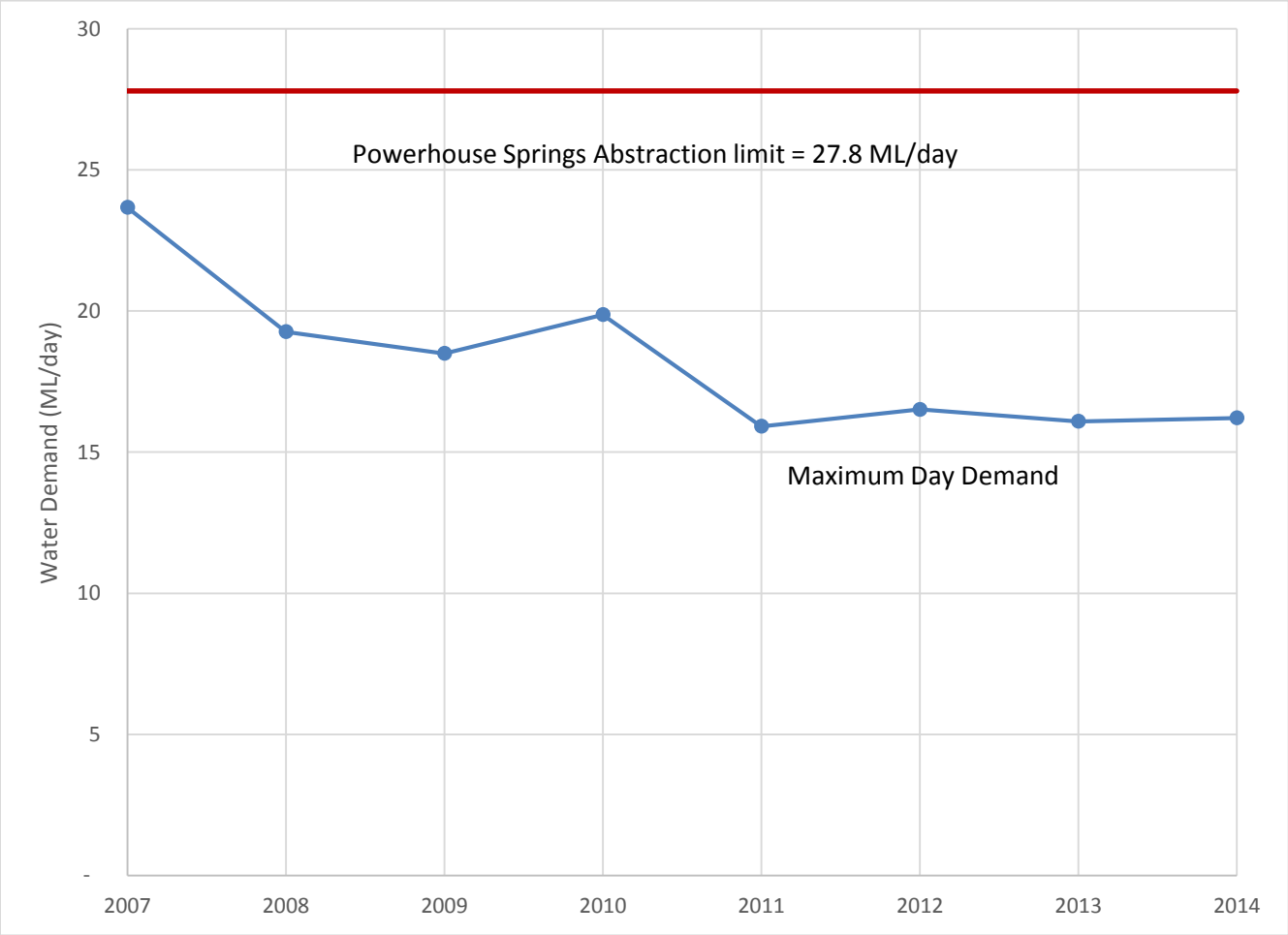

Figure 2.3: Abstraction Limit and MDD

2.6.4 Comparison with Lower Mainland Municipalities

According to 2012 data, the District's per capita consumption is in the higher tier of the Lower Mainland municipalities participating in the National Water and Wastewater Benchmarking Initiative (NWWBI). The per capita consumption values equate to the total volume of water supplied to the network divided by the residential population in the calendar year. The calculated values were not adjusted for variances in ICI consumption and water loss between each utility as they are deemed comparable within this subset of the larger group of utilities participating in the NWWBI. In 2012, each utility, except the District, had a program promoting the conservation of potable water. At the time the District utility had outlined four stages of water restrictions.

Figure 2.4 provides this comparison of water usage in the District to nine other Lower Mainland municapalities.

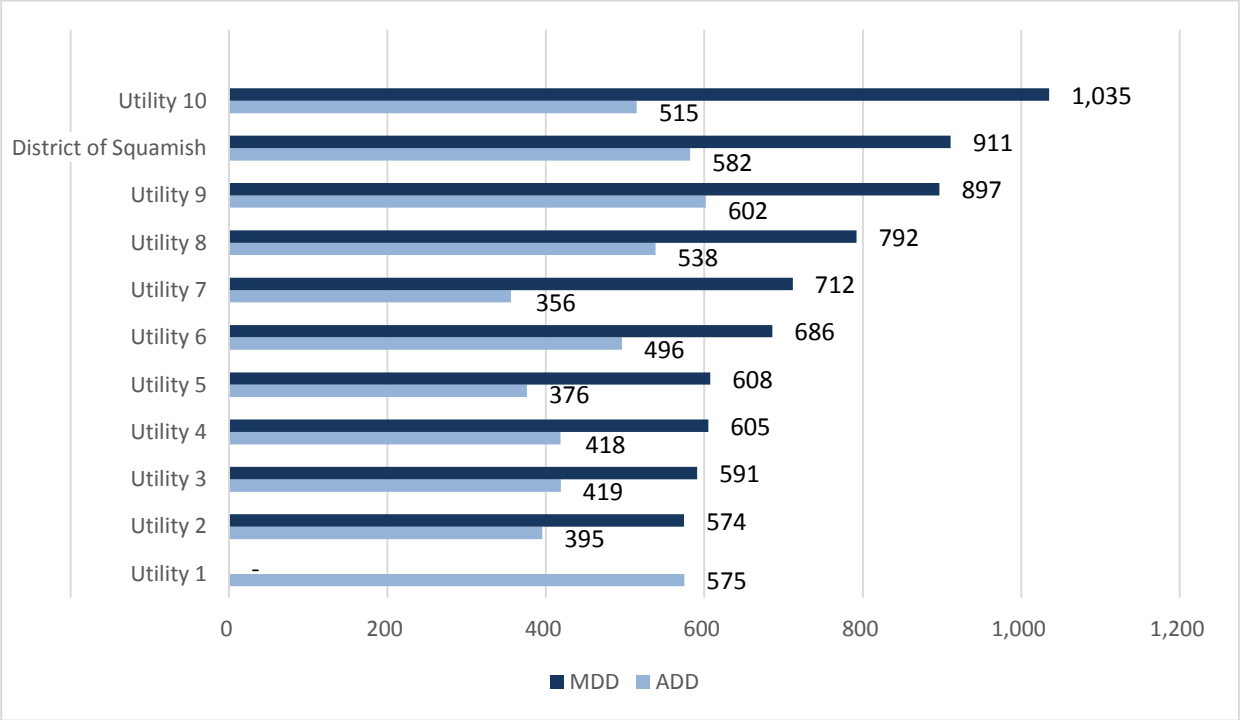

Figure 2.4: 2012 Per Capita Daily Usage (litres/capita/day)

3 Future Water Demand

3.1 Population Growth

Future water use in the District is predominantly dependent on population and ICI growth. A population growth rate of 3.0% was used to estimate future demand projections. This is the annual compounded growth rate that brings Squamish's current population to 31,525 by 2031 as per the OCP projection.

Assuming that per capita water demand remains static, using the 2014 value of 851 L/capita/day, the MDD can be expected to increase from 16 ML/d to 27 ML/d in 2031 according to population growth alone. The 2031 projection was calculated with consideration for growth in the SF, MF, and ICI customer groups according to what is defined in the traffic zone maps for 2031. These maps did not assume more residents were moving into MF housing such as condominiums and townhouses.

This value of 27 ML/d in 2031 nears the available production capacity (i.e. total available abstraction limit) at the Powerhouse Springs wellfield. Figure 3-1 shows the growth in water demand over time due to the increase in population and the greater economic activity that comes with it. No allowances for energy sector growth were made as the implications of this industry sector are not accurately quantifiable at this time.

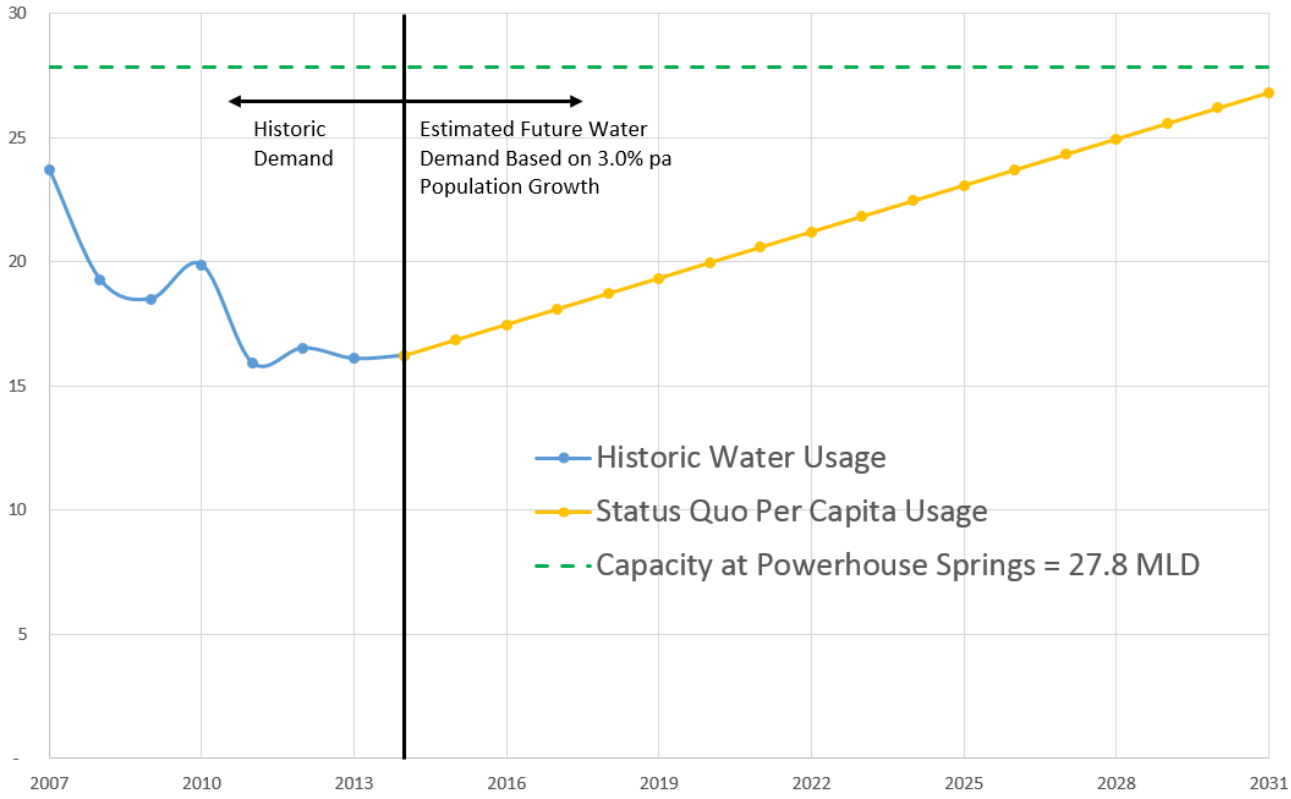

Figure 3.1: Projected Future MDD in the District

3.2 Climate Change

Another factor which may affect future water demand is climate change, which 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 and various demand management initiatives. Adaptation activities include using new technologies, adjusting planning and investment practices, and revising regulations. While adaptation measures have the benefit of achieving sustainability goals, they should not be considered as only having the capacity to address climate change. Both adaptation and mitigation are required in this case.

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 District of Squamish has considered climate change impacts on the community in the Official Community Plan. As stated in the OCP: *"In BC, climate change is anticipated to result in increased temperatures, increased precipitation, more extreme precipitation events, sea level rise, glacial retreat, and changes in estuary salinity and ecology."* Discussion surrounding climate change in the OCP namely focuses on natural hazards such as flood hazards and slope instability in land use planning. These represent grave economic and public safety risks.

Although the effects of climate change cannot be predicted accurately, the District is likely to experience variations in weather resulting in both flooding and drought conditions. Even though the District has a small demand compared to the available water resources in its vicinity, there should still be careful management of the supply and consumption of water.

If the Mamquam glacier retreats, flow may reduce in the Mamquam River, and subsequent recharge to the aquifer may drop as well. This combined with less rain in the summer could impact available capacity of the aquifer to supply the District. These observations were taken from the hydrogeological assessment of the Ring Creek aquifer that was completed for the Well Protection Plan. The District is installing apparatus to monitor the aquifer.

If average temperatures increase due to climate change, the likelihood of District residents' innate desires to consume more water will correspondingly increase. Additionally, the increase in water use may be coupled with drought conditions, which could create the need for stringent water restrictions. The belief of limitless abundance of water, partly rooted in the geography of the land that surrounds the community, should be curbed.

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.

4 Water Conservation Target

There are numerous program options available to the District in shaping its Water Conservation Plan (WCP). The determination of a water conservation target is foundational to determining the course of action that the WCP will constitute. The target will enable the District to scale its efforts, appropriately select the conservation programs, commit resources to the plan, and measure progress.

4.1 Previous Water Conservation Targets

With this document the District is in the process of establishing its first WCP. Prior to this WCP no water conservation target has been formally endorsed by District Council. Though through its Water Loss Management Program the District was recommended an Infrastructure Leakage Index (ILI) target, a measure of network losses, the ILI target does not equate to a water conservation target that may be used within a WCP.

4.2 Water Conservation Goals and Targets

Through this WCP the District will formally establish its first water conservation target.

4.2.1 Water Conservation Goals

The water conservation goals guide the selection of programs that constitute the WCP. The goals recommended by Opus for this WCP are:

- to maintain or reduce maximum day demand;
- to achieve reliable reductions in water demand;
- to increase the perceived value of potable water; and,
- to improve knowledge and management of utility infrastructure.

These goals align with the goal of the District's existing Water Conservation Education Plan which is:

"*To promote a community-wide capacity for water conservation and water-use efficiency with the overarching goal of reducing gross community water consumption by focusing on reducing seasonal increases and daily peak time usages*."

Although not a goal of water conservation, keeping program implementation costs low is a utility management objective that was considered in the development of the Plan. This goal and the goals mentioned above are encompassed in the criteria for evaluation the water conservation strategies.

4.2.2 Water Conservation Target

In general, reduction of ADD is important to alleviate stress on source supply capacity. With the source capacity in the District governed by groundwater supplies, which are currently replenished through seepage from the Mamquam River and Mashiter Creek, there is minimal concern for source capacity. This unless impacts from climate change are realised, hence the District is monitoring the aquifer to verify this.

Alternatively, reduction of MDD is important to alleviate stresses within the operation of the water system infrastructure. Supply, pump, pipe network and storage capacities are all designed to handle the MDD in the water system. The District is currently preparing a Water Master Plan, in which it is assessing the capacity of the water supply and distribution system to determine necessary upgrades. Reducing MDD will have an effect on reservoir upgrades and water supply capacities in particular; not as much on watermains as their sizing is more directly influenced by required fire flow. Reduction in MDD should therefore be a higher priority.

For the purposes of setting water conservation targets, the 2014 average and maximum day per capita demand of 564 and 851 L/c/d was used as the basis for all planning. These values include the Stawamus First Nation Indian Reserve 24 water consumption and population. It is a subset of utility customers that, although not covered by the WCP, does not significantly impact the utility's performance.

The water conservation target needs to align with the proposed goals of this water conservation plan which are to:

- In the short term: Increase the perceived value of this public service amongst residents and their awareness of the benefits of water conservation; Achieve reliable reductions in water demand.
- In the long term: Delay capital expenditure on infrastructure upgrading projects; Increase operational knowledge about the water distribution network and water demand.

The B.C. MoE Living Water Smart Campaign set a target for 33% reduction in water use between 2008 and 2020. If the District adhered to this target, it would correspond to a 24% reduction to the current average day per capita water demand in the next 6 years. This is an ambitious target to achieve that would require significant investment from the District and potentially universal water metering.

A more attainable target would be a 15% reduction in water demand (ADD and MDD) over the Official Community Plan horizon, to 2031. This target is supported through the ICI and Multi-Family metering strategy currently proposed in the District's Water Master Plan and would be more in line with the District's goals. A comparison of the two targets is given in Table 4.1.

Table 4.1: Water Conservation Target

	Living WaterSmart		15% Reduction by 2031	
	Base year 2014	End year 2020	Base year 2014	End year 2031
ADD (L/capita/day)	564	429	564	479
MDD (L/capita/day)	851	647	851	723

Figures 4.1 and 4.2 show the impact of reducing per capita demand over the next 17 years versus maintaining the status quo. The depiction of the aggressive short term conservation target related to the Living WaterSmart Strategy shows the District achieving the per capita demand target by 2020, as per the provincial program schedule, and maintaining that demand across the community from then on. The other 15% target is shown to be consistent and more gradual over the 17 year period.

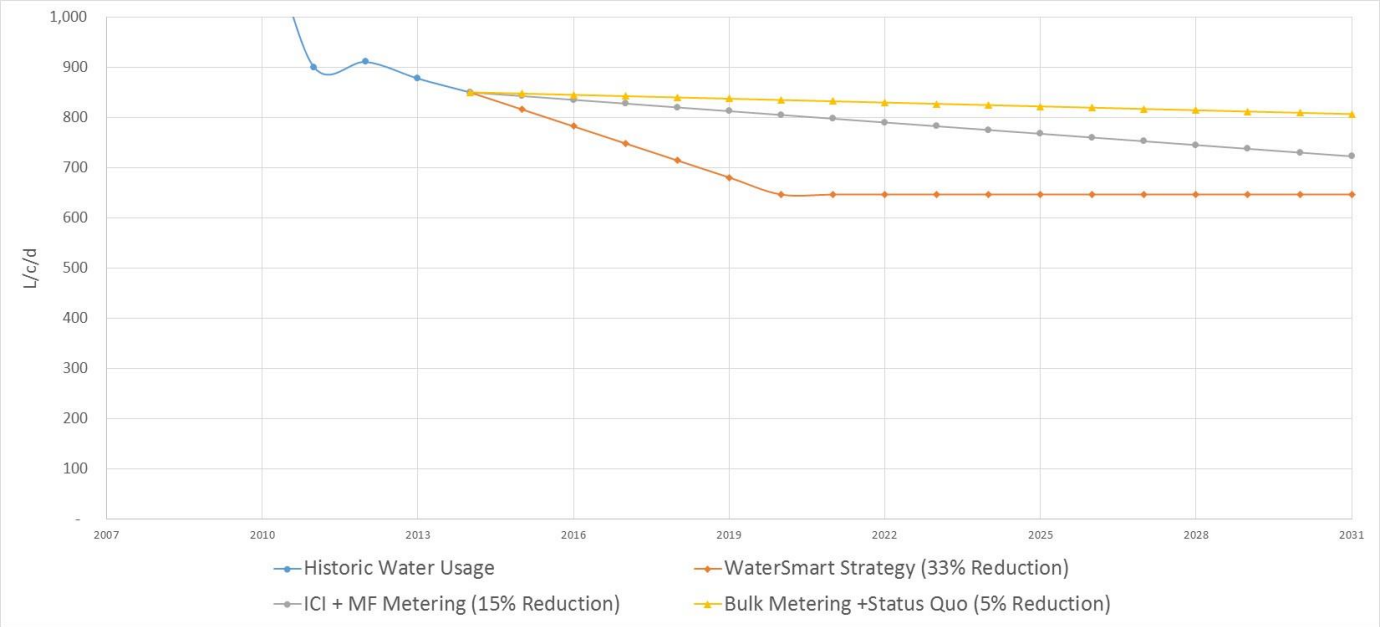

Figure 4.1: Projected District Per Capita Maximum Day Demand with Water Conservation Targets (L/c/d)

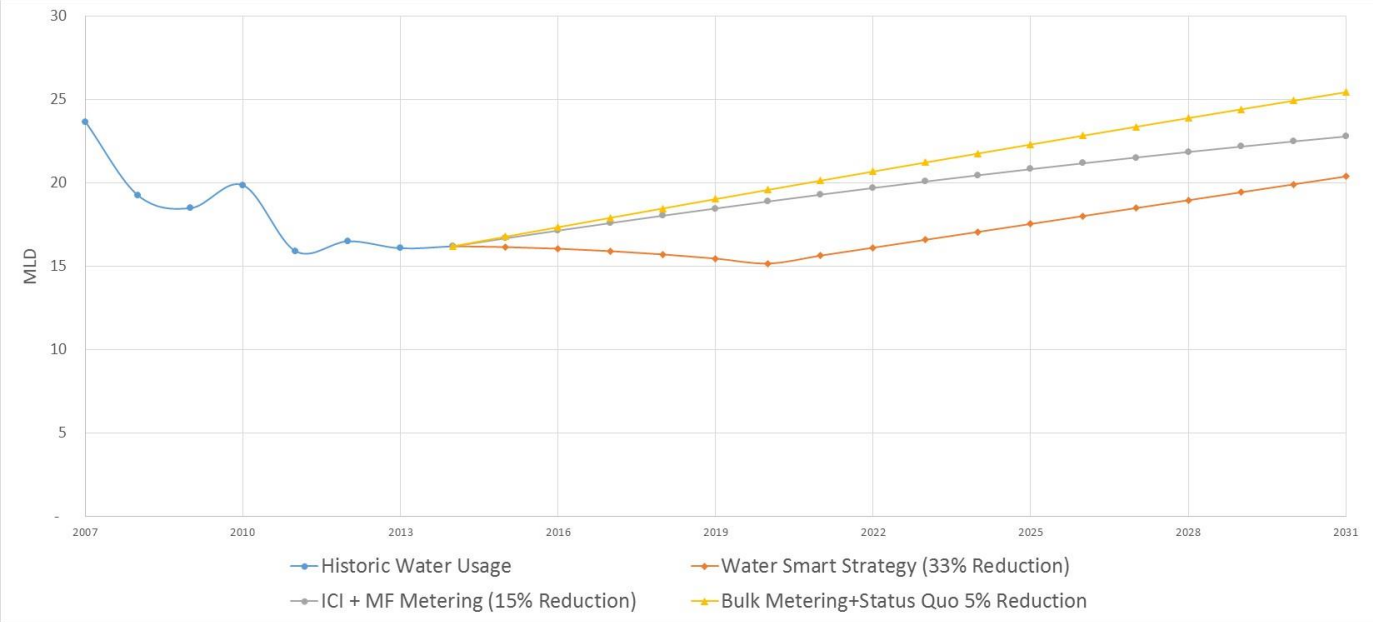

Figure 4.2: Projected District Maximum Day Demand with Water Conservation Targets (MLD)

5 Previous Water Conservation Efforts

The following milestones highlight the progression of water conservation in the District of Squamish since 1995.

Table 5.1: Progression of Water Conservation Measures

Year	Milestone
1995	Four stages of water restrictions are outlined by the water utility.
2005	March 22 Council Resolution: - THAT in light of the low precipitation levels during the winter, Council consider a strategy regarding public education and early implementation of a water conservation strategy, including water metering be developed.
2006	October 6 Council Resolution: - THAT staff bring forward, to a meeting in November, a water metering strategy for the District of Squamish.
2008	March 18 Recommendation to Council: - THAT the District of Squamish Subdivision and Development Control Amendment Bylaw No. 1767, 2003 be amended requiring water meters to be installed with all new developments; A subset of existing customers elected to have their water connection metered.
2010	Water Loss Management Program - Purchase of leak detection sounding equipment and training of staff. - Installation of temporary district metering areas and night flow monitoring. - Step testing.
2011	Asset Management Plan - Need for infrastructure renewal, some of which caused leakage, identified and funded with rate increase.
2012	Water Loss Management Program - Installation of additional district metering areas and flow monitoring. Official Community Plan (Water & Sewer 24-22) - Statements regarding water conservation are included. They read as follows: Water conservation will be encouraged through policies and programs such as: a. water metering; b. requirements for low water usage fixtures (e.g. low flow shower heads and toilets); and, c. landscaping designs with lower demands for watering (eg. Native & drought-resistant plants)
2013	Annual Report Strategic Initiatives regarding water - Statements regarding water conservation are included: • Update OCP to include a Development Permit area promoting energy conservation, water conservation and reduction of greenhouse gas emissions. • Introduce Indoor Water Use Bylaw. Outdoor Water Use By-Law (No. 2254) Amendments - Recognition of special water uses (addition of Fire Chief Notice allowing Chief to dictate community water restriction in order to fight forest fires).

Year	Milestone
	- Allowable and unallowable water uses and enforcement measures are determined for the staged water restrictions. Water Conservation Officer. - First employ of a part-time water conservation officer. - Development of 2013-2014 Water Education Plan - Roll out of water conservation education initiatives - First occurrence of Stage 3 water use restriction and Outdoor Water Use By-Law enforcement
2014	Water Conservation Officer. - Outdoor Water Use By-Law enforcement. - Roll out of water conservation education initiatives. - Discussions with the planning department regarding building construction bylaw amendments. October 7, Council Resolution - THAT the District of Squamish adopt the option 3 recommendation – meter water for (ICI) properties and multi-family dwellings and formalise the current voluntary residential metering program and bring back a strategy to consider option 4 – universal metering before the next water master plan is established. December 16, Council Resolution - THAT the District of Squamish approve funding for the municipal contribution for installing Industrial, Commercial and Institutional (ICI) and Multi-Family water meters at a cost of $295,047 in 2016 and $275,128 in 2017.
2015 Anticipated	Water Conservation Plan - Development and Council endorsement of first WCP.

The primary objective of the 2013 and 2014 Water Education Plan was to connect people to the water they consume. In two years the communications strategy has improved with an increase in the quality of the educational material and targeted messages to the community. In 2014, the water conservation officer worked with the District's communications team and the graphics manager to transform the communication strategy and broaden the program's reach. Examples of public education and outreach measures taken thus far are summarized below:

- Every week a table which depicts water consumption across the community is released in the local paper and the e-newsletter published by the District on its website. Every month it includes a comparison of water consumption for that same period to the previous year's consumption. The figure created also shows rain events and how they impacted consumption.
- Pamphlet/brochures, fridge magnets, and door hangers were distributed. The messaging on these communication tools has been edited to be less verbose and the content more accessible.
- Community outreach events hosted by other departments have been used to meet with the public. The water conservation officer for example joined the fire department during its events to teach people about the Outdoor Water Use Bylaw and water conservation measures.
- To facilitate bylaw enforcement, the water conservation officer has built working relationships with local irrigation companies and the school district to inform them and keep them up-to-date on water restriction stages.

These measures and some of the communication materials used thus far are included in Appendix A.

6 Review of Potential Water Conservation Programs

The various water conservation program options available to the District have proven beneficial to many utilities. Especially so to water utilities that are unmetered as leaks or other forms of wasting water can be substantial yet remain unaccounted for. Reducing customer water demand helps to:

- Ensure the future reliability of infrastructure;
- Protect water supplies and be responsible environmental stewards; and
- Promote efficient use of water resources.

This section outlines potential water conservation programs that the District of Squamish may choose to implement to meet water conservation targets. Each program has different strengths and weaknesses. Each water conservation measure has been assessed in order to identify the strategies that would best meet the District's goals with regards to water conservation (summarized in Section 4). The evaluation criteria are:

- Targets maximum day demand;
- Reliable reductions in water demand are achieved;
- Perceived value of potable water increases;
- Implementation costs are low; and,
- Understanding of the network's operation and management of infrastructure will improve.

6.1 Legal Tools and Enforcement

6.1.1 Outdoor Water Use Restrictions

Outdoor water use is a seasonal occurrence in which potable water is mainly used to irrigate landscapes. The amount of water consumed in this manner is driven by the hot and dry periods experienced during the spring, summer, and early fall. Outdoor water use is temporarily curbed by rainfall events which offsets the need for landscape irrigation during these seasons. However, with few rainfall events during the summer, the total amount of water consumed during this seasonal period exceeds the amount of water consumed during the winter months. Utility managers often seek to reduce the volume of water consumed during peak periods to offset investments in new infrastructure.

An example where water use restrictions have been used successfully is at the Sunshine Coast Regional District (SCRD). The SCRD has experienced severe water shortages in recent years, and, due to the low water levels in its main supply reservoir, has been forced to use staged water restrictions as its primary water conservation method to manage maximum day demand. The breakdown of the four stages of water restrictions used by its water utility is as follows:

- Stage 1 – Sprinkler use limited to three days per week
- Stage 2 – Sprinkler use permitted on only one day per week
- Stage 3 – Ban on sprinkler use

- Stage 4 – Ban on all outdoor water use

At the SCRD Stage 1 restrictions have been in place every summer since 1995. Stage 2 water restrictions were sanctioned in 2009 and 2012. However, in 2012, water shortages were so bad that the SCRD was forced to go as far as Stage 4 water restrictions.

In the 2005 to 2011 period, the SCRD issued 315 warnings related to violation of water restrictions and seven fines. The SCRD estimates that their water conservation strategies, with a major part being the enforcement of water restrictions, resulted in a 23% reduction in MDD and 12% reduction in ADD between 2003 and 2013. Table 6.1 summarises the estimated peak week demands recorded by the SCRD during the various stages of water restrictions. The data in Table 6.1 suggests that it is possible to reduce MDD by 700 L/cap/day with enforcement of a complete ban on outdoor water use.

Table 6.1: Sunshine Coast Regional District Water Restrictions

Water restriction Level	Year Implemented	Estimated Peak Week Demand (L/cap/day)
Stage 1	Implemented every summer since 1995	1,100
Stage 2	Twice in 2009 and 2012	830
Stage 3	2012	450
Stage 4	2012	400

The City of Abbotsford used a bylaw enforcement program until 2011 at which point the combination of the advanced metering program and the tiered water rate was the driver for bylaw conformance. In the nearby District of Mission where they are not universally metered they continue with bylaw enforcement. Under the pressure of this billing system customers self-regulate. When it was in operation the City's bylaw enforcement program was conducted by teams of summer students. The summer students always worked in pairs for security reasons and travelled in a vehicle marked by the City's water conservation program. They gave warning to customers that were non-compliant and informed them of the scope of the bylaw. If the customer was found to be non-compliant on a third occasion the students informed the bylaw officer of this occurrence who then was responsible for emitting the violation ticket. In 2012 and 2013 students handed out friendly door hanger notices with the restrictions to homes that did not comply with the bylaw.

Since 2013 the District of Squamish has staged outdoor water use restrictions in effect from May 1st to October 31st that limit the days and hours during which residents may conduct outdoor watering. The first occurrence of Stage 3 water use restriction occurred in 2013. The breakdown of the four stages is as follows:

- Stage 1 – Two days per week
- Stage 2 – One day per week
- Stage 3 – No lawn watering
- Stage 4 – Ban on all outdoor water use

The District's four stages of water restrictions is in keeping with a breakdown followed by other BC utilities. The effectiveness of water restrictions in the District would be enhanced by strict enforcement. This could be achieved by hiring an additional officer to patrol the community and identify households that are in violation from May to October. Increasing the fine associated with violations may also act as a stronger deterrent. Cities in the Lower Mainland typically charge at least $100 for a water restrictions violation.

RECOMMENDATION:

Outdoor water use restrictions should be considered for inclusion in the District's WCP. Consideration should be given to increasing resources dedicated to this initiative to bolster community support and compliance.

Outdoor water use restrictions target maximum day demand, but are only effective if they are adhered to. This requires community support or strict enforcement. Maintaining the current regime of water restrictions is inexpensive but will not by itself yield the outcome sought.

6.1.2 Building Construction Bylaws – Irrigation & Indoor Water Use

Municipal bylaws can also cover a range of indoor water conservation measures. Development bylaws and construction specifications to be followed by developers and contractors offer other policy means of saving water. These bylaws are generally only applicable to new building construction within the community or through significant retrofits. This limits the bylaws' impact and the overall amount of water that can be conserved by this method. Fixtures that can be targeted by these measures include:

- Irrigation apparatus,
- Low flow showerheads,
- Low flow faucets,
- Low flush toilets, and
- Ban on installation of garburators.

Building construction bylaws requiring installation of automatic irrigation system, low flush toilets, faucets, showerhead restrictors and other water saving devices is a policy tool followed by many municipalities. As of 2008, the Province of B.C. has mandated the use of ultra-low-flow toilets (6.0 L/flush) and other water-saving plumbing fixtures and fittings in new construction and renovations. This was defined in the B.C. Building Code through the Water Conservation Regulation.

Many municipalities have written the requirement for low-flow fixtures into their bylaws for new construction. For the most efficient use of water in irrigation, turf areas should be irrigated separately from other plantings. Trees, shrubs, flowers, and groundcovers can be watered efficiently with low volume drip emitters, sprayers, and bubblers. Water conservation achieved in terms of reductions in ADD and MDD is difficult to quantify accurately for the utilities using this conservation measure.

The District included in its OCP a statement that indicates: *"water conservation will be encouraged though policies and programs such as requirements for low water usage fixtures (e.g. low flow*

shower heads and toilets)." The introduction of an indoor water use bylaw was a strategic initiative included in the District's Annual Report. This is a measure that has internal buy-in as it is currently being considered by the Development Services department and the Water Conservation officer.

RECOMMENDATION:

Modification of existing building construction bylaws and permits should be considered for inclusion in the District's WCP. This low cost measure supports efforts already underway in the District as well as statements in the District's OCP and Annual Report.

In the short term, implementation of such bylaws does not guarantee a significant reduction in water demands. Year by year it impacts a small subset of the utility customer base which in the long-term will amount to a noteworthy reduction in water demand.

6.1.3 Building Construction Bylaws - Landscaping by Xeriscaping

This conservation strategy targets reduction of outdoor water use during the dry summer months by modifying the community's landscape. Xeriscaping aims to create a visually attractive landscape that uses plants selected for their drought resistance.

Properly maintained, a xeriscape can require less than half the water of a traditional landscape. Xeriscaping can reduce the time spent watering, fertilizing and mowing, and it can increase the beauty and value of a property. Once established, a xeriscape should therefore require less maintenance than a turf landscape. Xeriscaping along with a well-planned and well maintained irrigation system can significantly reduce water use compared to a traditional landscape.

This strategy has been implemented by municipalities throughout the B.C. with varying degrees of success. Similar to rebate programs, xeriscaping does not provide much financial incentive to homeowners until universal metering is implemented. Typical water reduction in terms of ADD and MDD reduction is difficult to quantify but water savings in excess of 10% can be achieved through xeriscaping principles and large landscape management.

The District included in its OCP a statement that indicates: "water conservation will be encouraged through policies and programs such as landscaping designs with lower demands for watering (eg. Native & drought-resistant plants). This is another measure that has internal buy-in as it is currently being considered by the Development Services department and the Water Conservation officer.

RECOMMENDATION:
Modification of existing building construction bylaws and permits to include policy on xeriscaping should be considered for inclusion in the District's WCP. This low cost measure supports efforts already underway in the District as well as statements in the District's OCP and Annual Report.

In the short-term, implementation of such a bylaw amendment does not guarantee a significant reduction in water demands. Year by year it impacts a small subset of the utility customer base which in the long-term will amount to a significant reduction in water demand.

6.2 Economic Tools

6.2.1 Water Metering

Metering is a primary element in an effective water conservation program and is a water conservation tool which is becoming more and more popular across B.C. This conservation strategy is able to monitor water usage by all residential and ICI customers within the utility. Billing of a water service, based on the water use measured by a meter, provides a strong incentive for customers to use less water, more than if they were billed on a flat-rate basis.

A reduction in water use after meters are installed is typically most substantial during the first year that follows installation. However, if water prices are kept low after the start of the metering program, there is little incentive for users to decrease their water consumption. This is West Vancouver's experience with metering. Therefore, metering is most effective in the long term if pricing reform establishes a rate structure which provides the consumer with enough financial incentive to conserve water.

Squamish currently runs a small scale metering program which covers a minor portion of the community's water utility customer base. Within the current metering program, a subset of the Industrial, Commercial and Institutional (ICI) customers and some large residential developments have meters built into their service connections. The District has approved the implementation of ICI and MF metering which will result in over 50% of all usage metered. The District will also be revising the billing method for this customer group as detailed in the water rate analysed completed for the Water Master Plan.

6.2.1.1 Universal Metering

The impact of universal water metering, in conjunction with an effective volumetric pricing plan in achieving reductions in water demand, are well documented. However, implementation of universal water metering is a large commitment that may be resisted by the community. The benefits of universal water metering include:

- The provision of an incentive for residents to be mindful of the amount of water used when implemented in conjunction with an effective volumetric pricing plan. This therefore reduces maximum and average day demand;
- Improved data on water use; and,
- Improved identification of private side leaks.

The downsides of universal water metering include:

- The high cost to install meters; and,
- Resistance from a portion of the public on program implementation.

Universal metering has been implemented by municipalities throughout B.C. and is a cornerstone of many water conservation strategies. Universal metering is a proven method for achieving significant water savings over long periods of time in this province. Water savings resulting from the installation of meters can vary anywhere from 13% to 45%. Several variables may contribute to the variation,

including housing type, lot size, climate, and season. A potential reduction of up to 20% in the utility's average day demand is possible from metering, while a reduction of up to 10% is possible for maximum day demand according to the experience of certain utilities.

Due to the high capital costs and resistance from the public, universal metering is generally only implemented in areas where there will be a demonstrated economic payoff. For example in areas where there are frequent water shortages and the reduced water demands associated with implementation of metering will defer construction of other costly infrastructure projects associated with expanding the existing water supply.

It should also be noted that a universal metering program is a very politically sensitive program which may take a long time to implement within the District. The District is not in a strong position to implement a universal metering program in the short term since the customer education programs are still relatively new to the community and have not yet achieved their full impact. The community is being educated to a higher degree, since 2013 through the water conservation officer's work, on the importance of reducing water usage during peak usage summer months and the stringent Outdoor Water Use Bylaw introduced very recently in 2013.

As the District expands the reach of its education program and as the outdoor water use regulations are enforced and followed, the atmosphere will be much more conducive to implementing a Universal Metering program in the future. Community readiness for an expansion of the ICI and Multi-Family metering program into a Universal metering program should be investigated in the District's next Water Master Plan in 5 – 10 years.

RECOMMENDATION:

Universal water metering should not be included in the District's WCP at this time.

As detailed in the Water Metering Strategy technical memo universal water metering is costly to implement and is generally not well supported by communities without extensive education campaigns. Although it can result in a significant reduction in water demand when combined with a volumetric rate structure and provides valuable knowledge about consumption of water, it is difficult for utilities to justify the implementation cost.

6.2.1.2 Bulk Water Metering

There are two bulk water filling stations at the District. These are the Clarke Drive and Production Way stations. The water filling stations in the District, each equipped with a cardlock system, are metered. Each water filling station user is billed according to his or her consumption of water.

RECOMMENDATION:

Metering the use of water filling stations should continue though it needn't be included in the WCP.

6.2.2 Volumetric Pricing and Rate Structure

The Water Rates Bylaw regulates the rates, terms and conditions under which water from the municipal water utility may be supplied and used. Research suggests that water demand is sensitive to changes in pricing structures as well as water prices. A set price or flat fee is considered to be the least effective pricing structure for promoting conservation.

In British Columbia, water prices generally fail to account for environmental costs or even the full financial costs of providing the water service. Environmental costs are not well understood at this time but improvements are being made in understanding the full economic cost of the service. Most water consumers are accessing potable water at a discounted rate that does not encourage conservation. This water conservation strategy involves understanding the overall value of potable water and conveying that to water customers according to their usage volumes through the pricing structure.

Water rates are normally set at a level designed to collect necessary revenue for utility operation. They should be reviewed to account for changes (increases or decreases) in costs, system size, and service level expectations.

There are several types of rate structures which can be used to encourage water conservation, including those listed in Table 6.2. The majority of these require measurement of customer's water consumption. Metering is therefore essential for the adoption of any volume-based pricing structure.

Table 6.2: Water Rate Structures

Volumetric Rate Structure	Customer bills vary with water usage	Pricing signal
Uniform rate	Price per unit is constant as consumption increases.	Reduces average demand.
Inclining block rates	Price per block increases as consumption increases.	Reduces average and peak demands.
Seasonal rates	Prices during season of peak use are higher.	Reduces seasonal peak demand.
Excess-use rates	Prices are significantly high for above average users.	Reduces peak demand.
Indoor / outdoor rates	Prices for indoor use are lower than outdoor use.	Reduces seasonal peak demand associated with outdoor use.
Sliding-scale rates	Price per unit for all water use increases based on average consumption.	Reduces average and peak demand.
Spatial pricing	Users pay for the actual cost of supplying water to their establishments.	Discourages new or difficult-to-serve connections.
Penalties	Charges certain customers a pre-specified amount for exceeding allowable limits of water use.	Reduces peak demand and discourages wasteful water use.

Typically, inclining block rate or seasonal pricing encourages efficient water usage. Inclining block rate structures have been effective in promoting reduced water consumption in many municipalities where universal metering has been implemented. According to the USEPA Water Conservation Plan Guidelines (August 1998), pricing and rate structures can result in water use reductions of 2 to 8%. An increasing block-rate structure can result in water use reductions of 5%.

The District does not currently have a volumetric pricing structure to encourage water conservation written in its bylaw. This measure would only be applicable to those properties that are metered. The District charged unmetered residents in single family homes a flat annual rate of $319.15 in 2013. Metered customers who were charged the metered rate in 2013 were charged a meter rent charge, and $1.50 per 100 cubic feet of water.

A small portion of the customers with metered service connections are billed according to their water usage, while the majority of these customers are charged a flat rate that is based on the Water Rates Bylaw (Bylaw No.676)

A recent 2013 water rate structure review carried out by the District was initiated as a response to public concerns around billing inequalities. While meters are currently being read, a metered water rate charge is not charged for most customers. The water rate challenges are compounded by the recent large (necessary) water rate increases which have been initiated in the last four years from recommendations in the District's Asset Management Plan.

Since the District does not meter all of its water customers, conservation based pricing and rate structure adjustments cannot be effectively carried out at this time. A robust water consumption dataset should be constructed to inform the development of the conservation based pricing.

When sufficient data is compiled inclining vs declining block structures should be looked into as they apply for the different customer groups. Declining block structures are most appropriate for residential customers whereas inclining block structures are for the ICI customer group. These and other volumetric pricing strategies should be reviewed at a later date as the ICI & MF metering program becomes established or when universal metering is considered.

RECOMMENDATION:

A robust water consumption dataset is required to progress this strategy further.

Volumetric pricing strategies should thus be reviewed at a later date. This may be considered once the ICI & MF metering program has been established for a few years and there is confidence in the dataset produced or when universal metering is considered.

6.3 Network and Customer Demand Tools

Customer and network demand tools address customer behaviours and losses through the water distribution network up to and including the point of consumption (i.e. the home or business). Customer behaviours are targeted by home or business water use audits, rainwater harvesting, water

efficient landscaping, and rebate programs. Network losses are targeted by system water audits, leak detection and repair programs, and pressure management.

Many of these tools may require up-front expenditures to both the water utility and the customer for their design, implementation, and servicing. Another obstacle to implementation of these tools is the degree of technical knowledge required.

6.3.1 Network Water Loss Management

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. 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 failure modes. The problems associated with ageing facilities and deteriorating system components are part of the growing infrastructure problem faced by most utilities.

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 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 two general components to water loss management; water audits and a leak detection and repair program.

6.3.1.1 Water System Metering & Audits

A water audit is a process to measure consumption and losses in a system. A water audit enables the District to determine the water supplied, consumed, and lost in the distribution system. It also allows the District 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
- Storage Reservoir Overflows

By reducing real losses, there is a direct conservation benefit. Every amount of reduced leakage is that same amount of water that does not need to be supplied by the source. A base level of information about the system is required to carry out a water audit. This may require installation of flow meters and other infrastructure in order to generate meaningful results.

Within the scope of its Water Loss Management program, the District has installed five District meters throughout its water network. These and additional meters will enable the District to complete water system audits on a periodic basis.

RECOMMENDATION:

The installation of district meters and the water audits carried out under the Water Loss Management program should be supported by and included in the District's WCP.

Water audits improve the utility's knowledge of the water supply infrastructure which can lead to significant reductions in demand by enabling the identification of leaks and allow the utility to monitor the efficacy of other water conservation programs. Beyond the initial costs of putting the required metering infrastructure in the network, costs for carrying out audits are generally low.

6.3.1.2 Leak Detection and Repair Program

A leak detection and repair program should be considered by utilities 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 and review reservoir overflow levels. They also include metering or estimating municipal uses such as main flushing, street washing, and firefighting. Information from the water audit is also an input.

Leak detection equipment was purchased during the development of the Water Loss Management program and staff received two days of equipment training. The system is not routinely inspected for leaks; the District currently is not following a proactive leak detection program. Staff currently use the equipment to identify the exact location of leaks upon receipt of service requests.

RECOMMENDATION:

The leak detection program currently carried under the Water Loss Management program should be expanded to periodically inspect high risk areas identified in the AMP and the District's WMP.

Implementing a program increases knowledge about the water supply infrastructure, and has a significant effect on water demand. The first steps in a leak detection program are relatively easy, inexpensive to implement, and have already been carried out by the District.

6.3.1.3 Pressure Management

This conservation strategy is designed to reduce the amount of leakage and water lost in the distribution system. During low consumption periods (i.e.: night-time flows) the distribution system is subjected to higher pressures than during the daytime. A pressure management strategy will use PRV stations to reduce pressure in the system during periods of low demand. Lower pressures reduce the amount of background leakage. Reduced pressures may also extend the life of existing water system infrastructure.

Implementing a pressure management system is most cost-effective where pressure zones are only supplied by PRVs and the elevation change across a pressure zone is relatively minor. This strategy has been implemented by municipalities throughout the B.C. with some success. Reducing pressure in residential areas can result in gross water use reductions of 3 to 6%.

While the valley area of the District is ideal for implementing pressure management, the characteristic of the Squamish River zone which may hold back the District from implementing pressure management within it is the fact that the elevation change across the zone is large when properties in the Garibaldi Estates area are considered. Options to transfer these properties along Garibaldi Estates to the Boulevard zone may provide the District with the ability to implement pressure management to the Squamish River zone. However, the implications and feasibility of transferring properties to the Boulevard zone and other pressure management opportunities have not been reviewed at this time.

The opportunity described was identified, through a cursory desktop study, as a possible quick win for the District. It appears to offer the highest return as it is the largest zone but this should be investigated further in the District's next Water Master Plan in 5 – 10 years.

RECOMMENDATION:

Pressure management should not be included in the District's WCP at this time.

While the valley area of the District is ideal for implementing pressure management, there are Squamish River zone characteristics which may hold back the District from implementing pressure management. The implications and feasibility of this measure should be assessed at a later date.

6.3.2 Customer Water Audits

6.3.2.1 ICI Water Audits

This conservation strategy involves hiring a trained water auditor to advise business owners on how to reduce water usage. 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.

The City of Abbotsford hired two external firms to conduct water audits of the large industrial customers served by the water utility. Through this pilot project between 20 and 25 industrial customers were audited. According to the Abbotsford experience the audit of industrial facilities is best inspected by technologists or engineers but smaller institutional or commercial businesses, even strip malls, can be adequately audited by trained students.

According to USEPA Water Conservation Plan Guidelines (August 1998), general industrial water use audits can result in water use reductions of 10 to 20%.

The District will be implementing ICI and Multi-Family (MF) metering in the early stages of its first WCP. Conducting ICI water audits in conjunction with the implementation of the metering program can facilitate the transition of this customer base from unmetered to metered utility billing.

RECOMMENDATION:

ICI Water Audits should be included in the District's WCP. If the timing of the program is optimized, it can facilitate the transition of this customer group from a flat charge water rate to a metered rate. The cost of the audit should be covered by the District at no cost to these customers as they will be covering the value of the meter.

Most of the District's largest water users are from the ICI customer category. This water conservation measure can produce a significant effect on water demands by targeting the high water use customer group whose consumption does not vary seasonally.

6.3.2.2 Residential Water Audits

This conservation strategy includes hiring a trained water auditor to advise residents most importantly about adjustments to irrigation practices/systems to save water. Residential water audits can reduce both indoor and outdoor water usage. A typical residential water audit includes a review of the residential water use pattern and billing (if applicable), leak checks of the water connection (with the help of a water meter or sounding tool), leak checks of toilets, and outdoor landscape and sprinkler assessments.

Water audits have been offered free of charge in the City of Richmond. They were used by its water utility as an incentive within the universal metering program launch. The City of Abbotsford also does residential audits with a focus on the irrigation water use practices and systems of this customer group. This program has been in place for the past three years and approximately 100 audits have been completed. The measured savings were significant at 0.27ML/day in 2013. Most peak water savings achieved across the Abbotsford water utility that year stemmed from this program.

The Abbotsford experience indicates that this program can be completed with the hire of summer students who should work in teams of two for security reasons. The students hired by Abbotsford were trained by a consultant and the Irrigation Association of BC. Abbotsford will be implementing an application to automate the production of water audit reports which are otherwise a time consuming task.

According to USEPA Water Conservation Plan Guidelines (August 1998), outdoor residential water use audits can result in water use reductions of 5 to 10%.

The cost and effort to have auditors visit every resident is high. For this program to result in significant reductions in demands, it requires residents to act on the advice provided by the auditors. It would nonetheless significantly increase awareness around water conservation practices.

The District will be implementing ICI and MF metering in the early stages of its first WCP. Conducting MF water audits in conjunction with the implementation of the metering program can facilitate the

transition of this customer base from unmetered to metered utility billing. Water audits of single family residential units should be considered at a later date when universal metering is implemented. This program, if offered free of charge to customers, can be used as an incentive for the change in billing methods.

RECOMMENDATION:

Residential Water Audits of Multi-Family customers should be included in the District's WCP. If the timing of the program is optimized, it can facilitate the transition of this customer group from a flat charge water rate to a metered rate. The cost of the audit should be covered by the District at no cost to these customers as they will be covering the value of the meter.

Water audits of single family residential units should be considered at a later date when universal metering is implemented.

6.3.2.3 Large Landscape Water Audits

This conservation strategy involves hiring a trained water auditor to advise customers of adjustments to irrigation practices/systems to save water. This measure targets high outdoor water users in the ICI customer group. A trained irrigation auditor evaluates the water use efficiency of irrigation systems and evaluates conservation measures, e.g. irrigation scheduling, efficient irrigation systems, Xeriscaping.

According to USEPA Water Conservation Plan Guidelines (August 1998), large landscape water use audits can result in water use reductions of 10 to 20%.

RECOMMENDATION:

Landscape water audits should not be included in the District's WCP.

There are no large irrigation users in the District that warrant a dedicated program. The primary irrigation schemes are the District's sports fields which are serviced by a system separate to the potable water distribution network. This separate system is fed by shallow groundwater wells.

6.3.3 Rebate Programs

There is a gradual increase of water efficient technologies being installed in homes and businesses as water conservation is promoted through public education programs and development bylaws. Rebate programs are tools which tend to increase the uptake of these technologies into homes and businesses in a short amount of time.

This conservation strategy provides utility customers with a financial incentive (e.g. low interest forgivable loans, tax credits, rebates and buy-backs of inefficient devices) to install water efficient devices. It helps to create awareness and motivation for water conservation. Incentives may offer a subsidy to the utility customer that helps cover the cost difference between purchasing a standard

water use appliance compared to a new lower water use appliance. It can thus stimulate replacement of old appliances in advance of their failure.

Devices and means that can be accounted for in rebate programs include the following:

- Retrofit kits
- Ultra low flush toilets
- Rain barrels (discussed further in 6.5.1)
- Grants for community xeriscaping
- High efficiency appliances (washing machines and dishwashers)

This strategy has been implemented by municipalities throughout the province of British Columbia with varying degrees of success. Rebate programs require a high level of uptake from the community for water demand to reduce by any noticeable amount. They can be very expensive for the municipality, as the value of the rebate given often exceeds the change in water demand achieved.

Rebate programs are more effective where the reduction in water demand has a direct effect on homeowners' water usage fees, for example, in areas where universal residential metering is in place. However, rebate programs are useful as an educational tool for indoor water conservation within the home. The SCRD implemented a low flush toilet and showerhead rebate program. They estimated that it had costed $2 million over the 2006 to 2011 period and that it led to a 411 m^3/day reduction in ADD (less than 1%).

For a utility like the District's, where there is no universal water metering combined with a volumetric water rate structure that encourages water conservation, there is little incentive for utility customers to take advantage of rebate programs. As the District expands the reach of its education program, the atmosphere will be much more conducive to the use of such rebates. The strategy should be reviewed at a later date when universal metering and volumetric pricing are being implemented.

RECOMMENDATION:

Rebate programs should not be considered for inclusion in the District's WCP. They are costly to implement, require a high level of community support, universal metering, and do not guarantee a significant reduction in water demands.

The program should be considered upon the implementation of universal metering a water rate structure that encourages conservation. It could be combined with the Water Audit programs as a means to assist utility customers in addressing the water audit findings.

6.4 Educational and Outreach Programs

6.4.1 Public Education

Information and education tools are used to encourage water conservation. These strategies are based on an assumption that personal actions are influenced by awareness and understanding. An essential

part of any water conservation program is a robust communication strategy that makes utility customers aware of the reasons for water conservation and the part they play.

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 and take conscious ownership of their water related actions. 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. It is an integral 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 District is engaged in the distribution of educational pamphlets, brochures, fridge magnets, news releases, and Frisbees and it makes water conservation information available on its website. It has also participated in community events and used these as a platform to promote the outdoor water use bylaw. The District should continue its current public education initiatives and incorporate relevant elements of the other water conservation programs rolled out within the WCP.

RECOMMENDATION:

Public Education campaigns should be further considered for inclusion in the District WCP.

Increasing awareness about water conservation is important in the long term and it supports many of the other water conservation programs identified in the WCP.

6.5 Partnership and Collaboration Initiatives

The District's water conservation officer has formally and informally partnered with stakeholders including the Fire Department, Development Services Department, irrigation companies, the School District, and the Climate Action Network (CAN) to promote water conservation. Most of the partnerships are informal and currently relate to the enforcement of the outdoor water use by-law. The partnership established with CAN is discussed here.

6.5.1 CAN & Rain Barrel Workshop

Rainwater harvesting with the use of rain barrels has the potential of curbing water consumption and mitigating stormwater flows. Depending on precipitation distribution and end use statistics, rainwater harvesting programs such as rain barrel rebate programs can be an effective tool to reduce the uses of potable water for household garden irrigation.

Delta, B.C., implemented a rain barrel rebate program which resulted in water savings difficult to quantify. Though Delta's program did have an outreach and education impact within the community. Other communities have achieved nominal success with low uptake of their rain barrel rebate program.

As the success of the program is dependent on the number of voluntary participants, the potential water reduction in terms of average and maximum day demand reduction for the District is difficult to quantify. It is the outreach through workshops for example that can lead to changes in customer behaviour.

The CAN is currently developing a workshop on how to build a rain barrel. The Water Conservation Officer has been approached about supporting this initiative through workshop promotion. This initiative should be encompassed within the broader public education program.

RECOMMENDATION:

Formal endorsements of such education programs that help the District meet its strategic goals should be included in the WCP. They should be highlighted as they foster community engagement/buy-in and recognise efforts made by local change agents.

7 Water Conservation Plan

7.1 Selected Water Conservation Programs

In keeping with the water conservation goals previously stated in Section 4.2 the following seven programs were selected for the District of Squamish's Water Conservation Plan.

Table 7.1: Water Conservation Plan Programs

Water Conservation Program	Program Recommendation Statement
Outdoor Water Use Bylaw Enforcement	The District's four stages of water restrictions in the Water Use Bylaw and Schedule U of the "*District of Squamish Municipal Ticket Information Bylaw No. 1832, 2004*" do not require amendments. Their structure is in keeping with other BC utilities. The fines associated with the offences listed in Schedule U act as a deterrent, however the effectiveness of these bylaws would be enhanced by stricter enforcement. The District should maintain the water conservation officer position created in 2013 and assign bylaw enforcement responsibilities to the role. Though this person may not give out fines, this person is best suited to assist bylaw officers with the enforcement of the Water Use Bylaw by patrolling the community from May to September. The water conservation officer should: - identify and record households that are in violation of the bylaw, - give notices of infractions whilst educating the public on the bylaw and water conservation measures they can take to comply, and - inform bylaw officers of repeat offenders that are to be fined. In order to enact this project the District needs to establish: - the number of notices bylaw offenders can be given prior to a fine, and - working alone procedures that ensure the safety of the water conservation officer when for example he or she is notifying customers of a non-compliance. The cost of these two actions are nominal and can be completed in house.

Water Conservation Program	Program Recommendation Statement
Customer Water Audits	A trained water auditor should be made available to customers who seek professional advice on their water use patterns and assistance in identifying water losses. During the first years of this program access to the water auditor should be prioritised for the MF and ICI customers (light industrial, commercial, and institutional) as they will be impacted by the metering program. A water audit can facilitate the transition of this customer base from unmetered to metered utility billing. The District should maintain the water conservation officer position created in 2013 as this person is well suited for carrying out the majority of water audits. Complex audits, such as those of industrial processing facilities, warrant the employ of an engineer and should be dealt with on a case by case basis. To balance the workload of the water conservation officer across the calendar year the water audit service should be offered during a small period outside of the summer months. In order to enact this project the District needs to establish: - a standard water audit form, procedure, and report, and - working alone procedures that ensure the safety of the water conservation officer when for example he or she completing an audit. The cost of these two actions are nominal and can be completed in-house by the water conservation officer. In the development process the officer can draw on the experience of nearby municipalities such as the City of Richmond and the City of Abbotsford.
Building Bylaw Amendments (1): Low Flow Fixtures	Modification to the existing building construction bylaws and permits that enforce use of low-flow fixtures in new construction or major rehabilitation projects should be completed. This low cost measure supports efforts already underway in the District as well as statements in the District's OCP and Annual Report. It can be completed by District staff. The cost of this program is nominal as it is expected to require a small amount of the Development Services department and the water conservation officer's time. As required, District staff can refer to the requirement for low-flow fixtures written into bylaws by other BC Municipalities. They can also refer to the B.C. Building Code through which the Province has mandated the use of ultra-low-flow toilets (6.0 L/flush) and other water-saving plumbing fixtures and fittings in new construction and renovations.
Building Bylaw Amendments (2): Xeriscaping	Modification to the existing building construction bylaws and permits to include a policy on xeriscaping should be completed. This low cost measure supports efforts already underway in the District as well as statements in the District's OCP and Annual Report. It can be completed by District staff. The cost of this program is nominal as it is expected to require a small amount of the Development Services department and the water conservation officer's time. Additional efforts invested in xeriscaping by the District should be otherwise limited. Xeriscaping does not typically provide much financial incentive to homeowners until universal metering is implemented. Therefore programs that encourage the use of water efficient landscapes and promote the xeriscaping policy are a subsequent step that should be considered at a later date.

Water Conservation Program	Program Recommendation Statement
Water Loss Management Program	The District is growing its capacity to locally and broadly manage the losses across its network. The District purchased leak detection equipment during the development of the Water Loss Management program and staff received two days of equipment training. Staff currently use the equipment to identify the exact location of leaks upon receipt of service requests. This practice is good though the use of the equipment should be expanded to complete periodic inspections of high risk areas of the network identified in the AMP and included in the District's WMP. This task will not require additional field staff time since existing resources can be diverted to complete it as and when needed. At a high level, only ten district meters are left to install between the network's pressure zones to have the entire network covered. Once this telemetry infrastructure is providing the necessary data, audits to determine network losses can be completed with much more ease and accuracy by District staff as and when needed. This data will also facilitate the occasional production of comprehensive engineering studies. The activities and programs that will be completed under the umbrella Water Loss Management Program are a means by which the District puts in practice its commitment to water conservation. Though the cost of the district meters, network water audits, and leak detection activities are budgeted separately from the water conservation plan, the benefits of these programs should be communicated to the community in the water conservation messaging.
Public Education Campaigns	The collaboration between the water conservation officer, the District's communications team, and the graphics manager to manage the communication strategy and educational material should continue. The outcome of their previous work broadened the Water Education Plan's reach and increased the quality of the targeted messages to the community. The District's current public education initiatives should be updated to incorporate elements of the water conservation programs into the messaging. The cost of this program is nominal as it can be completed internally on an ongoing basis. It will require District's staff time to maintain previously prepared communication materials and create new materials related to ongoing water conservation issues such as water audits and increased enforcement of the Outdoor Water Use Bylaw.
Endorsement of Local Initiatives	The District should continue to formally endorse water conservation programs prepared and delivered by stakeholders that align with the District's strategic goals. These local initiatives foster community engagement/buy-in for water conservation by recognising efforts made by local change agents. Endorsement of local initiatives, such as the Rain Barrel Workshop prepared by CAN, can be promoted at a nominal cost within the umbrella Public Education Campaigns program.

These programs will lay the foundation for the District to meet its water conservation target of an average day demand of 479 (L/capita/day) and a maximum day demand of 723 (L/capita/day) by 2031. The highest impact will be achieved in the short term by the Outdoor Water Use Bylaw enforcement. As this program is rolled out in the summer months and targets irrigation it will influence the MDD and consequently the ADD as well.

The full impact of the bylaw amendments, customer water audits, the education campaigns, and the support of local initiatives will take longer to be achieved and will be relatively smaller in scale. These programs remain nonetheless important. They develop the conservation ethic across the municipality which bolsters buy-in for future conservation programs that will have more bearing on customers.

The Water Loss Program is a means by which the District puts into practice its commitment to water conservation by targeting network losses. It has the added value of providing valuable data that can improve monitoring of the network's operation.

7.2 Proposed Implementation Schedule & Budget

The following five year plan outlines the short term implementation schedule and budget for the selected Water Conservation Programs. The annual costs included in the budget table pertain to the salary of the water conservation officer ($66,000), split between the three most time consuming programs, and an allocation for the cost of producing communication materials and publishing in local media venues ($2,000). Costs that are already incurred by the District such as the Water Loss Management Program, which is covered in utility operations, and the vehicle charges related to the water conservation officer's activities were not included in the plan.

Table 7.2: Water Conservation Plan Schedule and Budget

Water Conservation Program	Annual Cost	2015	2016	2017	2018	2019
Outdoor Water Use Bylaw Enforcement	$33,000	✓	✓	✓	✓	✓
Customer Water Audits	$16,500		✓	✓	✓	✓
Building Bylaw Amendments (1): Low Flow Fixtures	Nominal	✓				
Building Bylaw Amendments (2): Xeriscaping	Nominal	✓				
Water Loss Management Program Initiatives - Installation of district (zone) meters and completion of network water audits. - Continuation of leak detection program.	 - Utility O&M - Nominal	 ✓ ✓	 ✓	 ✓	 ✓ ✓	 ✓
Public Education Campaigns	$18,500	✓	✓	✓	✓	✓
Endorsement of Local Initiatives	Nominal	✓	✓	✓	✓	✓

The majority of the programs will occur on an ongoing basis as they should eventually become an integral part of utility management. Only the Bylaw Amendments are a one-time occurrence. Implementation of the Building Bylaw will fall under the responsibility of Development Services through the building inspection program it oversees. The implementation of the Customer Water audits was scheduled to coincide with the ICI and MF metering program that will commence in 2016.

This schedule of costs was incorporated in the financial analysis completed as part of the Water Master Plan.

7.3 Monitoring Demand Trends

Although not a program in and of itself the practice of monitoring system demands, as they are recorded at the well site through SCADA, should be carried out. The analysis of demand trends in

relation to water conservation programs, the Outdoor Water Use Bylaw Enforcement program in particular, should be periodically completed by the water conservation officer in collaboration with utility staff. This trend analysis will serve to verify the efficacy of the District's water conservation programs in decreasing demand towards the previously stated water conservation target.

8 Additional Recommendations

Activities that do not relate to the current Water Conservation Plan but that will inform revisions of the WCP in years to come were identified in the process of writing this document. These are as follows:

- Improve service connection dataset: This is a task that was previously identified in the District Asset Management Plan. One of the values of an increase in the accuracy of this dataset, as it pertains to the WCP, is that it will improve the quality of future feasibility assessments of universal metering programs.
- Collection and storage of consumption data: This data is necessary to any water rate restructuring analysis which would investigate the possibility of implementing for example inclining or declining block rate structures. The quality of the data produced through the ICI and MF metering program should be verified and assured.

APPENDIX A

Your hose draws from our drinking water supply.

Please reduce consumption.

While you were out, the Water Conservation Educator called at your address at _____a.m. /p.m. Date_____

- ☐ To advise you that we are in Stage 1, Stage 2, Stage 3 of the Outdoor Water Use Bylaw.
- ☐ It appears that your outdoor water use may not be in compliance with the current water restrictions.
- ☐ We received a call from you neighbourhood about your outdoor water use.
- ☐ To thank you for conserving water.

_____

_____

_____

_____

_____

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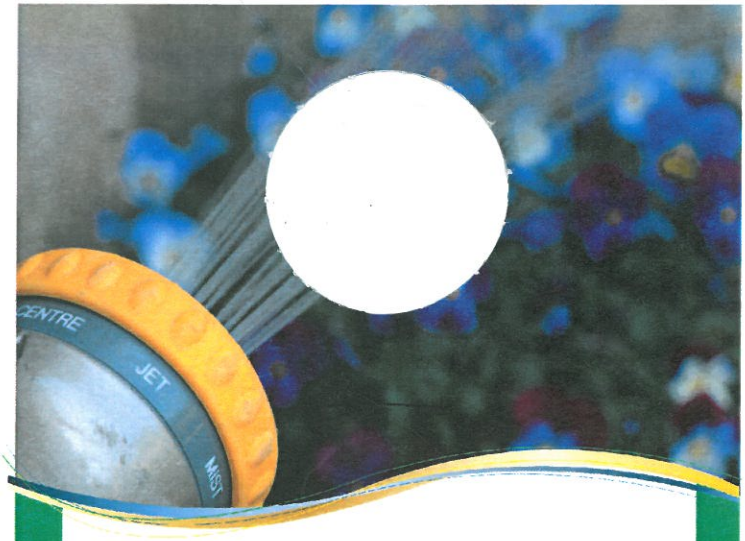
To learn more about the Outdoor Water Use Bylaw or stage change notifications: s**quamish.ca/water**
Facebook.com/districtofsquamish
Twitter:@squamishtown

SQUAMISH



We are in STAGE 2 of the Outdoor Water Use Bylaw

Stage 2 divides the community into seven areas, and provides each area with **ONE** day upon which they can water with a sprinkler:

Monday	Valleycliffe, Hospital Hill
Tuesday	Downtown
Wednesday	Dentville, Business Park, North Yards
Thursday	Loggers Lane, Quest University
Friday	Garibaldi Highlands
Saturday	Garibaldi Estates
Sunday	Brackendale

Even numbered addresses:
6 a.m. to 9 a.m.

Odd numbered addresses:
7 p.m. to 10 p.m.

Exterior washing
A person must not use District water to wash a sidewalk, driveway, parking lot, exterior window or exterior building surfaces, except as necessary to apply paint, preservative, stucco or similar product; or prepare a surface prior to paving or repointing bricks; or to comply with an enactment for health and safety or as otherwise required by law.

Please conserve water.

How to work within the Outdoor Water Use Bylaw

ACTIVITY	METHOD	STAGE 2
Lawns	Sprinkler	One day/week based on Water Conservation Map. Even # address: 6-9 am Odd # address: 7-10 pm
	In-ground	Allowed between 10 pm and 4 am on the days established for Stage 2
Trees, Flowers & shrubs	Sprinkler	One day/week based on Water Conservation Map. Even # address: 6-9 am Odd # address: 7-10 pm
	hand-held container or a hose with an automatic shut-off device	On any day between 6-9 am and 7-10 pm.
	Micro or drip irrigation	On any day and at any time.
	In-ground irrigation	Allowed between 10 pm and 4 am on the days established for Stage 2.
Vegetables	Sprinkler	Allowed on any day, regardless of address between 6-9 am and 7-10 pm
	hand-held container or a hose with an automatic shut-off device	On any day and at any time.
	Micro or drip irrigation	On any day and at any time.
	In-ground irrigation	Allowed between 10 pm and 4 am on the days established for Stage 2.
Washing vehicles or boats	hand-held container or a hose with an automatic shut-off device	Allowed

Questions? 604.815.6868
Please report violations to bylaw: 604.815.5067

Visit squamish.ca/water
for the full bylaw and stage change notifications.

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