The Corporation of the City of Grand Forks

Water Conservation Plan

Final Report
April 2010

KERR WOOD LEIDAL
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CONSULTING ENGINEERS

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KWL File No. 147.130

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Section 1

Introduction

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1. INTRODUCTION

1.1 BACKGROUND

The Corporation of the City of Grand Forks (City) has been awarded funding from the Province of British Columbia's Municipal Rural Infrastructure Fund for the replacement of the Park Lift Station. As part of the funding agreement the City of Grand Forks is required to complete an up-to-date council endorsed water conservation plan.

This report is intended to meet the requirements of the funding agreement as well as provide the City with a water conservation plan that will meet the City's needs.

1.2 BACKGROUND REPORTS

The following background reports and information were reviewed as part of this study:

1. *City of Grand Forks Drought Management & Conservation Plan*, Dobson Engineering Ltd, February 2005.

2. *Waterworks Regulation Bylaw No. 1501*, The Corporation of the City of Grand Forks, 1997.

3. *2007 Municipal Water Use Report - 2004 Statistics*, Environment Canada, April 2007.

4. *Residential End Uses of Water*, AWWA Research Foundation, 1999.

5. *Handbook of Water Use and Conservation*, Amy Vickers, May 2001.

6. *Thinking Beyond Pipes and Pumps – 10 Ways Communities Can Save Water and Money*, Brandes et al, University of Victoria, October 2006.

7. *Water and Energy Savings from High Efficiency Fixtures and Appliances in Single Family Homes – Volume 1, US EPA*, March 2005.

8. *Leak Detection Reports for the City of Grand Forks*, completed by Teale's Water Utility Services Ltd, August 2006.

1.3 ABBREVIATIONS AND DEFINITIONS

Base Demand	The base water usage (indoor usage). Typically occurs during the winter months.
Summer Demand	Base demand plus irrigation usage, as recorded in the summer.
Seasonal Demand	The summer usage less the base demand. Volume of water utilized for irrigation.
ICI	Industrial, commercial, institutional and multi-family customers
UFW	Unaccounted for water

1.4 CURRENT WATER CONSERVATION MEASURES

The City has currently implemented a universal water metering program for the multi-family, industrial, commercial, institutional (ICI) sectors, bylaws 1673 and 1822. Meter readings are completed on a bi-monthly basis and are billed on a declining block volume basis according to Bylaw 1501 water rates.

Grand Forks also has adopted water restrictions in Bylaw 1832. In 2009, the bylaw restricted houses with even house numbers to watering on even days, and odd numbered house numbers to water on odd days between approved times. Currently no bylaw enforcement has been undertaken and the degree of compliance is unknown.

1.5 CURRENT WATER RATES

The City's current water rates are included in Appendix A.

Non-metered customers are charged a fixed capital charge ($37.50 for residential properties) customer charge ($7 for residential properties) and a variable water charge ($10.75 for residential property) on a bi-monthly basis. Metered customers are also charged a fixed capital charge and customer charge, plus a declining block volume based rate ($0.04 to $0.10/$m^3$ at lowest block rate).

The metered water rate blocks increase in steps of 40,000 m^3 per bi-monthly period, (i.e. 0 to 40,000 m^3/period, 40,001 to 80,000 m^3/period). It should be noted that for the 2008 and 2009 billing periods the lowest rate block was only surpassed by one customer.

1.6 ACKNOWLEDGEMENTS

The staff at the Corporation of the City of Grand Forks were vital to the completion of this report, in particular:

- Sasha Bird, AScT – Manager of Technical Services; and
- Mike Irmie - Operations and Maintenance.

Section 2

Existing Water Demands

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2. EXISTING WATER DEMANDS

This section provides a summary of the City's current water usage.

2.1 WATER SUPPLY

Water is supplied to the City's water distribution system from five wells: Well 2, Well 3A, Well 3, Well 4, and Well 5. The annual volume of water pumped from each well, is summarized in the table below.

Table 2-1: Summary of Source Well Pump Volumes

Well	Pumped Volume (m^3/yr)				
	2005	2006	2007	2008	2009
Well 2	440,118	494,831	266,916	227,496	319,462
Well 3A	740,657	616,270	500,923	225,882	444,995
Well 3	74,005	846,736	908,522	398,086	503,247
Well 4	502,946	1,306,089	978,841	179,492	217,564
Well 5	822,043	248,538	517,264	749,228	374,590
Total	**2,579,769**	**3,512,464**	**3,172,466**	**1,780,184**	**1,859,858**

Source: The Corporation of the City of Grand Forks

The recorded volume of water pumped from the wells dropped significantly in 2008. From discussion with the City's operations and maintenance staff the reduction is likely due to the calibration of the source flow meters, universal metering of the ICI sector, and the closing of the Canpar Industries door core manufacturing plant.

The per capita total daily average water usage for the City was calculated from the source water usage, and is summarized below.

Table 2-2: Summary of per capita Annual Water Usage

	Year				
	2005	2006	2007	2008	2009
Total Water Pumped[(1)] (m^3/yr)	2,579,769	3,512,464	3,172,466	1,780,184	1,859,858
Population[(2)]	4,085	4,059	4,005	4,126	4,126
Total Average Daily Usage (L/ca/day)	1,730.2	2,370.8	2,170.2	1,178.8	1,235.0

Sources:
1. The Corporation of the City of Grand Forks – Water Usage.
2. BC Statistics Community Facts for Grand Forks – Population.

The max day demand (MDD) for the City is summarized in the table below.

Table 2-3: Summary of Max Day Demand (MDD)

	Year				
	2005	**2006**	**2007**	**2008**	**2009**
Max Day Demand[1] (m^3/day)	21,986	19,794	17,912	14,373	14,264
Population[2]	4,085	4,059	4,005	4,126	4,126
Max Day Demand (L/ca/day)	5,382.1	4,876.6	4,472.4	3,483.5	3,457.1

Sources:
1. The Corporation of the City of Grand Forks – Water Usage.
2. BC Statistics Community Facts for Grand Forks – Population.

2.2 ICI USAGE

Currently the City supplies three large industrial customers and 194 multi-family, commercial, institutional clients with water. All customers are metered, and are billed on a bi-monthly basis. A summary of the ICI usage for 2008 and 2009 is presented in the table below.

Table 2-4: Summary of Grand Forks ICI Usage

Date Range	**ICI Usage (m^3)**	
	2008	**2009**
Jan. to Mar.	77,889	62,953
April to Jun.	121,305	122,520
Jul. to Sept.	84,711	100,950
Oct. to Dec.	159,078	125,787
Total (m^3/year)	**442,983**	**412,210**
Total (m^3/day)	**1,210**	**1,129**

Source: The Corporation of the City of Grand Forks

Note: ***** Based on Statistics Canada 2008 projection population of 4,129.

According to City staff, some water connections to the large industrial clients may not be metered. If this is the case, service connections that are not metered should be retrofitted with meters.

Typically, ICI usage is reasonably consistent throughout the year, but as seen in the table above the ICI usage tends to be higher in the April to June and October to December time periods.

2.3 NON-METERED USAGE

Residential customers in Grand Forks are not metered. The non-metered usage (primarily residential) is estimated to be the total volume of water pumped from the wells

less the metered ICI usage. The estimated per capita non-metered water demands are summarized in the table below.

Table 2-5: Summary of Grand Forks Non-metered Usage

Date Range	Non-metered Usage			
	2008		2009	
	(m^3/day)	(L/ca/day)	(m^3/day)	(L/ca/day)
Jan. to Mar.	2,209	535	2,557	620
Apr. to Jun.	3,752	909	5,294	1283
Jul. to Sept.	7,123	1726	7,240	1755
Oct. to Dec.	1,515	367	757	183*
Average	**3,654**	**885**	**3,966**	**961**
Base Demand	**1,860**	**451**	**1,647**	**399**
Average Summer Usage (July to Sept)	**7,123**	**1,726**	**7,240**	**1,755**
Average Seasonal Demand (July to Sept)	**5,263**	**1,275**	**5,593**	**1,356**
Note: *Data for December 2009 was incomplete.				

As seen in the table above the water usage is higher in the summer months than in the winter months. The summer usage less the base demand is called the seasonal demand and is the volume of water used for irrigation, and other summer demands (i.e. pools, water parks).

UNACCOUNTED FOR WATER (UFW)

Unaccounted for water (UFW) can be the result of leakage from the City owned distribution main and infrastructure, or from residential properties (indoor leakage, service connection leakage) or both. Other sources of UFW are: construction uses, fire demands and water main flushing. At this time the volume of UFW is unknown, and has not been separated from the non-metered usage.

Based on typical residential usages, UFW could account for up to 19% of the average day demand. To determine the actual volume of UFW, a water audit can be completed. A discussion on the potential water audit program is available in Section 4.4.

RESIDENTIAL USAGE

To estimate the residential usage, the UFW was assumed to be 10% of the average day demand. The breakdown of water usage for the different customer classes is summarized in the table below.

Table 2-6: Summary of Water Usage for Different Customer Classes

Date Range	Total (m^3/day)	ICI (m^3/day)	UFW* (m^3/day)	Residential Usage (m^3/day)	Residential Usage (L/ca/day)
Jan. to Mar.	3065	856	486	1723	418
Apr. to Jun.	5085	1333	486	3266	792
Jul. to Sept.	8044	921	486	6637	1608
Oct. to Dec.	3244	1729	486	1029	249
Average	**4864**	**1210**	**486**	**3167**	**768**
Base Demand	**3155**	**1295**	**486**	**1374**	**333**
Average Summer Usage (July to Sept)	**8044**	**921**	**486**	**6637**	**1608**
Average Seasonal Demand (July to Sept)	**4889**		**0**	**5263**	**1275**

Notes:
*Based on UFW of 10% of average day demand
2008 data was used to calculate the residential usage, because the 2009 data was incomplete for December

The estimated residential base demand corresponds to the residential indoor usage.

Section 3

Typical Water Usage

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3. TYPICAL WATER USAGE

Typical water usage in Canada varies from province to province and by municipality size. A summary of the relevant typical water usages are summarized in the table below.

Table 3-1: Typical Average Day Flows

	Average Daily Flows (L/ca/day)		
	Total	**Residential**	**Residential Indoor Usage**
Typical Water Usage			
Canada	609 (1)	329 (1)	264(2)
B.C.	646 (1)	426(1)	
Municipality with a population of 2,000 to 5,000	946 (1)	497(1)	
Grand Forks Water Usage			
2008	1,178	768*	333*

Sources:
1. 2007 Municipal Water Use Report.
2. Residential End Uses of Water, AWWA Research Foundation, 1999.

Note: * Estimate, based on UFW of 10% of average day demand

As seen in the table above, the 2008 water usage in the Grand Forks is higher than the typical water usages in Canada, B.C. and in municipalities of a similar size. The average daily flows could be higher, due to high seasonal demands (irrigation demands), high UFW (leakage), or high water use.

From discussions with the City's operation and maintenance staff summer irrigation demands may be high due to the flood irrigation method used by some of the residential customers to water their lawns. Flood irrigation has a potential efficiency of 40-50%, where sprinklers have a potential efficiency of 60-85%[1]. Which means that to achieve the same amount of irrigation, flood irrigation will require 1.6 times more water than a properly used sprinkler.

Seasonal demand could also be higher in Grand Forks due to the typically large lot sizes. It is estimated that each lot has approximately 600 m^2 or more of irrigable area (lawn area), which can require up to 2,800 L/dwelling/day (1,150 L/ca/day) to irrigate lawns, based on an evapotranspiration rate of 3.3 mm/day and a irrigation efficiency of 70%.

UFW (leakage) may be high within the City due to:

- the climate in Grand Forks may require customers to bleed pipes during the winter months in order to prevent pipes from freezing;

[1] *Handbook of Water Use and Conservation*, Amy Vickers, April 2001.

- leakage from City owned distribution main and infrastructure, which can not be easily tracked due to ground conditions; or
- leaks from residential properties, which are not normally corrected due to lack of incentives for the home owner.

High water usage within the City, in particular high residential usage, could be a contributing factor in the higher than normal average daily demands.

Table 3-2, below summarizes typical indoor household usage as published by AWWA Research Foundation, Residential End Uses of Water Report.

Table 3-2: Typical Water Usage for Indoor Fixtures

Usage	Residential Indoor Usage
	Typical Usage (L/ca/day)
Toilets	66.9
Clothes Washer	56.8
Showers	49.2
Faucets	41.3
Baths	4.5
Dishwasher	3.8
Other Indoor Use	6.0
Leaks	35.9
Base Demand	264.4

Source:
Residential End Uses of Water, AWWA Research Foundation, 1999

As seen in the table above the typical indoor residential usage is 264 L/ca/day, compared to the estimated residential usage in Grand Forks of 333 L/ca/day. One potential reason for the higher indoor usage in Grand Forks could be due to toilet usage. Toilet usage in Grand Forks is predicted to be higher than the typical because of the age of the existing dwellings. Until the 1990s, toilets typically were 20 L/flush. After the 1990s, the 13.25 L/flush toilet was introduced. Since many of the existing dwellings were constructed prior to the 1990s it is estimated that up to 40% of residential customer may still have a 20 L/flush toilet, with the remaining toilets being 13.25 L/flush. The estimated toilet usage in Grand Forks could be as high as 80.3 L/ca/day.

Section 4

Water Conservation

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4. WATER CONSERVATION

This section of the report will identify water conservation targets, and measures that can be utilized by the City of Grand Forks.

4.1 WATER CONSERVATION TARGETS

The Province of British Columbia Living Water Smart Plan states that by 2020, water use will be 33% more efficient and that 50% of new municipal water will need to be acquired through water conservation.

If the City adopts the Living Water Smart Plan water conservation target of 33% more efficient, the City would need to reduce the total average day demand of 1,178 L/ca/day to approximately 790 L/ca/day, based on 2008 water usage.

To meet the 50% new development target, any new development in the City would require that half of the water is supplied by water conservation measures. Due to the low growth/development rate in Grand Forks, the 50% target is negligible.

The recommended target for the City is to meet the 33% more efficient target by 2020. The reduction can be achieved by reducing both the estimated residential average day demand and the ICI or UWF usage.

If the estimated residential average day demand of 768 L/ca/day is determined to be correct from the water audit (See Section 4.4), then reducing the demand to 450 L/ca/day would achieve a 27% reduction of the total water use. The target usage of 450 L/ca/day would bring the residential usage inline with water usage in BC and other municipalities of similar size. Section 4.2 will discuss water conservation measures that will allow the City to meet the reduced residential usage target.

The remaining reduction can be achieved by reducing either the ICI usage or the UFW.

Savings can be achieved in the ICI sector by:

- modifying the declined block rate structure, to a flat volume based rate or seasonal volume based rate;
- educating the ICI sector on ways to reduce their water usage; or
- completing ICI water audits.

UFW can be reduced by addressing leakage from the City owned infrastructure. If the leakage is found to be 16% or greater, reducing the leakage to 10% would allow the City to meet the water conservation target.

In the future the City may want to adopt a more stringent water conservation target to protect the aquifer or reduce the requirement for additional infrastructure.

4.2 WATER CONSERVATION MEASURES

This section reviews some of the potential water conservation measures that can be used to reduce Grand Forks water usage. The potential water conservation measures that were examined are:

- leak detection and repair;
- education;
- toilet replacement program;
- fixture retrofit/replacement program;
- universal water metering;
- conservation water pricing; and
- water wise irrigation program.

Table 4-1 at the end of this section summarizes the estimated capital costs and potential savings for each measure.

LEAK DETECTION AND REPAIR PROGRAM

Generally in Canada an acceptable amount of leakage from a distribution system is 10%, following the American Water Works Association general guideline. In addition to leakage from the distribution system household leakage on average is approximately 36 L/cap/day or 3% of total usage. Based on typical residential water usage, it is predicted that the system and household leakage within Grand Forks could be as high as 19 %.

If the majority of the leakage is found to be within the city owned distribution main or infrastructure, the potential reduction that could be achieved from a leakage detection and repair program ranges from approximately 5% to 8% of the total water usage. The potential savings are based on reducing the leakage from the city owned infrastructure to 10%. Additional savings could be achieved if household leakage, including leakage from service connections, could also be identified and repaired.

As a first step a water audit should be completed to determine the amount of leakage within the system and the location of the leakage. After the completion of the water audit, the cost to complete a leak detection and repair program can be estimated.

Section 4.4 discusses the potential water audit work program.

EDUCATION

Educating the public is key to raising awareness about the need to conserve water, and to make the public aware of water conservation programs. A report prepared by Kerr Wood Leidal for Metro Vancouver (formerly the Greater Vancouver Regional District) indicated that education program may be able to achieve 0-1% indoor water use reduction, and a 1-2% outdoor water use reduction over a 20 year program.

Even though education may not reduce the overall water use dramatically, education has been shown to increase the participation rate in water conservation programs that do significantly reduce water use. For this reason any water conservation measure adapted by the City should include an educational component.

Currently the City universally meters all ICI customers. As part of this program the City could educate the customers about water usage and conservation measures. Customers may be more inclined to reduce water usage if they understand the impacts excess water usage can have on the environment, or because they may be able to realize a reduced water bill. Education materials for this program could be as simple as bill stuffers in the bi-monthly water bill, which would cost approximately $1,000 per year.

Since education is integral to the success of water conservation measures an allowance for education has been made for the proposed residential water conservation measures discussed in this section.

TOILET REPLACEMENT PROGRAM

Toilet replacement programs in BC municipalities generally consist of a rebate for the purchase a new low flush toilet (6 L/flush) or high-efficiency toilet (HET). These programs offer rebates from $50 to $200 depending on which municipality you live in.

The cost to implement a toilet rebate program, assuming a rebate of $75 (2 toilets per house) for 1,650 residential customers, is estimated to be approximately $35,000 per year for a ten year program. The implementation cost includes a budget for program administration and education.

With the implementation of the toilet replacement program, the potential water savings is estimated to be approximately 120,000 m^3/year. This potential savings corresponds to a reduction in the total annual water usage of 6%, reducing the estimated indoor residential usage from 333 L/ca/day to 264 L/ca/day. The savings calculation are based on the assumption that up to 40% of the residential properties still have 20 L/flush toilets, while the remaining have 13.25 L/flush toilets.

Other options for a toilet replacement program include providing coupons to customers for the purchase of a new low flush toilet, or the purchase of a number of low flush toilets by the municipality to be distributed to customers.

UNIVERSAL WATER METERING

The installation of water meters alone will not save water, but the installation of water meters in combination with a volume based water rate, excluding declining block water rates, and an education program is an effective water conservation measure.

Currently the multi-family, industrial, commercial, and institutional (ICI) customers are universally metered, but the single family residential customers are not.

The budgetary cost to implement a single family residential universal metering program is estimated to be approximately $1.5 million. The cost includes the installation of the water meters, meter reading equipment, and an allowance for education, program administration, engineering, and contingency. If the cost of installing meters was amortized over ten years at a rate of 6% the annual cost would be approximately $210,000 per year.

Installation of water meters can reduce water usage by: modifying customers existing behaviours, making customers aware of potential leakage or giving customers incentives (higher water bill) to retrofit their homes with low flow fixtures and appliances.

Additional advantages to water meters are:

- improved system operation and data;
- assist in the assessment of system leakage;
- City is able to identify high water users; and
- equity between customers and customer classes.

The potential savings that may be realized with the installation of water meters in combination with water conservation pricing is estimated to be between 6% and 16% of the total water usage (110,000 m^3/year to 280,000 m^3/year). The large variation in savings depends on a number of factors:

- water pricing and structure;
- the location and volume of leakage from the system (for example if a large percentage of the existing leakage is located on residential properties additional savings may be realized); and
- education program.

CONSERVATION WATER PRICING

Conservation water pricing in combination with water meters are a very effective way to reduce water usage. Two examples of conservation water pricing include inclining block water rates and seasonal water rates.

Inclining block water rates, charge increasing volume based rates for increased consumption. Separate rate blocks should be established for each customer class. An advantage to an inclining block rate is that it sends a strong price signal to the customer regarding water conservation. A disadvantage to this rate structure is that the rates can seem inequitable and be hard to manage.

Seasonal water rates vary by time of year. Utilities establish a higher rate during the peak-demand season, which also reflects the increased costs of providing service during peak times. Seasonal water rates have the advantage of providing a price incentive for water conservation during peak periods.

Currently the water meter rates for the ICI customers are a declining block rate, which does not encourage water conservation. It is recommended that the water rates for the ICI customers are modified to either a flat volume based water rate, or a seasonal water rate.

The potential savings that can be achieved with the modification of the water rates are included in the universal water meter savings of 6% to 16%. Potential savings from water rates and water meters are dependant on one another. Meters alone can not save water unless combined with an effective water rate structure.

The cost to modify the existing water rates and establishing new rates for the different customer classes is estimated to be $10,000, which is included in the water metering capital cost.

FIXTURE RETROFIT/REBATE PROGRAM

Replacing existing showerheads with a low flow showerhead and installing aerators on faucets can reduce annual water usage in Grand Forks by up to 2%, or approximately 35,000 m^3/year.

A fixture replacement program could consist of either providing the residential customers with a retrofit kit (includes low flow shower head, 2 x faucet aerators & dye tablets), or provide the customer with a rebate or a coupon towards the purchase of these items.

The cost of a retrofit kit is approximately $35. The total program cost is estimated to be approximately $8,600 per year for a ten year program. The program cost includes a budget to cover program administration and education.

RAIN BARREL PROGRAM

Rain barrels collect rainwater from roofs, to be used at a later date for irrigation. It is estimated that on an average year from June to September a 200 L rain barrel could be filled approximately 25 times, saving up to 5 m^3/dwelling. The savings are estimated to be 0.2% of total water use or 0.6% in seasonal demand.

The cost to implement a rain barrel program is estimated to be approximately $9,200 per year over a ten year program. The program could consist of the City providing a $75 rebate towards the purchase of a rain barrel, or the City purchasing the rain barrels then selling them to the participating residence. The cost estimate assumes that 85 homes per year would purchase a rain barrel.

WATER WISE IRRIGATION PROGRAM

A water wise irrigation program can reduce water. The City of Kelowna recorded a 27% reduction in water usage in July 2001 for participants of an outdoor watering education program. The program educated participating houses about proper watering techniques, and modified their sprinkler timings, accordingly.

In Grand Forks it is estimated that the average irrigation area per house is 600 m^2 or more, which requires approximately 2,800 L/day of water to maintain lawns. If residences are educated about proper watering techniques or if the irrigation area can be reduced then significant savings, as seen in the City of Kelowna, could also be achieved.

This program could consist of hiring a number of summer students each summer to meet with residence, and educate them on proper watering techniques, water efficient landscaping and help the residences modify any automatic sprinklers. The cost to implement this program would cost approximately $18,000 per year per student hired. The estimate cost includes an allowance for program development, project administration (supervision), and education. It is estimated that each student could visit approximately 200 homes over the summer months.

In addition to the education program, the City could complete demonstration projects on city owned properties around town to show customers what water efficient landscaping looks like, as well as to reduce the City's water usage.

The potential savings that can be achieved due to this program were estimated to be approximately 5% of the total usage or approximately 100,000 m^3 of water per year. The potential savings were estimated based on 50% of the residential properties reducing their summer irrigation by up to 40%.

The installation of universal residential water meters would allow the success of this program to be tracked, not only by the City but also by the participating residence, potentially increasing and/or maintaining the water savings.

SUMMARY OF WATER CONSERVATION MEASURES

Table 4-1 below summarizes the estimated capital cost and potential savings that can be achieved for each water conservation measure presented in this section.

Table 4-1: Summary of Residential Water Measured Conservation

Program	Implementation Rate	Total Usage Reduction by 2020	Estimated Annual Capital Cost (averaged over program duration)	$/Year/ % Saved	Assumptions
Education	10 year program	0.7%	Incorporated into other water conservation measures		0 - 1% of indoor water usage, 1 - 2% of outdoor usage over a 20 year program length, assumes distribution education material during implementation of water conservation measures.
Toilet Replacement Program	165 homes per year (10 year program)	6.2%	$35,000	$5,700	Assumes all houses are retrofitted with 6 L / flush toilets. Assumes 40% of customers have a 20 L/flush toilet, and the remaining have 13.25 L/flush toilets.
Faucet / Showerhead Retrofit	165 homes per year (10 year program)	2.0%	$8,600	$4,400	Assumes BC Plumbing code maximum flows.
Water Efficient Appliances	85 homes per year (10 year program)	1.6%	$5,000 -$12,500	$900 to $8,100	Assume half of residents replace older clothes washers with high efficiency models. Program can either be to offer $100 rebates towards new purchases (program cost $12,500/year), or for an education program (program cost $5,000/year).
Rain Barrel	85 homes per year (10 year program)	0.2%	$9,200	$44,300	Assume only a 50% participation rate. Approximately 1% reduction in SD for customers who install and use rain barrels.
Leakage Detection and Repair Program	TBD	4.6% to 7.7%	TBD	TBD	Reduce distribution system leakage to 10%.
Water Metering & Conservation Water Pricing[1)]	550 homes per year (3 year installation period)	6.3% to 15.5%	$210,000	$33,500 to $13,600	Cost includes conservation water pricing and is amortized over 10 years at 6%. Universal metering will reduce household leakage and SD. Cost does not include ongoing administration or meter O & M.
Water Wise Irrigation Program	10 year program	5.3%	$22,500	$4,300	Program would educate residential users on proper irrigation techniques, and encourage customers to reduce their irrigated lot areas to less than 400 m^2 per household. Assume only a 50% participation rate with education program. Should be completed in combination with universal water metering program, so that customers can see their progress.

Note: 1. Water meters may encourage customers to install low flow fixtures and appliances, as well as modify usage. The City of Kelowna realized a 19% decrease in water usage 4 years after the completion of a universal metering program.

4.3 AFFECT OF CLIMATE CHANGE ON WATER DEMANDS

To quantify the affect that climate change will have on the aquifer and water usage in Grand Forks is beyond the scope of this report, but some potential affects as listed in the Drought Management and Conservation Plan are:

- increase in crop water demand; and
- increased drought conditions.

In addition to those identified in the Drought Management Plan, climate change could also increase the length of the growing season, and seasonal temperatures, requiring additional irrigation water.

The increased drought conditions and water requirements may contribute to a reduction in the water available from the aquifer. To counter act the potential reduction the City is working towards reducing the City's water consumption.

The first water conservation measure that was implemented was the installation of water meters for the ICI sector. The installation of the meters combined with the volume based water rates will provide water saving as well as allow the City to track the ICI sectors current water use.

The City will continue to implement water conservation measures to further reduce water usage, in order to secure their water supply.

4.4 IMPLEMENTATION STRATEGY

To meet the City's water usage target a number of water conservation measures can be implemented, but as a first step a system wide water audit should be completed. The objective of a water audit is to determine how water is being used within the City and to determine the volume and location of leakage from the system.

The tasks included in the proposed water audit are:

- test the existing large industrial water meters and source water meters to determine if meter readings are accurate;
- record night time flows at source, from reservoir, and large industrial users;
- estimate water usage for authorized usage (i.e. main flushing, fire usage);
- review system for unauthorized usage;
- estimate system leakage;
- record max day demand and peak hour demands;

- test a sample population of residential properties to estimate percentage of system leakage that is attributed to residential leakage; and
- complete a night time and annual water balance for the water system.

Once the water audit has been completed and it is understood what usages (i.e. leakage, residential usage) contribute to the high water use, the City can work towards a water conservation implementation strategy. To aid in this task a decision tree has been developed for the City of Grand Forks, Figure 4-1.

The steps of the decision tree are discussed in detail below.

If the system leakage is found to be greater than 15% of the total usage then the source of the leakage should be examined. The source of the leakage could be attributed to either the City owned distribution main and infrastructure, or leakage from residential properties (indoor leakage, service connection leakage) or both.

The target rate of 15% leakage was chosen because the cost to implement a water audit, leakage detection and repair program for leakage less than 15% would not be as cost effective as implementing another water conservation strategy, such as the water wise irrigation program.

If 15% or more of the leakage is attributed to the City owned infrastructure then a leak detection and repair program should commence.

From the water audit if the residential leakage is found to be greater than 10% of the total usage, then the City can review a number of options:

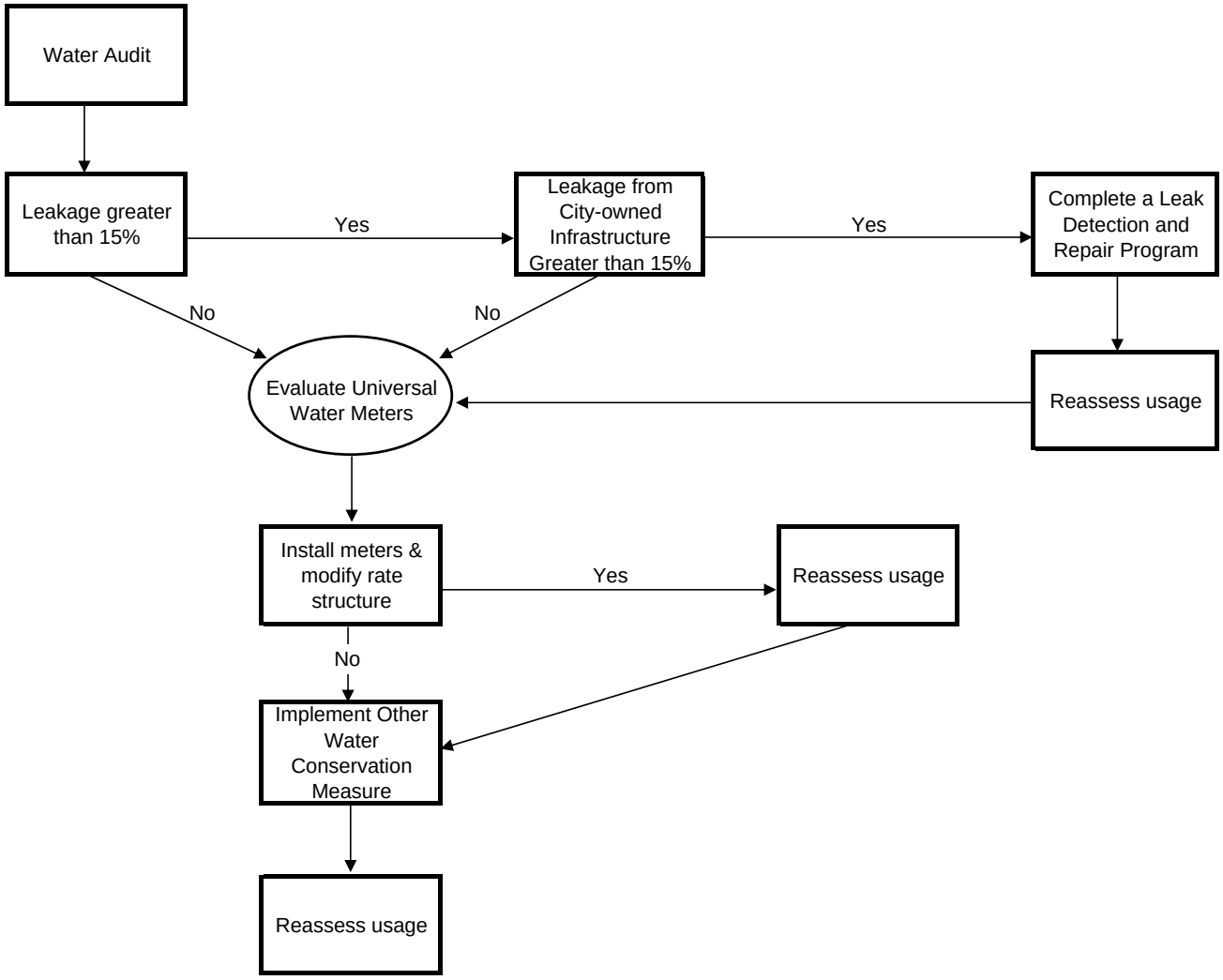
- move forward with a universal metering program; or
- extend the leakage detection program city wide. For the residential properties that have leakage in excess of 100 L/cap/day as determined by the program, either:
  - meter only offending properties; or
  - educate the client about their excess leakage, and provide documentation on how to repair home leaks.

If the system leakage is found to be less than 15%, the City can move forward with the water conservation measures as detailed in Section 4.2.

The first water conservation measure that should be evaluated is universal water metering. As mentioned in Section 4.2, the cost to implement the program is higher than other programs per volume of water saved, but the potential savings is the highest. In addition to the high potential savings the installation of water meters would allow the City to manage their system more effectively, as well as track the implementation of other water conservation measures.

Additional or alternate water conservation measures that are recommended are the water wise irrigation program, toilet replacement program and faucet/shower head retrofit program.

After implementing any of the water conservation measures the City should reassess water usage for a approximately one year, or one irrigation season for the water wise irrigation program or rain barrel program, to determine the savings that were achieved by each measure.



WATER CONSERVATION MEASURE FLOW CHART

FIGURE 4-1

Section 5

Summary and Recommendations

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5. SUMMARY AND RECOMMENDATIONS

5.1 SUMMARY

The main findings of the Water Conservation Plan are summarized below:

- The City's per capita water usage (1,178 L/ca/day) is higher than other jurisdictions of similar size.
- Unaccounted for water (UFW) could account for up to 19% of the City's total water use.
- The volume and location of leakage within the water system is unknown.
- To achieve the BC Living Water Smart water conservation targets, the average day demand needs to be reduced by 33% to 790 L/ca/day.
- Water conservation measures if implemented have the potential of reducing the annual water usage by 0.2 % up to approximately 39%, depending on the type and number of measures implemented.
- Drought conditions and increased water requirements due to climate change may potentially reduce the capacity of the aquifer. The City is working towards reducing the City's water use in order to secure their water supply.

5.2 RECOMMENDATIONS

The City should:

- Install water meters on any ICI connection that currently do not have a meter;
- modify ICI water rate structure from a declining block rate structure to either a flat volume based rate structure or a seasonal demand rate structure, to encourage water conservation; and
- Adopt the BC Living Water Smart water conservation target of 33% more efficient by 2020.

To meet the water conservation target, the City as a first step should complete a water audit of the water system to determine the volume and location of leakage.

Once the volume and location of leakage has been determined the City should utilize the water conservation measure decision tree, Figure 4-1, to determine the best course of action in order to meet the water conservation target.

The first water conservation measure that should be evaluated is universal water metering. As mentioned in Section 4.2, the cost to implement the program is higher than other programs per volume of water saved, but the potential savings is the highest. In addition to the high potential savings the installation of water meters would allow the City to manage their system more effectively, as well as track the implementation of other water conservation measures.

Section 6

Report Submission

KERR WOOD LEIDAL
associates limited
CONSULTING ENGINEERS

6. REPORT SUBMISSION

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Appendix A

2008 Water Rates

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SCHEDULE "B"
WATER RATES -- Effective January 2008

User Class	per unit Bi-Monthly 2008 Fixed Charge & Capital Charge	per account (per meter) Bi-Monthly 2008 Fixed Charge & Capital Charge	per account Bi-Monthly 2008 Customer Charge	Metered Water Rates charge per cubic meter				Bi-Monthly 2008 Variable Water Charges for Non-Metered
				0 to 40,000	40,001-80,000	80,001-120,000	120,001 or more	per Residence
Metered Multi-Family Apartment (one tax folio)	20.50		7.00	0.04	0.03	0.02	0.01	
Multi-Family Strata (multiple tax folios)-Transitional Rat	20.50		7.00					
Commercial Office Properties (water use restricted to staff washroom		18.50	7.00	0.04	0.03	0.02	0.01	
Commercial (Class 06) Properties not listed below		51.00	7.00	0.04	0.03	0.02	0.01	
Large Industrial (Class 04) Properties		51.00	7.00	0.10	0.09	0.08	0.07	
Commercial laundry, car wash Properties		51.00	7.00	0.10	0.09	0.08	0.07	
Hotels, Restaurants, Malls		51.00	7.00	0.10	0.09	0.08	0.07	
Institutions, schools, recreation facilities (arenas, pools) irrigation syst		51.00	7.00	0.10	0.09	0.08	0.07	
Buildings not connected to Water System on lots where service is ava		13.50	7.00					
Residential Properties not metered	37.25		7.00					10.75