Preface

To frame our recommendations and comments as provided in the attached summary, we note significant changes in watershed function and water-use in recent years, including:

- significant shifts in Kiskatinaw River flow rates over a forty year period since 1966, with an earlier low-flow period now being experienced affecting water withdrawals during the late-summer, and early fall periods;
- recent impacts from both drought and flood events (2010-2012) indicating increased vulnerability on water supply from the Upper Kiskatinaw River;
- current and anticipated increased land-use (gas and hydraulic fracturing activity, riparian logging, cattle grazing) in the lower sub-basins of our watershed point to potential increased turbidity from channel destabilization and potential increased contaminant risk therefore, creating a need for systematic integration of land-use management and water quality monitoring;
- current water-use demand which has increased 126% since 1960 and an anticipated 16% increase in water-use to 2017 based upon population growth, with the highest demand being in mid-summer as the system shifts to prevailing low-flow conditions extending through the winter period;
- a SureWater Initiative launched in 2013 to address water security needs;
- increasing water allocations (permitted or approved) for the natural gas industry / hydraulic fracturing operations, and incomplete information on extracted volumes from groundwater or other private surface storage infrastructure. Further to this, a note of caution has been stated by the Forest Practices Board (2011), suggesting that based upon minimum low-flow indicators, there is potential for excess water demand from the Kiskatinaw River in an intensive water-use scenario, and includes consideration for a major expansion of liquefied natural gas (LNG) development.

Comments on Legislative Policy Proposal – British Columbia's New Water Sustainability Act

To highlight our priority concerns, we offer the following key comments and recommendations as we wish to see them applied to our particular area of interest in the Dawson Creek Domestic Water Supply area of the Kiskatinaw River watershed:

2.3.1 General Water Use Purposes:

The City advocates for maintenance of domestic water use license protection to ensure long-term water supply needs are fully considered. Further, some priority must be provided to consider modified or supplementary domestic water license in the future if existing water supplies prove unsustainable based on ongoing hydrological monitoring. We feel this is important where there is an

understanding of existing upstream water flows, and intra-regional climate differences. Any changes to the FITFIR principle must reflect thorough accounting of water use demand by all sectors, in association with water conservation practices. Where a lack of water supply data exists, the FITFIR principle should be maintained.

Providing definition for mineralized and oil/gas purpose must consider the current state of knowledge and need for further research and understanding of 'water balance' considerations such as role of wetland storage, groundwater recharge dynamics, and groundwater-surface interactions within the context of anticipated climate change effects. We support the need for integrating groundwater use as part of a water-purpose definition.

Policy 1: Protect Stream Health and Aquatic Environments

Although baseline data on river flows may exist at a watershed scale (e.g. since 1966 on the Kiskatinaw River) little is known of in-stream flow on the sub-basins and the role of intermittent water courses which are pathways for physical, biological and chemical contaminants , therefore we support:

- a flexible use of In-Stream Flow Needs assessments , while also requesting that the provincial Regional Water Manager also consider flow-sensitive areas, recognizing the importance of both fish- and non-fish bearing channels and groundwater recharge areas which impact upon aquatic habitat, domestic raw drinking water quality and licenced abstractions during times of peak and low flow;
- making provision for ordering protection against dumping debris for any contaminants that might impact surface and/or groundwater from any development activity, and including but not limited to gas industry operations
- ordering of a qualified environmental professional to undertake remediation or mitigation where an impact has been determined;

In addition, we recommend, making regulatory provision for:

- the integration of all new stream-flow/aquatic data produced by government or industry operational processes (including EIA's, Fisheries research) into the Water Inventory Data Mgt System (WIDM)periodic public reviews to be undertaken with major Water Licence holders to determine possible implications or restrictions for annual use, where significant risk to stream health and aquatic environments is clearly established and substantiated;
- posting of environmental protection securities/bonding to address environmental clean-up or restoration for violations of the Act

Policy 2: Consider Water in Land-Use Decisions

For several years, the City of Dawson Creek has been an active participant in all relevant public (provincial/federal) and private (regional district) land-use planning processes. In addition, it has made considerable investment in Integrated Water Management Planning and recently a Source Water

Protection Plan that is currently being updated. Although there is recognition in these Plans for its Domestic Water Supply areas, and wide recognition of domestic water supply/quality interests, there remains considerable effort to ensure these Plans are implemented and appropriately resourced. In that regard, we support the WSA proposal regarding:

- articulation of Water Management objectives for water quality , water supply and aquatic ecosystem health for consideration by all decision-makers (Comptroller of Water Rights, or Regional Water Manager) through identification of appropriate processes, measures and parties to be engaged;
- the creation of Water Sustainability Plans incorporating both surface and groundwater management that recognizes and build-upon all existing water and land-use plans development by local and regional governments;

Further, we ask that consideration during the Legislative proposal process be given to:

- updating the 2006 MOU regarding the Interagency Accountability and Coordination on Drinking Water Protection to including the BC Oil and Gas Commission as an agency signatory;
- review of tenure/industrial project referral processes, where there is currently lacking adequate attention to water impacts, and shifting to an area-based review and regular reporting process through a collaborative agreement with BC Environment, and the BC Oil & Gas Commission;
- provide statutory recognition of the City's Domestic Water Supply area as a " Community Watershed" under the BCE Forest and Range Practices Act, and as a "Designated Watershed" under the Environmental Management and Protection Guidelines related to the Oil & Gas Activities Act;
- develop cumulative effect thresholds in sub-basins with high land-use intensities using appropriate water quality/flow indicators (e.g. within Domestic Watersheds where sub-basin monitoring indicates potential for significant cumulative adverse downstream impacts to water quality/supply including social, ecological, and economic costs).

<u>Policy 3: Regulate Groundwater Usage</u>

Groundwater supply and quality protection has been identified as an important consideration to ensure maintenance of the Kiskatinaw hydrological regime. The Montney Water project – an industry/government I initiative had limited applicability to the Upper Kiskatinaw River watershed but provided a foundation to enable further hydrogeological research. By extending this work, a greater understanding of the relationship between and shallow aquifers is needed to determine groundwater contribution to river flow. The WSA proposal to regulate groundwater usage is critical and supported by the City. In addition, we support:

- regulation of groundwater usage, through Licences for large industrial withdrawals with regular reporting of both volumes and quality and if enabled with an information-sharing protocol, there would be enhanced predictive management capacity for municipal water purveyor during periods of extreme low flow as per our current Licence requirements.

Further consideration is needed to:

- shallow aquifer characterization, and vulnerability mapping expanded network of provincial groundwater observation wells;
- requirement for local government consultation on Water Act Sect 8 groundwater water-use applications and temporary suspension of all new groundwater licenses in the Upper Kiskatinaw Regional Watershed (UKRW) pending a better understanding and monitoring regime for this critical resource.

Policy 4: Regulate During Scarcity

This policy thrust is a high priority for the City of Dawson Creek. Through its Water Strategy (see Appendix B), the City was an early adopter of the province's Water Smart Strategy and a commitment to meet the 50% water conservation target in 2020 for new demand. It further instituted a four-tier Water Conservation policy and bylaw tied to a Water License amendment during low flow conditions. In addition, it invested in expanded storage infrastructure (Bearhole Lake reservoir, and water reservoir expansion) to reduce water supply risk during low-flow periods. Other measures are improving water-use efficiencies through building code and design standards, improved storm-water management, system leak detection and water conservation initiatives. In regards, to this WSA policy objective, the City supports:

- the development of Critical Supply Thresholds (CST's) linked to In-Stream Flow Assessments, and potential applied only to affected sub-basins within vulnerable watersheds where adequate upstream real-time gauging exists to inform decisions for curtailing water use;
- timely short-term regulation during drought periods to avoid potential conflicts over water allocations based upon FITFIR priorities and including existing or new groundwater allocations.

To augment the City's efforts, we support:

- improve water supply forecasting capabilities in domestic watersheds through establishment of telemetry-based hydrometric stations, and hydrometric modeling capability tied to Water Sustainability Plan objectives (i.e. refinement of the North East Water Tool);
- expanded network of regional climate weather stations to improve water management forecasting.

Policy 5: Improve Security, Water Use Efficiency, and Conservation

As indicated above, the City of Dawson Creek is implementing various measures including (i) scaled water pricing rates for all users (ii) commissioning of a waste-water re-use facility to offset demand for potable water, and (iii) promotion of water-conservation devices and practices. With this respect to this policy thrust, we advocate:

- the declaration of beneficial use for all users through the prescription of water efficiency targets based on use monitoring, reporting and auditing;

- possible identification of Agricultural Water Reserves where such use is reported and subject to curtailment during periods of low flow;
- 30 year term-based review of Water Licences and incorporation of all relevant water use, demand and hydrological assessments;
- the creation of Area-Based Regulations, linked to a Water Sustainability Plan, Water Objectives, Critical Environmental Flows .

Policy 6: Measure and report large-scale water use

At present, there are no protocols in place for the exchange of information on actual water use by various users. The City, however, does provide regular on-line reporting of treated volumes and bulk-water sales. The City supports, this objective for:

- increased transparency of actual water-use by large surface and groundwater users, in particular volumes used by the gas industry through any unreported water storage (burrow pits), in addition to currently reported (Water Act) Section 8 permits and licences.

Policy 7: Provide for a range of governance approaches

Watershed governance is a fundamental consideration to foster accountability of all water users and regulators. Delegation of responsibilities for water sustainability planning to the regional level will ensure effective integration of locally-relevant information and needs. In that regard, we agree that the provincial government should:

- Adopt an area-based approach, with local and regional advisory mechanisms (Interagency Working Groups such as Regional Drinking Water Teams, Watershed Advisory Councils) for implementation of existing Water Management/Source Water Protection Plans and future Water Sustainability Plans;
- Creation of the proposed provincial Water Governance Framework to evaluate and build upon successful decision-making/advisory models.

Further consideration should be given to:

- priority "Watershed designations" in chronic problem areas with known challenges and sensitivity to both water supply, and quality as articulated by existing management plans;
- Support for municipal watershed stewardship programs, and "state of watershed" reporting for improved water/land-use decision-making.

Water Sustainability Act Implementation

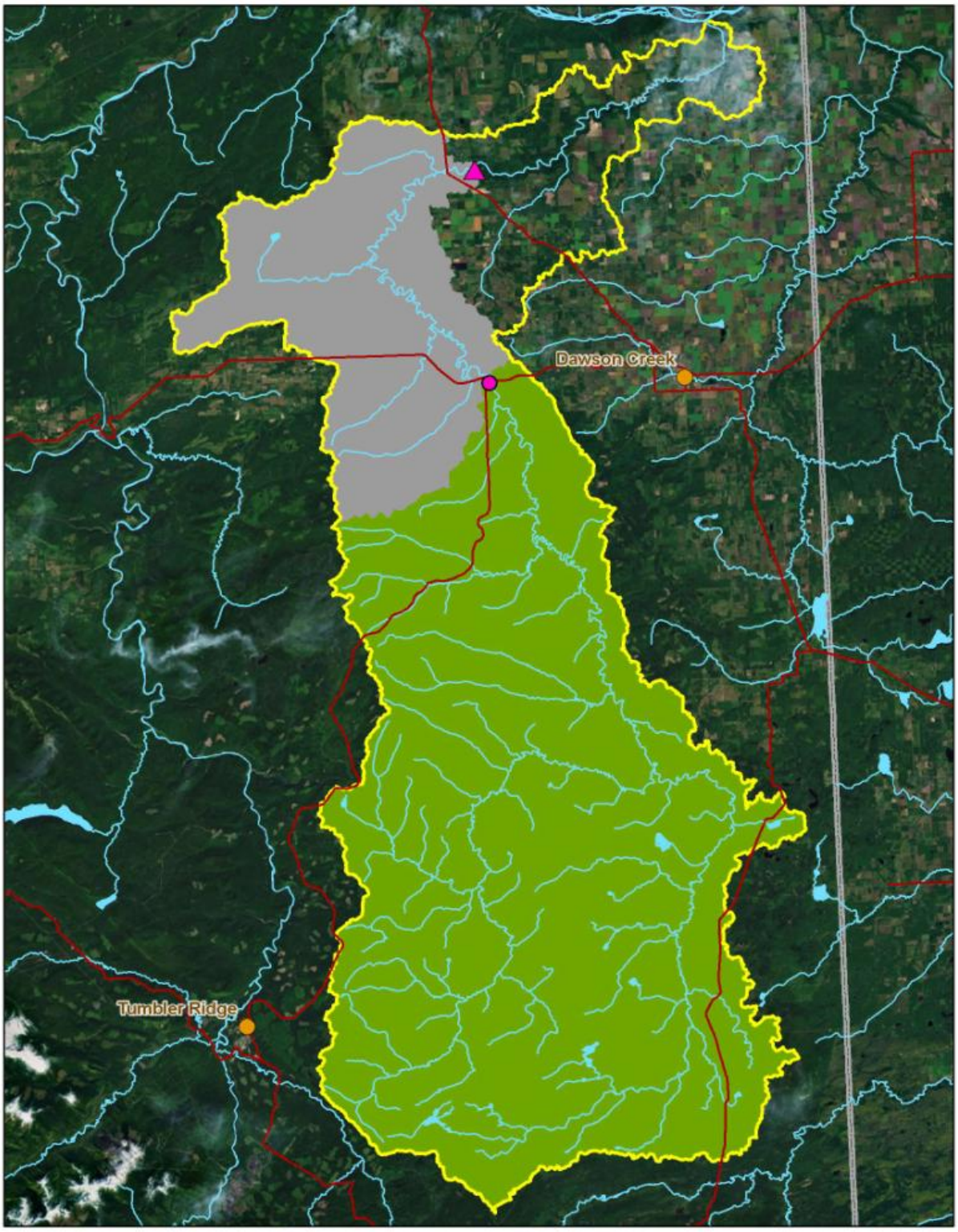
The City supports the phased development of regulations for implementation of the Act, and giving impetus to existing processes and plans aimed at improving watershed understanding , decision-making and governance.

Water Pricing

A proportional approach to water pricing for all regulated water use is strongly supported. Consideration should be given to regional allocations of funds to support implementation of Water Sustainability Plan, watershed research and monitoring.

Technical review provided by: Reg C. Whiten, P.Ag MCIP, InterraPlan Inc
Watershed Steward, City of Dawson Creek

Appendix (A): Map of Dawson Creek Domestic Watershed



Appendix B Part I: City of Dawson Creek Water Strategy

the City of Dawson Creek
BRITISH COLUMBIA
"the Capital of the Peace"

REPORT TO COUNCIL

DATE: August 25, 2009 **REPORT NO.:** ADM 09-195

SUBMITTED BY: Kevin Henderson
Director of Operations **FILE NO.:** 4-1-2

SUBJECT: Water Strategy update

PURPOSE
To request Council adoption of a comprehensive water strategy including a new vision along with strategies and actions for water use within the City of Dawson Creek.

SUMMARY/BACKGROUND
In the Fall of 2008, Council directed staff to proceed with the development of a water strategy to better align with the provincial 'Living Water Smart' program. The first step was to document water usage through all sectors (residential, commercial, Institutional, etc) in the City as a baseline from which to launch the strategy so that results could be measured. That initial step has been completed and is attached for review.

Highlights of the baseline water usage report include the following for Dawson Creek:

- Higher than Canadian average consumption per capita
- Consumption in all sectors increases as river flow rates decrease
- Unaccounted for water volumes are slightly higher than Canadian average
- The oil and gas Industry consumes a high volume of fresh water, typically for non-potable uses, and the demand for water is increasing rapidly.

Although the City of Dawson Creek average total consumption is at 584 litres/capita/day, the average consumption for single family dwellings is only 256 litres/day. There is a great opportunity to reduce the overall consumption by targeting strategies that are aimed at the industrial sector, such as effluent reuse in the oil and gas industry. The effluent reuse project alone could help the City of Dawson Creek achieve a minimum of 10% reduction in over all consumption.

A number of the strategies in the report are either already in progress or on the horizon for the near future. Staff is confident that the vision and strategies noted in the report are a positive step towards water conservation and the overall strategy.

The recommendations from the report are as follows:

1. ***Adopt a water vision for the City of Dawson Creek***

In line with new British Columbia Legislation, the City of Dawson Creek will meet 50% of its new water needs through conservation measures by 2020

a. As a volume target, the City of Dawson Creek will reduce the current per capita daily consumption by 20% by year 2020, going from an average of 584 litres/capita/day to 467 litres/capita/day by 2020.

2. ***Adopt corporate measures to help meet the new vision.***

- Update current water metering system to wireless technology, in order to obtain more accurate and timely water consumption rates and better monitoring and prevention of leakage / loss. This will result in lower volumes of unaccounted for water in the future. Up to 10% leakage / loss can be due to faulty meters.
- Further trends towards xeriscaping in all public spaces, a trend which greatly reduces the demand for irrigation.
- Update current irrigation practices in order to ensure they are the most efficient practices possible.

3. ***Community involvement / engagement***

- Update water pricing structure
- Continue the development of an effluent reuse station for non-potable uses for industry.
- Expand on current community education initiatives. This will convince the community of the value of water conservation, and also provide them with the necessary tools to do so.
- Implement a strategy to increase the uptake of low flow fixtures in the home, such as a rebate program.
- Promote the usage of grey water reuse systems in new construction and rainwater capture in all homes.

ALTERNATIVES

Council could adopt the strategy as presented, Council could adopt the strategy in an amended form, or send it back to staff for more information.

IMPLICATIONS

(1) Social	The adoption of a water strategy will put the City of Dawson Creek in company with water conscious communities like Vernon, Kelowna, the Capital Regional District, and the Sunshine Coast Regional District. The proposed vision aligns with the Province of British Columbia Living Water Smart plan.
(2) Environmental	A reduction in water consumption will help ensure supply for all stake holders in the Kiskatinaw Watershed, and provides for a healthier ecosystem.
(3) Personnel	N/A
(4) Financial	Conservation is the cheapest form of increasing capacity; less consumption will translate in to lower treatment costs and deferred capacity related infrastructure upgrades.

GUIDING PRINCIPLES

The Environment – We will demonstrate respect for the future of the earth by advocating for the preservation of clean air, clean water, and healthy land.

STRATEGIC PRIORITIES

The creation of a water strategy was one of the strategic priorities identified by Council in January of 2009. Staff is also committed to bring a complete overview of the system with a narrative on upgrades, studies, and source options discussed over the years. The narrative will be completed this fall.

IMPLEMENTATION/COMMUNICATION

If adopted by Council, staff will take the required actions to implement the new strategy and vision, including a communication plan through the City website and local advertising, to keep the public informed.

RECOMMENDATION

THAT Council adopt the Water Strategy and Vision, summarized in Section 10.0 Recommendations of the Water Consumption Baseline Report, (pages 28-29).

Respectfully submitted,

ORIGINAL SIGNED BY

Kevin Henderson, AScT
Director of Operations

APPROVED FOR AGENDA BY CAO/DCAO

KH/th

Appendix B, Part II

City of Dawson Creek

Water Consumption Baseline Report

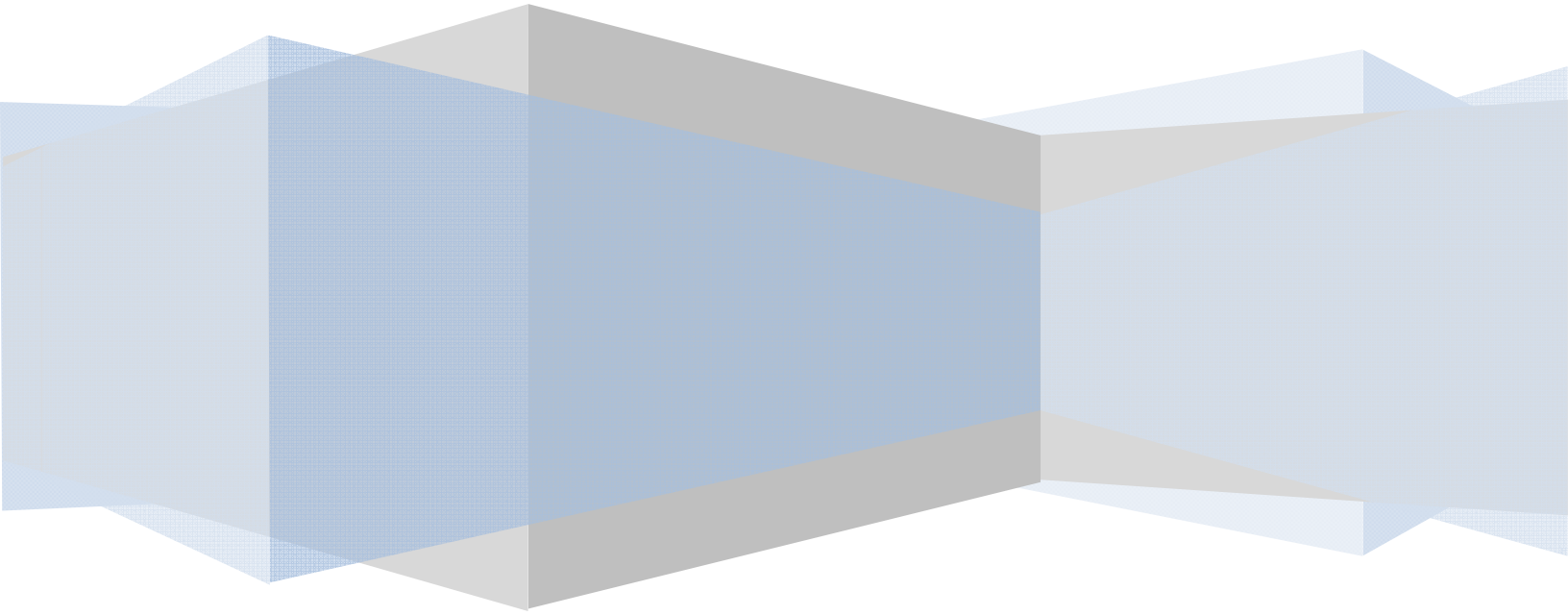


Table of Contents:

Table of Contents for Water Baseline

List of Figures

Glossary of terms/abbreviations

- DM – Demand Management – water management approach that has efficiency as its main goal – attempting to provide all of the same services, but with less water.
- M3 – Cubic Meters – a measure of 1000 litres
- POLIS Project on Ecological Governance - The POLIS Project on Ecological Governance is a centre for trans-disciplinary research that investigates and promotes sustainability.
- DC – City of Dawson Creek
- SF – Single-family dwellings
- Disaggregated- broken down to specific water end-uses by account or usage type
- ICI – Industrial, Commercial and Institutional water usage
- TOC – Treated out of City – refers to treated water that services homes and businesses laying outside of the City limits
- Raw – water that is delivered using City infrastructure prior to the water being treated

Water Account Types

WAT-A – Business accounts in City limits

WAT-B – Residential Accounts in City limits

WAT-C – Raw water

WAT-O – Business Accounts in City limits with over 2” pipes

WAT-R – Treated Water outside City limits with over 2” pipes

1.0 Purpose of this report

This baseline report was prepared for the City of Dawson Creek and submitted July 2009. The report is a measure of current water consumption in all sectors of the City and outlying region. Council has committed to developing a comprehensive water strategy for the City. The data in this report will serve as a benchmark for assessing how effective the plan will be in the future.

1.1 Why Water Conservation?

The City of Dawson Creek (herein referred to as "the City") and the Village of Pouce Coupe as well as surrounding rural residences rely on the Kiskatinaw River for their drinking water. The water treatment plant in the City services all business and residential customers in the City, as well as in Pouce Coupe. Indirectly it also supplies drinking water to rural residential customers and several oil and gas companies. The river, as well as several reservoirs that are owned and operated by the City, provide a sufficient supply of fresh water year-round to all of the City's water customers. To be able to meet the demands of a growing population, the City will implement a comprehensive water strategy to ensure future demands can be met. Also, recent legislation from the British Columbian Government (as outlined in their Living Water Smart policy) demands that "fifty percent of new municipal water needs will be acquired through conservation by 2020" (2008). The City aims to meet that target.

The case for conservation goes beyond legislation. Water conservation measures constitute good governance, especially in water-abundant Canada. Due to Canadians' perception of plentiful freshwater, we as Canadians use four times the amount of water of the average European (Brandes and Ferguson, 2003). In the past twenty years, Canadians have increased their water usage by 25%- while other countries in Europe and even the United States have managed to decrease their overall usage (Brandes and Ferguson, 2003). In BC water usage is even higher than the rest of Canada- according to the BC government, British Columbians use an average of 490 litres per person per day, while in the rest of Canada the average consumption is 330 litres per person per day (2008). While helping guarantee supply, water conservation also results in savings in many ways- in lowered water bills, lowered energy bills and of course, more water for the ecosystem that also relies on the Kiskatinaw.

Demand Management Approach

This report is being prepared with a comprehensive Demand Management (DM) approach in mind. This approach is growing in popularity among communities due to the benefits that it provides. The benefits of DM include:

- Maximizing the service from existing infrastructure by using built assets more efficiently and effectively.
- Minimizing the need for new infrastructure thereby avoiding, postponing, or reducing capital costs and the associated operating costs; and
- Potentially reducing the net capital and operating costs over the long term

The DM approach to water management does not mean that residents will experience a significant change in their lifestyle. In fact, several benefits to the community can be expected by adopting the DM approach, including:

- Maintaining or increasing the affordability of, and access to, services by residents and businesses by reducing waste and pollution, and increasing resource use efficiency
- Preserving or enhancing public health and safety through access to affordable services and reduced air pollution
- Increasing the public sense of system equity or fairness as the benefits of DM are realized and the costs reflect recognized community needs
- Reducing degradation of water resources, air quality, climate stability, biodiversity, and natural spaces such as forests, wetlands, and meadows (Wong & Porter-Bopp, 2009).

The City, upon implementing this water conservation strategy, would join the likes of other water-conscious communities, such as Vernon, Kelowna, the Capital Regional District and the Sunshine Coast Regional District. The City is perfectly poised to take on this type of management approach, as it has a history of energy efficiency programs and environmental awareness. The City has already undertaken steps towards developing a DM approach, including commissioning a water cost study and implementing a conservation bylaw. We can guarantee our water future through a comprehensive water conservation strategy now.

Data Sources

Many sources were consulted in the creation of this report. Most of the statistical information is drawn from the water utilities and billing departments of the City. Other documents consulted included: (City documents are available online at www.dawsoncreek.ca)

- Living Water Smart – British Columbia's Water Plan
- The Kiskatinaw River Watershed Source Protection Plan (City document)
- The Water Quality Assurance Plan (City document)
- The Water Conservation Measures Bylaw (City document)
- Environmental Development Plan (City document)
- Water Rates and Regulations Bylaw (City document)
- Water Regulations Outside the City Bylaw (City document)
- Thinking Beyond Pipes and Pumps
- The City of Calgary Draft Water Efficiency Plan
- A Guidebook for Comprehensive Integrated Long-term Water Conservation Planning in British Columbia Communities (The format for this report is taken from this document)
- Other sources referenced include Environment Canada Freshwater Website, Environment Canada National Climate Data and Information Archive, and flow data from the Kiskatinaw River (from water utility).

2.0 Water System Profile

2.1 Source and Supply

The City of Dawson Creek's water supply is the Kiskatinaw River. Typically, the major problems on this river have been high turbidity and seasonal low flows. A weir was installed near the Arras intake to help with the problems of low flows, and the turbidity is lessened by the water flowing through the reservoirs. For more information on water quality challenges and supply assessment, see the Kiskatinaw River Watershed Source Protection Plan or the City's Water Quality Assurance Plan. There are several licenses on the watershed, including agricultural, dust control, oil and gas and conservation licenses. For more information on these licenses see Appendix ii. Typical activities in the watershed include recreational uses, oil and gas, forestry and agriculture. The risks that each of these poses are described in detail in the Water Quality Assurance Plan. According to the BC government, the Pine Beetle outbreak has already spread to the Peace Region (Action Plan 2006-2011). The loss of any significant number of trees in a watershed can negatively impact the ability of the watershed to absorb and slowly release precipitation levels. Therefore, the pine beetle infestation in the Kiskatinaw watershed will need to be closely monitored.

2.2 Surface Water Supply

Records of the historical flow of the Kiskatinaw River have been taken from the Farmington Station. Below are the data for "record" minimum and maximum monthly flows.

Note that the winter months flow is viewed as "zero" on the graph- this does not indicate a "zero" flow, but very low flow.

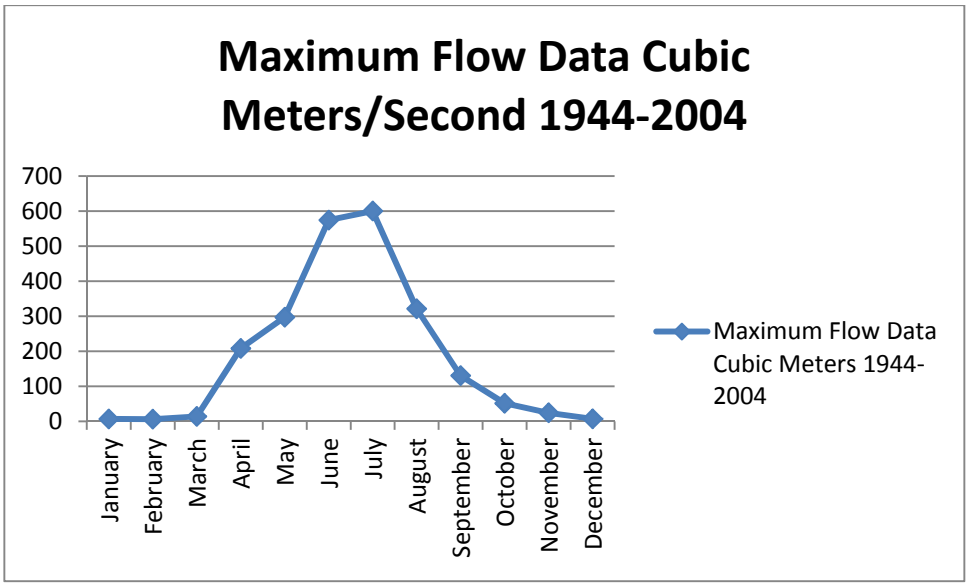


Fig. 1

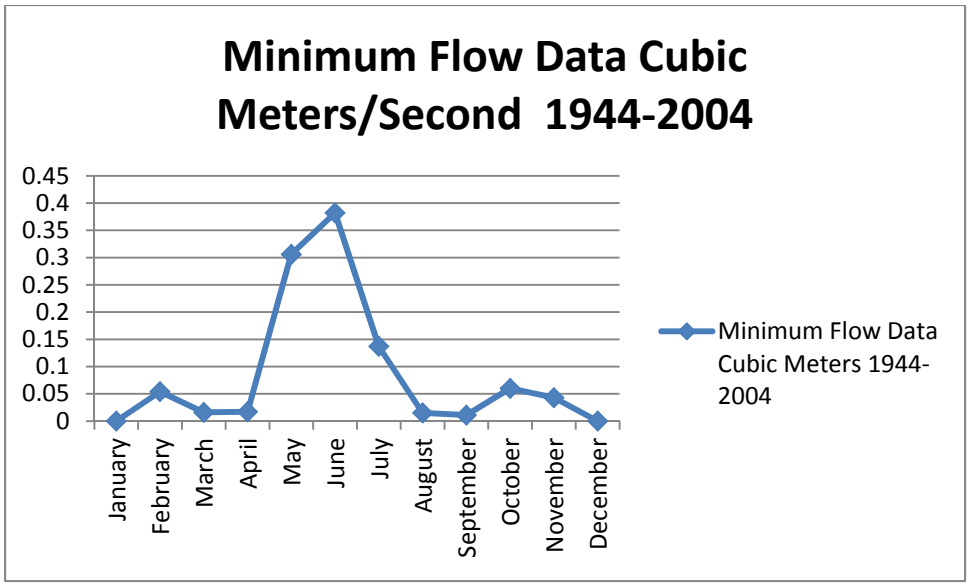


Fig. 2

The average annual flow rate and the average river flow for the past six years are both shown in the graph below. It is important to note that June and July tend to be the peak months for river flows with the winter months seeing very little flow. Consumption, as seen in the remainder of this report, peaks in the summer months, after the peak of the river flow. Note also that the minimum flow data indicates that July and August can also be very low flow months- during the height of consumption.

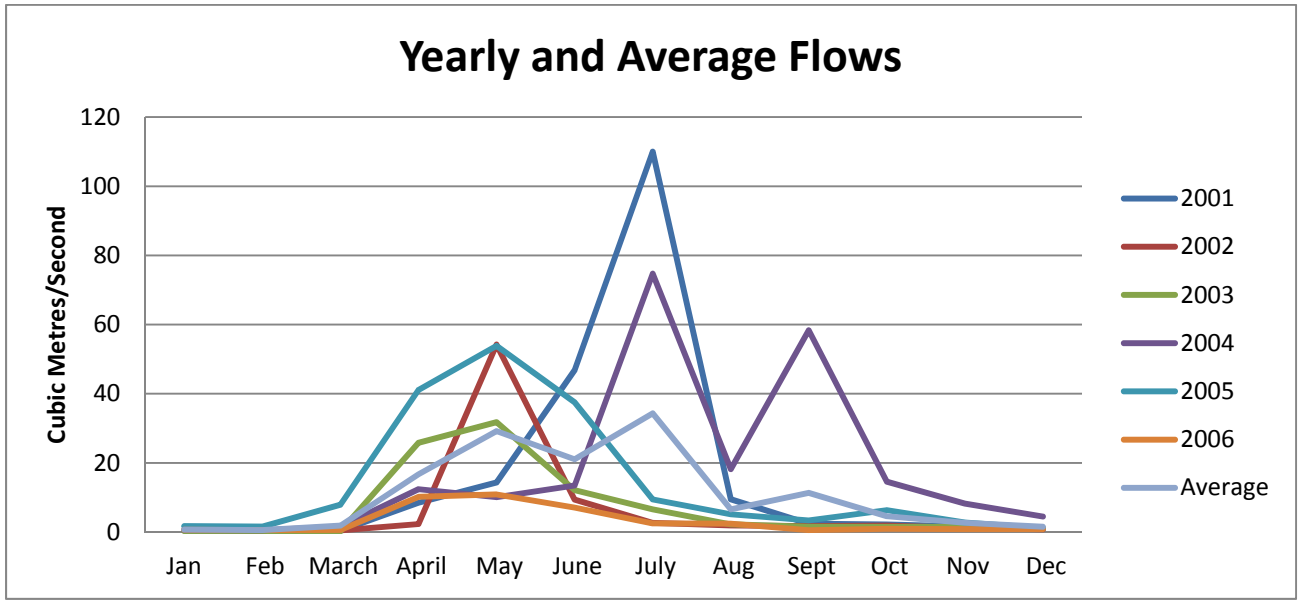


Fig. 3

On the river there is a weir that helps to regulate the flow in the Arras intake. The process of constructing another weir on Bear Hole Lake has begun. This weir, along with the existing one, will help to regulate the flow throughout dry and wet seasons. The fluctuation in flow as shown above also emphasizes the importance of the various reservoirs.

2.3 Infrastructure Design

The water is taken in at the Arras pumphouse station on the river and then flows through a series of reservoirs before arriving at the water treatment plant. (See Appendix i for schematic).

2.4 Climate Data

Current climate trends are shown below including annual precipitation and annual mean temperature. All climate data is taken from Environment Canada's National Climate Data Archive.

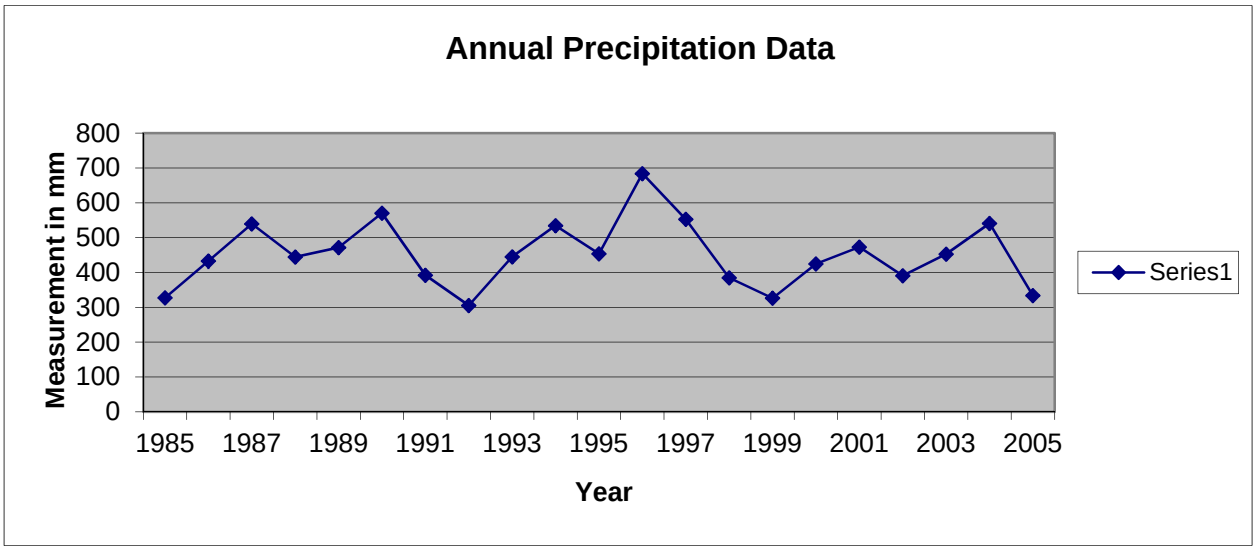


Fig. 4

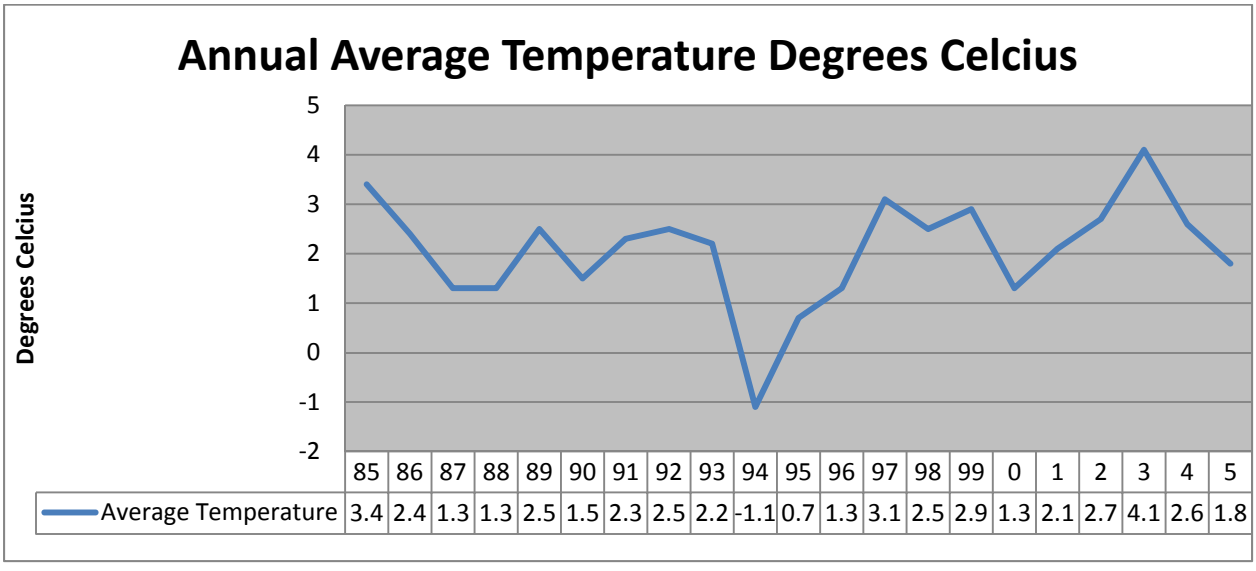


Fig. 5

A recent (2008) publication from the British Columbia Government entitled "Taking Nature's Pulse: The Status of Biodiversity in British Columbia" highlights some of the changes in the Peace region as a result of climate change. Since 1971, some areas of the Peace Region have experienced up to a 2.9 millimetres

per decade decline in precipitation, and an overall increase in temperatures of 0.65 to 0.71 degrees Celsius. Given that the Kiskatinaw River is precipitation-fed, any decrease in precipitation levels or increase in temperatures would negatively impact river flow levels.

2.5 Water Quality Issues

The major water quality issues in the Kiskatinaw River are issues of turbidity (high amounts of dissolved solids in the water), particularly during the spring freshet. There are concerns of elevated levels of organic matter and parasites due to the poor maintenance of riparian areas on farms that line the river. Furthermore, there is a risk of petroleum compounds polluting the river should one of several pipelines crossing the river burst. Many of these water quality concerns have been addressed in the City's Water Quality Assurance Plan.

3.0 Surface Water Supply Capacity

3.1 Water Treatment Plant

- Location and source water body
  - The Kiskatinaw River is the source body of water for the City of Dawson Creek. The river is part of the Peace River watershed and drains into the Peace River.
- Service Area
  - The City of Dawson Creek is the only municipal water licensee on the Kiskatinaw. The City provides drinking water to at least 15,000 people in the City of Dawson Creek, the Village of Pouce Coupe and the outlying region.
- Rated Capacity – the plant has a production capacity of 11.34m3/minute.
- Current Annual Average Water Production (Production corresponds to demand)

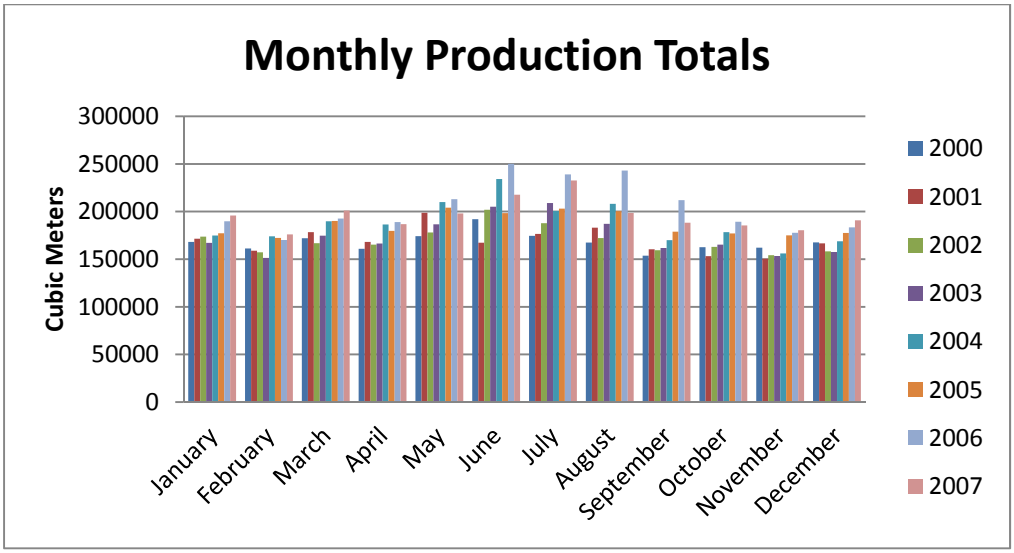


Fig. 6

The average production for the plant is 2,182,489 cubic meters a year over the last 8 years. (Data from Treatment Plant Records).

- Treatment Technologies Employed
  - The water treatment plant is a class 4 water treatment plant. The plant uses a system of coagulation, flocculation, sedimentation, filtration (mixed media), absorption, and UV in the water treatment process. Chlorine is injected just as it enters the pipes to town (residual disinfection). Chlorine is re-injected before it goes to Pouce Coupe, again for residual disinfection.

3.2 Distribution and Treatment Systems

- Kilometres of water mains and connections served by system
  - There are approximately 140km of water mains (this is a low estimate as the new subdivisions are not included in this number). This estimate also does not include the Pouce Coupe lines. (Data from the City's Engineering department)
- Total number of connections
  - There are approximately 5000 connections, with each billing period at 2040 and 2382. This number (5000) also takes into account connections that are seasonally active or not active yet. Pouce Coupe connections are billed separately, and are therefore not included in this number. (Utilities Billing Department provided this information)
- Rated capacity of all reservoirs and storage facilities: *(Please note that these are approximate values, as provided by Water Treatment Plant operator.):
  - *Stranded refers to water that cannot be used, as it is unavailable
  - Hart Reservoir has a total capacity of 22712.47 m3, with 7570.824 m3 stranded
  - Trail #1 has 200626.8 m3 usable with 4542.494 m3 stranded; Trail #2 132489.4 m3 usable, 30283.29 m3 stranded
  - Parkhill Reservoir has a total of 6813.741 m3, 946.3529 m3 stranded,
  - Under the Treatment Plant there is a reservoir which contains 1192.405 m3.
- Currently, work is being done to build a weir on Bear Hole Lake for additional storage.
- An additional reservoir is also in the planning stages.

3.3 Wastewater Treatment and Infrastructure

- Wastewater treatment facilities – the wastewater treatment plant consists of two anaerobic ponds and two aerated ponds. In the anaerobic ponds, solids are digested and inorganic materials settle. Floatables (solids that have been disposed of in the sewage system) are contained here. The water then moves to the aeration ponds that contain roughly 14.5 km of aeration line.
- Type of treatment used - Aerobic and anaerobic digestion are both used in the wastewater treatment plant. The water is treated for roughly 3-6 months in the system, after which it is released into the Dawson Creek, which flows into the Pouce Coupe River.
- Rated capacity – the waste water treatment plant can handle the volume that the lift stations can pump. The capacity of the ponds is not precisely known.

- Current average annual flows:

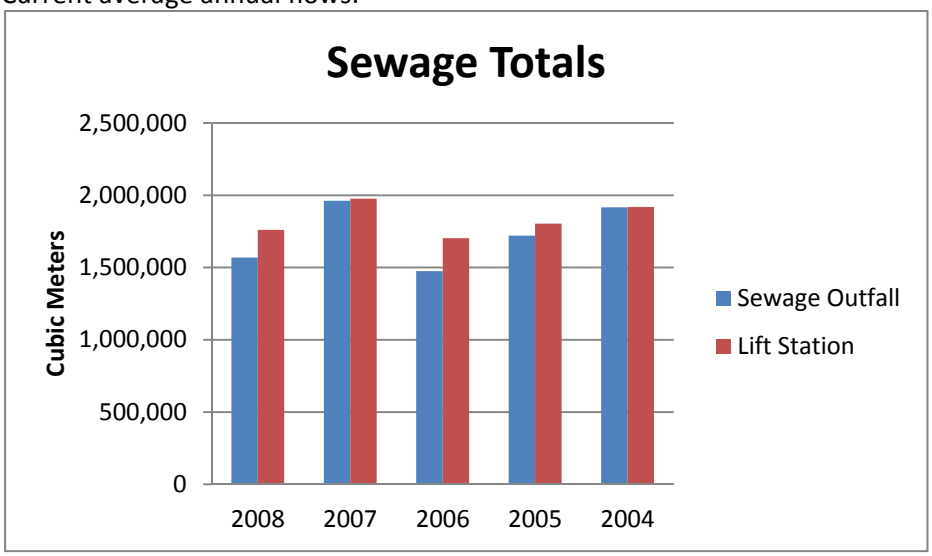


Fig. 7

- Service area and discharge point – The sewage system serves only the residents of the City of Dawson Creek, as well as a few sewage dump trucks – these trucks totalled 5900 m3 in 2007. Pouce Coupe has its own treatment system.

4.0 Historical Water Consumption

The City of Dawson Creek has a price structure that is currently undergoing review. A water cost study was recently done for the City, suggesting that the City make rate changes. The authors of the study are in the process of making price recommendations. "Pricing it right" is one of the top ten strategies listed by POLIS is terms of establishing an effective water conservation plan (Brandes, Mass & Reynolds, 2006). It is important that this pricing review be seriously considered by Council, as it can help to offset revenue that might be lost as the conservation measures become effective, as well as become an incentive for conservation. The prices (from current billing rates) are as follows:

User Type	Price/Cubic Metre
In-City Residential and ICI	$0.6886
Outside City Limits Treated	$0.8652
Raw water (non-potable)	$0.6356
Bulk water (Business Account)	$2.91
Water Card (Business Account)	$2.44
Water Card (Residential Account)	$3.49

- Residential and ICI (institutional, commercial and industrial) customers in town have a maximum usage of 42 cubic meters per billing period (2 months)
- Raw water is sold for non-potable use (usually agricultural)
- Bulk water is sold at a much higher rate than other ICI
- Water Cards, which can be purchased and filled with credits to be used at private filling stations sell at a rate of $0.10/credit for residential customers and $0.07/credit for bulk haulers – these water haulers often sell to rural residents or oil and gas companies.

4.1 Water Usage in the City of Dawson Creek

Using billing records, water treatment plant records, meter readings from water stations and data supplied by Pouce Coupe, the following graphs highlight the water usage patterns in the City for 2006 and 2007. Please note that the year 2007 has two versions, one being a more detailed breakdown of water end uses.

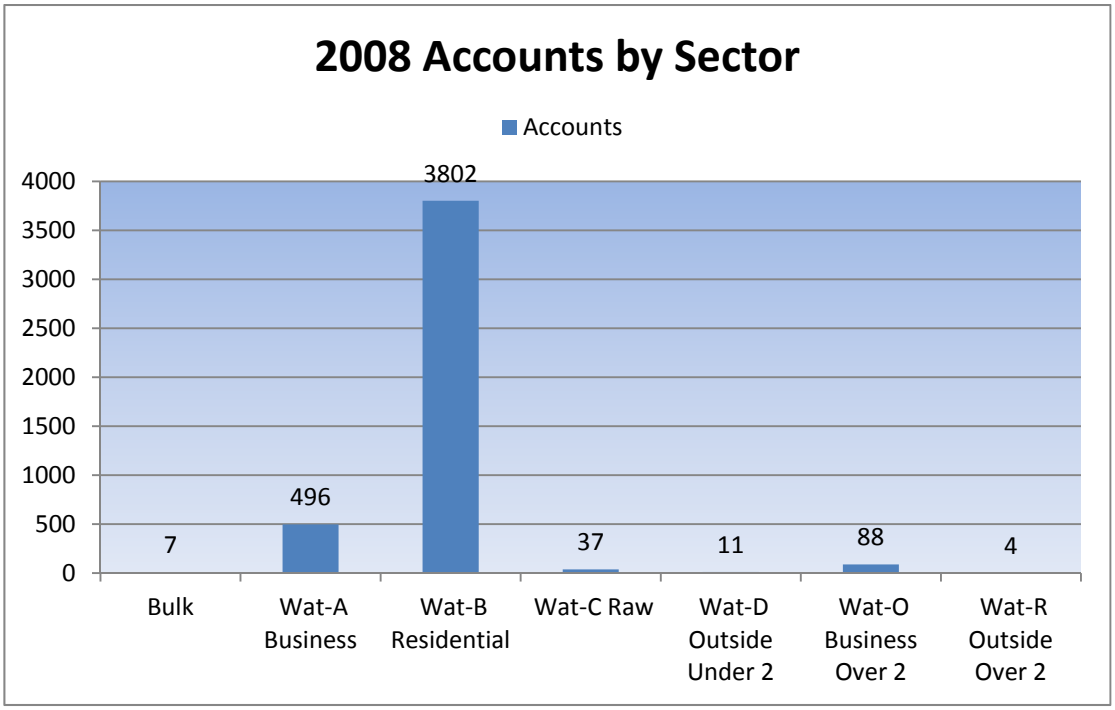


Fig. 8

Due to billing methods discussed in the "recommendations" section of this report, a detailed analysis of water end usage has only been compiled for 2007.

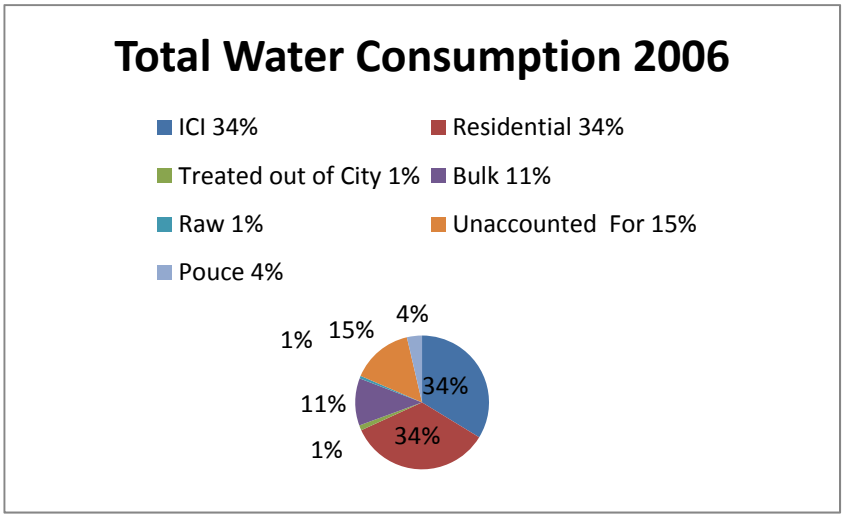


Fig. 9

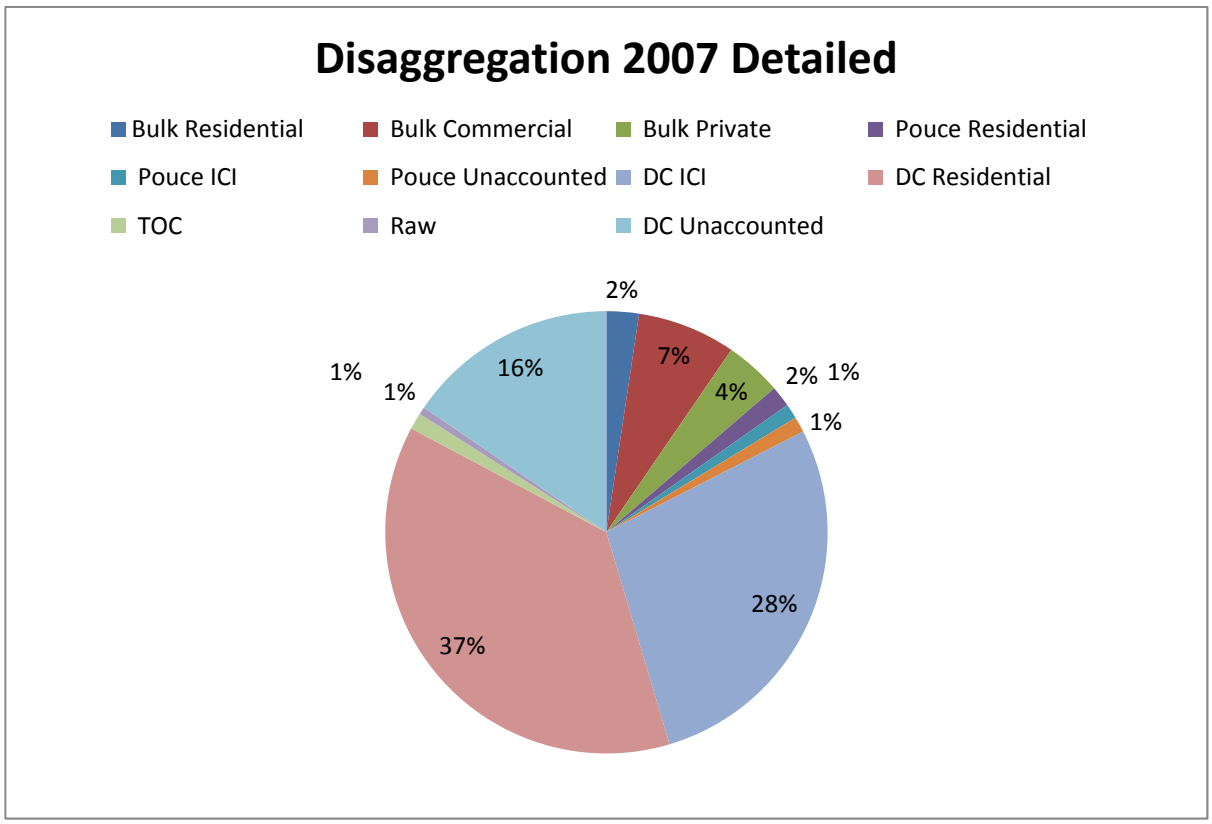


Fig. 10

City and Village staff are aware of the volume of "unaccounted for" water in the system and are working towards reducing this volume.

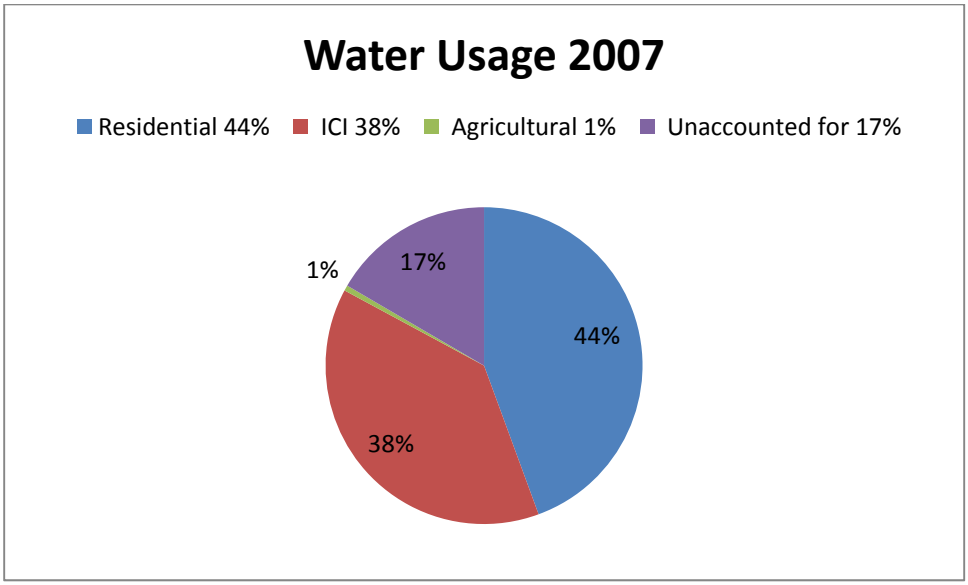


Fig. 11

The City's water consumption can be compared to the Canadian average, highlighted in the graph below. The "unaccounted for" water in the City is slightly higher than the national average, as is the ICI sector's usage. The residential usage is slightly lower in the City than the national average. The following graph (used for comparison purposes) is taken from Environment Canada.

The figure (to the right) shows the Canadian national average for comparison purposes.

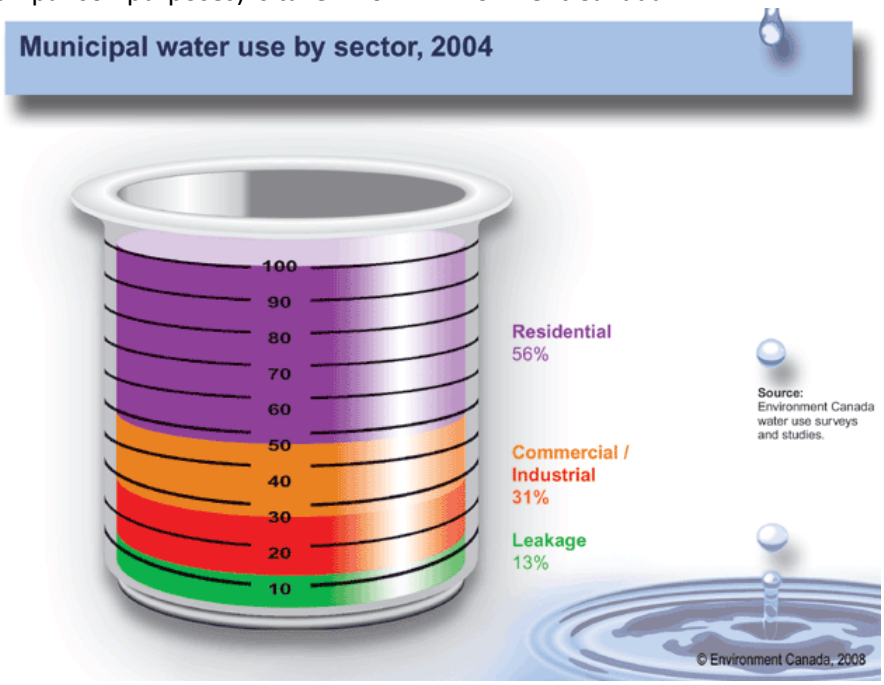


Fig. 12 (Environment Canada)

The village of Pouce Coupe also receives its water from the City and should, therefore, be included in any conservation plan that is developed. Their usage is shown below for the year 2007. (Data taken from Pouce Coupe Village billing records)

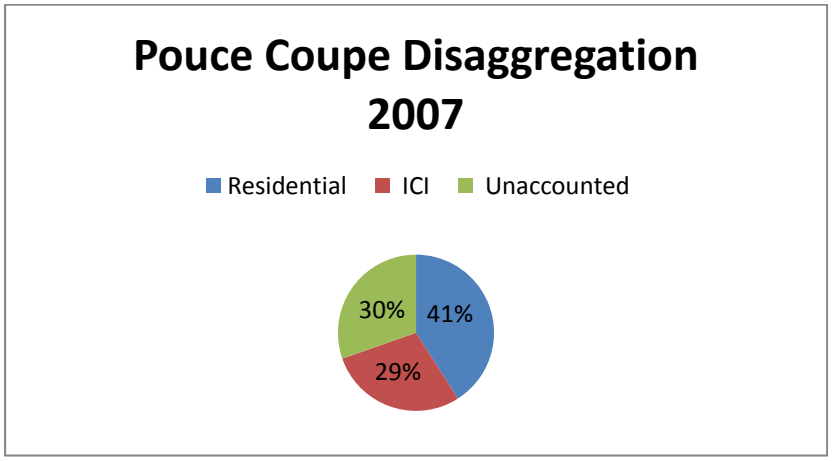


Fig. 13

Please note that the Village of Pouce Coupe is aware of the large "unaccounted for" sector- they are currently investigating this loss.

4.2 Average Annual Day Demand/Maximum Day Use

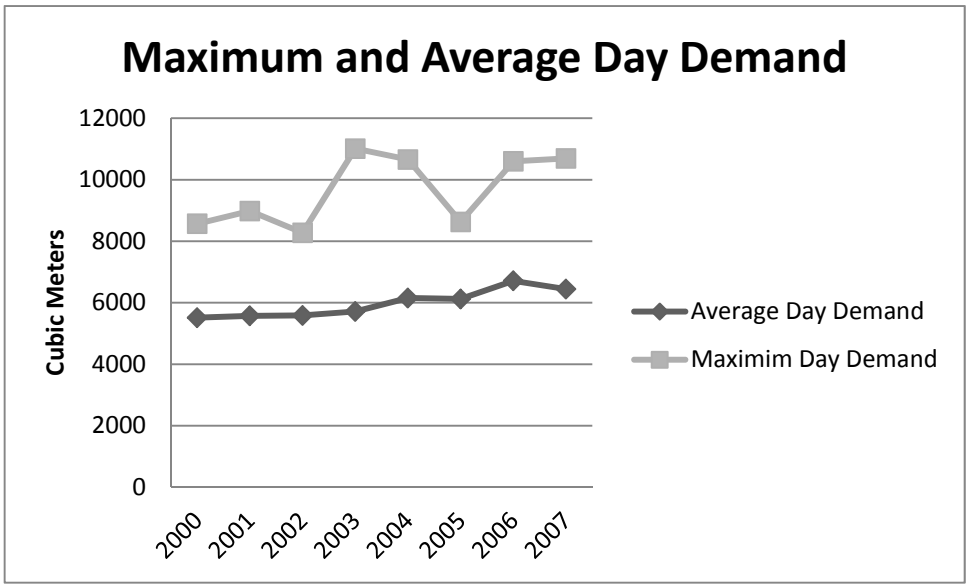


Fig. 14

The average maximum day demand and average annual day demand over the last 8 years are 9676.5 cubic meters and 5975.5 cubic meters, respectively. Average annual day demand refers to the total gross amount of water that is withdrawn and distributed throughout the system in a year divided by 365. The maximum day demand refers to the peak amount of water withdrawn in a day- the most water withdrawn from the system in one day for the year shown.

4.3 Residential

Indoor/outdoor usage – these numbers are not available for the City, so below is a chart of typical indoor water use of Canadian homes. According to BC Hydro, outdoor water use in British Columbia accounts for 40% of residential drinking water usage (2009).

The figure (to the right) shows the average usage in Canadian homes for comparison purposes.

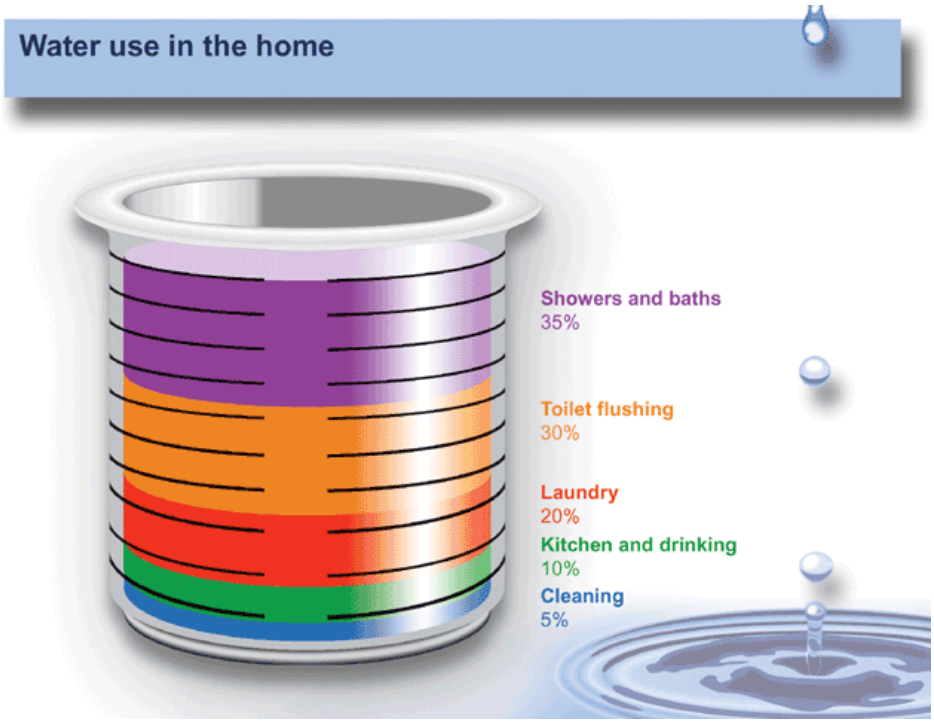


Fig. 15 (Environment Canada)

4.4 Residential Usage – Detailed Analysis

Residential Usage in the City is difficult to obtain from billing records, as apartment buildings are billed as businesses, therefore skewing the results towards a higher ICI consumption rate. Also, several rural households rely on water delivered by independent businesses in Dawson Creek- but the exact number of customers is not known. In this section of the report there are three scenarios being used for determining per capita flows and consumption rates. They are:

- Scenario A – the most reliable, includes the populations of the City of Dawson Creek and the Village of Pouce Coupe from the 2006 Canadian Census – 10,994 plus 738 equals a total population of 11,733.
- Scenario B- Contains the census population as well as the customer averages from the water hauling companies in the City – there are an average of 2.4 people per residence in the City. The water hauling companies estimated that they had roughly 1640 regular residences that they deliver to, at an average of 2.4 people per home, plus the combined populations of the City and the Village = 15,669 people.
- Scenario C- This includes the census population, the water hauler estimates and also an estimate on the number of regular customers that haul their own potable water from the bulk stations in town. This estimate, in the opinion of the treatment plant operator, is estimated at roughly 20,000 users.

The annual per capita demand is shown in the chart below using the three scenarios.

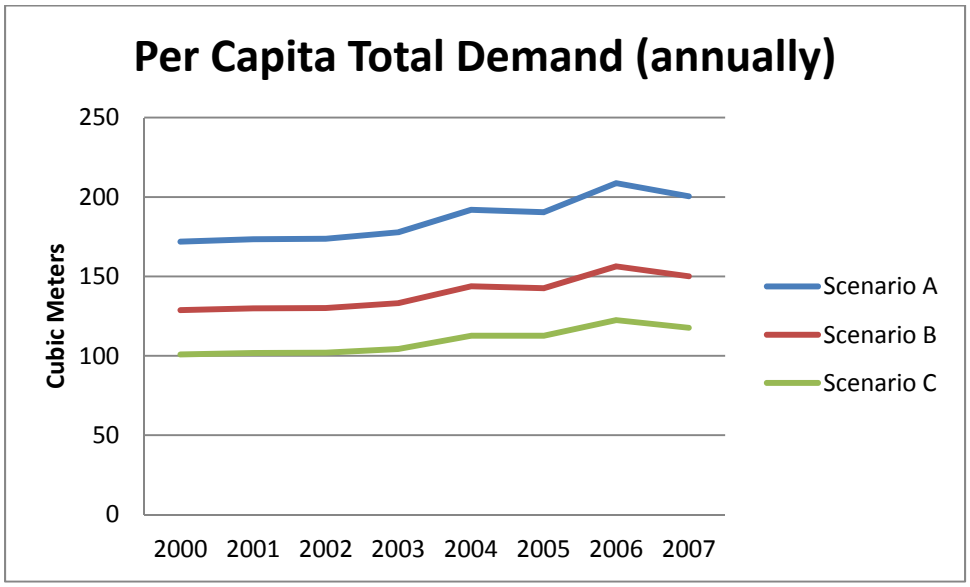


Fig. 16

Using the filter flows (total amount of water sent out of the treatment plant towards the City) the following chart shows the per capita daily usage in all three scenarios.

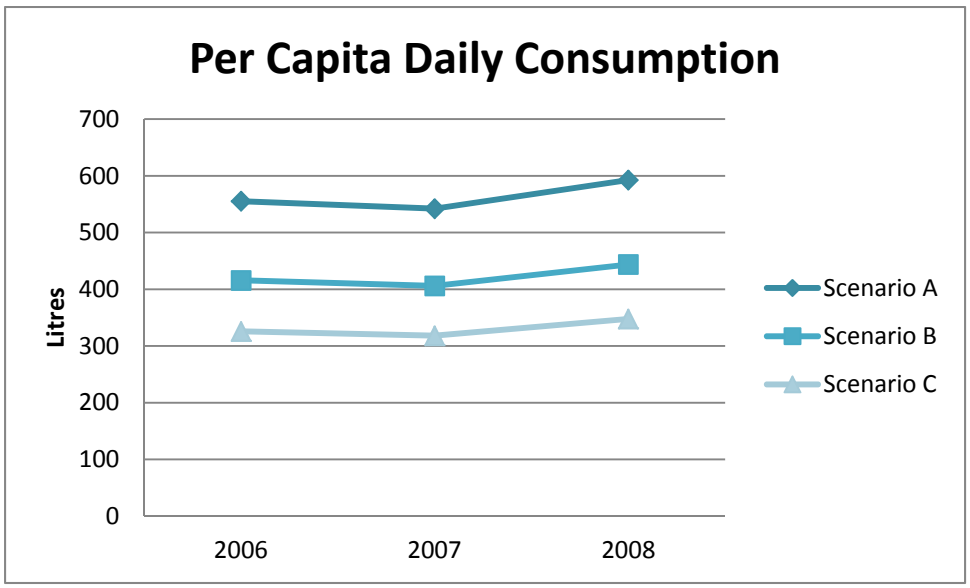


Fig. 17

Based on the residential billing accounts, seasonal consumption patterns can be seen below. As is typical, consumption rises dramatically in the summer months.

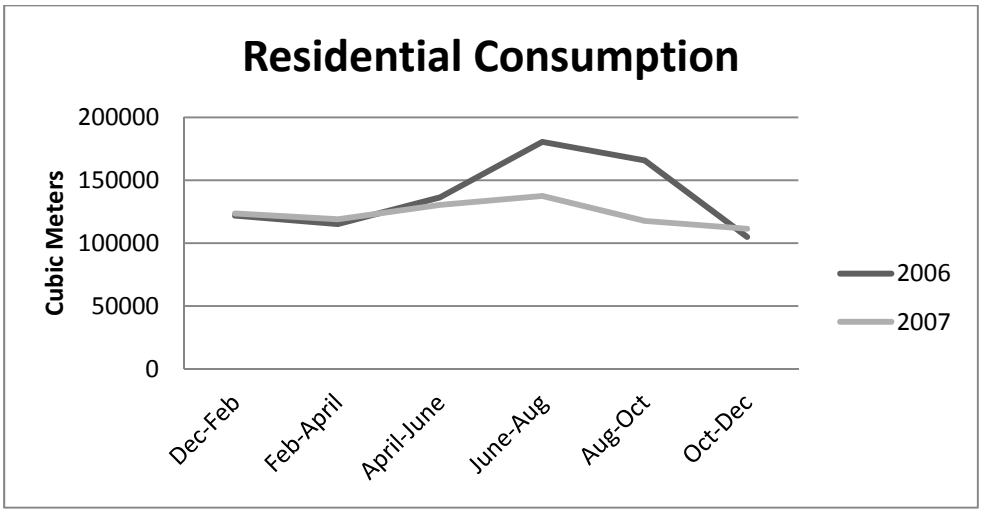


Fig. 18

Note that the peak in residential consumption typically takes place June-August.

The five-year river flows show the river flow levels peaking in May, and steadily decline through the summer months, the months during which consumption peaks.

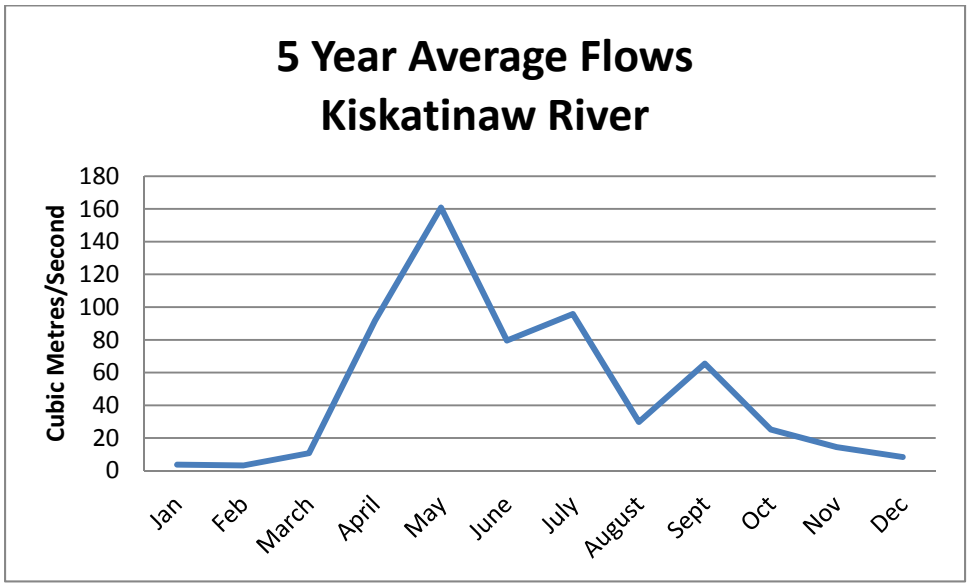


Fig. 19

Environment Canada released a study of urban residential water consumption in 1999. This report explored domestic water consumption in 20 Canadian cities. The lowest users were Charlottetown at 156 litres/capita/day (lcd – the total amount of water produced divided by the total population divided by 365) and Yellowknife at 164 lcd. The highest users were Whitehorse at 519 litres/capita/day and St. John's at 659 litres/capita/day. The City ranks among the higher users with its domestic consumption rate of 572 lcd in 2006 and 549 lcd in 2007. These figures are based on total annual production divided by total Dawson Creek population. Based on billing records, single family homes (roughly 80% of the population) used roughly 256 lcd in 2006 and 205 lcd in 2007 (this figure represents actual billed volumes per capita).

4.5 Treated out of City

The Treated out of City water consumption has varied uses, some residential, some agricultural and some commercial. The usage can be seen to follow higher consumption in the summer months for both 2006 and 2007.

Note that the peak in Treated out of City consumption typically takes place June-August.

The five-year river flows show the river flow levels peaking in May, and steadily decline through the summer months, the months during which consumption peaks.

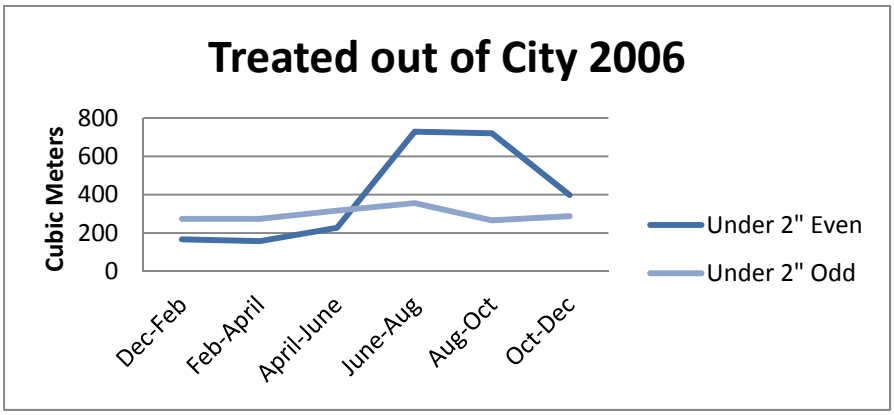


Fig. 20

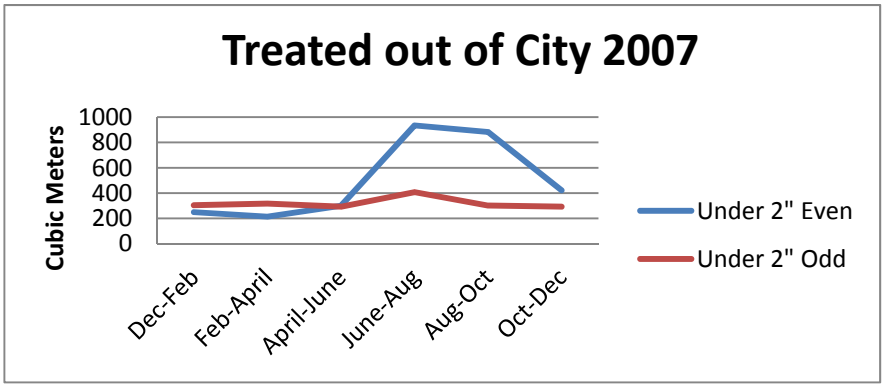


Fig. 21

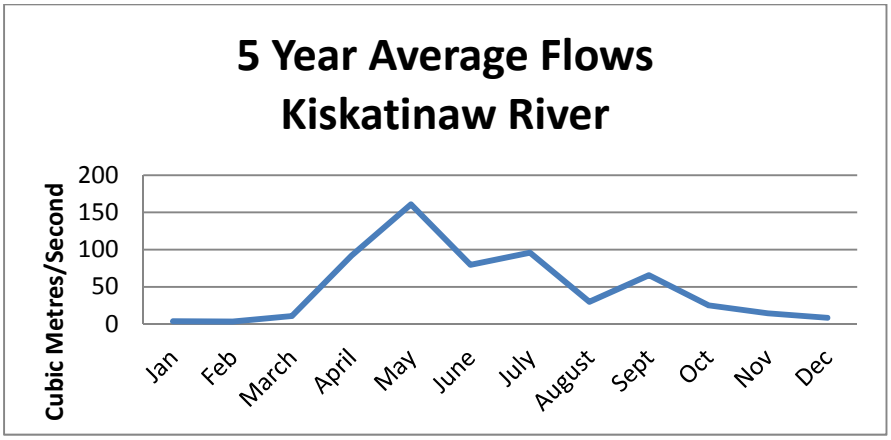


Fig. 22

4.6 Industrial Commercial Institutional

Shown below is the ICI consumption for the year 2007. The graph is drawn using data collected from two-month billing periods, which is why the volume appears to be constant for two-month periods.

Note that the peak in ICI consumption typically takes place August-September.

The five-year river flows show the river flow levels peaking in May, and steadily decline through the summer months, the months during which consumption peaks.

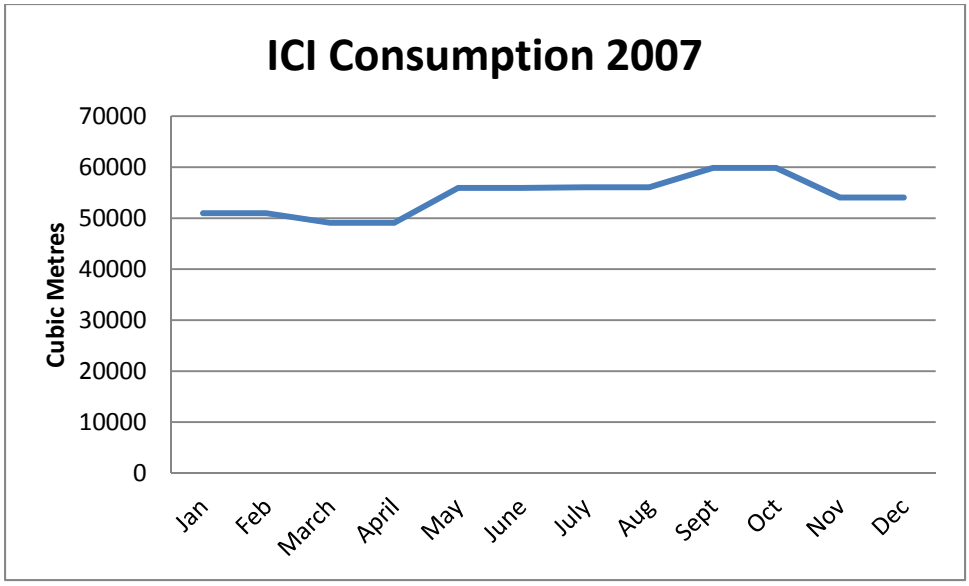


Fig. 23

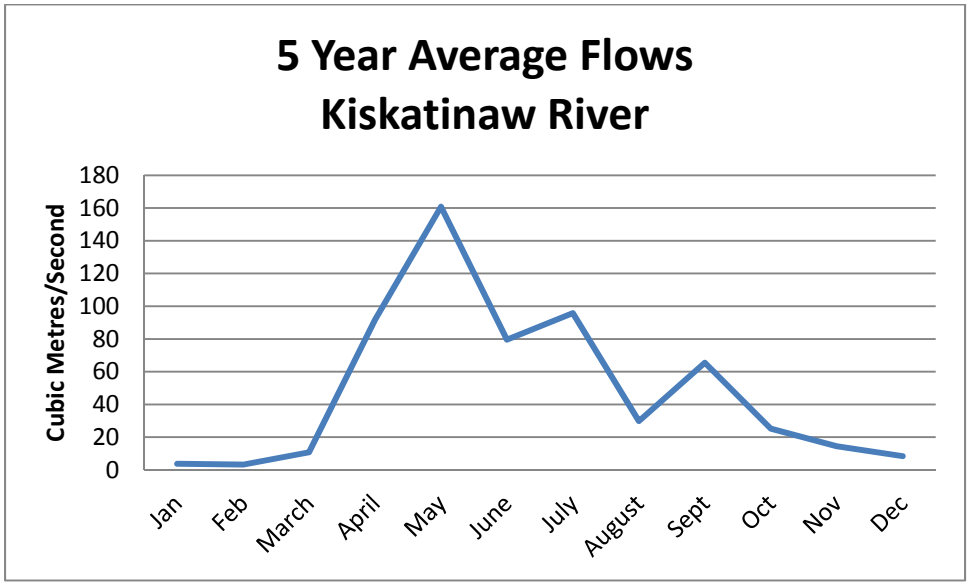


Fig. 24

4.7 Biggest Users

In a one-year analysis, three major water users have been identified. They are:

1. Oil and Gas Industry
2. Forestry Industry
3. Health Services

Together these users account for roughly 300,000 cubic meters (or roughly 12%) of the annual water usage. The other top users include:

4. Car Washes
5. Food Services (restaurants and grocery stores)
6. Hotels
7. Educational Services
8. Government
9. Laundromats
10. Drinking Water Providers

Other top users include: grocery stores, restaurants (sit-down, fast food, and convenience stores) and hotels. In developing a water strategy it is crucial to include the water-intensive businesses of Dawson Creek.

4.8 Current Average Annual Use

The maximum day use of the ICI sector is currently unknown. The rated supply for ICI would be the capacity of the water treatment plant, but the permitted total supply is unknown.

4.9 Agricultural Use

While not a major part of the City's water consumption (1% in 2007, see Figure 11), the patterns in consumption vary with season, again peaking in the summer months, as can be seen in the graph below. This increase could be due to increased non-agricultural usage (such as lawn or garden watering). The spike in the fall of 2007, during the river's low-flow period, should be investigated for the purposes of creating a conservation plan.

Note that the peak in agricultural consumption typically takes place June-August.

The five-year river flows show the river flow levels peaking in May, and steadily decline through the summer months, the months during which consumption peaks.

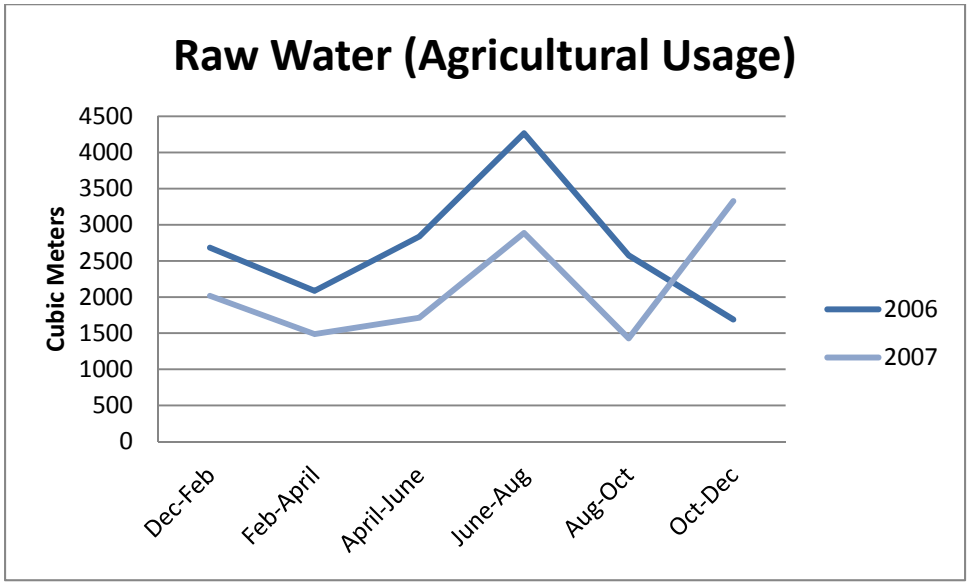


Fig. 25

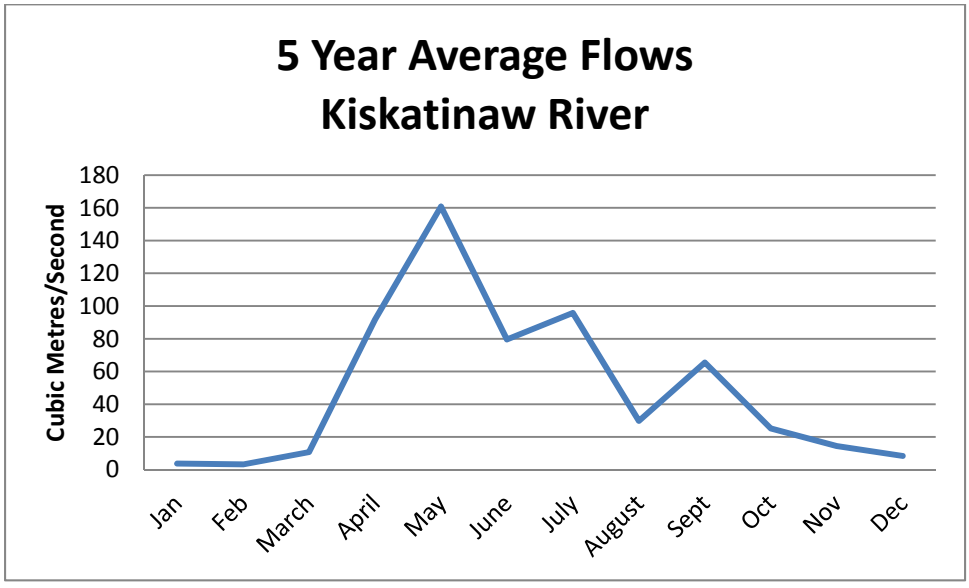


Fig. 26

4.10 Water Card Sales

Water cards sales are predominantly made up of commercial sales, which would indicate that any plans to reduce the consumption of water card users should be directed at the commercial card holders, rather than the residential card holders.

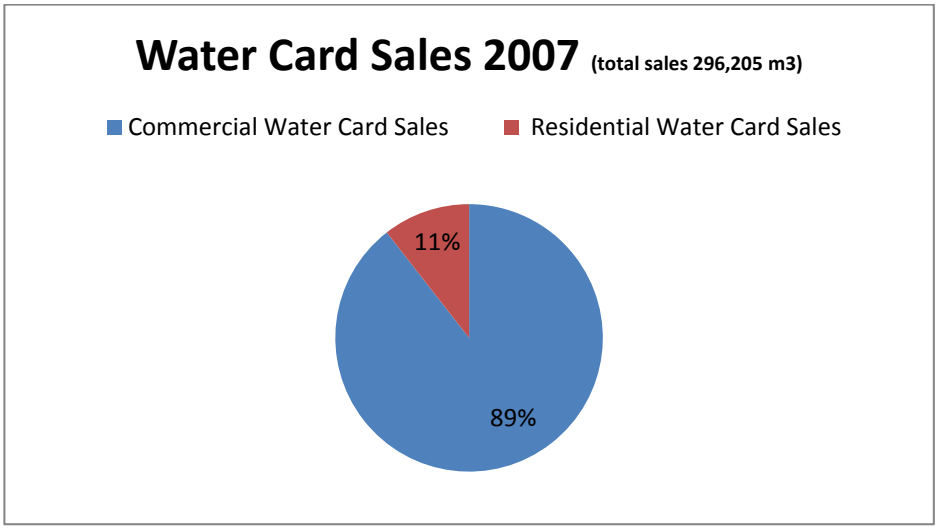


Fig. 27

5.0 Unaccounted for Water

The soil around Dawson Creek is clay. Any major leaks are detected almost immediately as the water comes to the surface. The City is almost entirely metered and for the most part, leaks can be detected by meter readings that are irregular. The water treatment plant has also made some base calculations and has determined the unaccounted for water for 2006 and 2007. It is listed below:

- 2006: 355,347 cubic meters equalling $241,636 in lost revenue
- 2007: 360,562 cubic meters equalling $245,182 in lost revenue

The treatment plant staff have discovered many of the areas where water passes through the system but is not billed, which include:

- Irrigation
- Hydrants
- Water line flushing
- Treatment Plant backwashing
- Occasional pipeline leaks

The treatment plant staff have selected several strategies for remedying this situation, which include:

- Moving towards zone metering to enable a water auditing process once new residential metering system is in place
- Adding a meter at the water treatment plant on water that leaves the plant to monitor more accurately
- Hydrant meter has been purchased for contractors who use City hydrants

Other suggestions from the water treatment plant operator include:

- Public works, parks and fire department (non-emergency) departments should meter or give estimates of water usage
- All leaks should have a report estimating water usage
- All fires should have a report estimating water usage
- All irrigation systems should be metered

6.0 Primary ecosystem challenges

One of the major considerations when developing a demand management approach to water management is ensuring that there is enough water for all users in the watershed. In a recent government report "Taking Nature's Pulse: The Status of Biodiversity in British Columbia", it states that "one of the six major stresses that threaten biodiversity is ecosystem degradation (change to structure of a natural system from activities such as...water diversion)" (XVIII, 2008). The ecosystems that rely on the Kiskatinaw River also need to be considered in the development of the City's water strategy. The Government of British Colombia reports on their website the following about the Kiskatinaw River watershed:

- The Kiskatinaw River Protected Area conserves rare grassland vegetation in the Peace Lowland ecosystem. A red-listed species, the fennel-leaved desert parsley (*Lomatium foeniculacrum var. foeniculaceum*) has also been recorded at this site.
- Wildlife - Mule deer, white-tailed deer and other ungulates frequent the open hillsides. Coyote, beaver and other small mammals are also common throughout the area. The area has a great diversity and abundance of songbirds such as warblers.

The ecosystem that relies on the Kiskatinaw River needs to be protected through the conservation plan.

7.0 Population and growth

The current population of the City of Dawson Creek (as of the 2006 Canadian Census) is 10,994. The Village of Pouce Coupe's population in 2006 was listed as 739. Both the City and the Village have had fluctuating populations over the past several years, consistent with the boom and bust associated with industry. According to the Comprehensive Environmental Development Plan by Urban Systems (2003) the average annual growth has been 0.4%. Based on this growth, three possible future growth scenarios have been developed:

- at 0.4% annual growth, the population will increase by 894 by 2021 to 11888
- at 1% annual growth, the population will increase by 2,368 by 2021 to 13362
- at 2% annual growth, the population will increase by 5,226 by 2021 to 16220

Urban Systems also estimate that should the City grow at the following rates, new residential units would need to be built as follows:

- 0.4% growth rate would require up to 331 new residential units with an area of 70 acres of new land
- 1% growth rate would require up to 877 units with an area of 185 acres of new land
- 2% growth rate would require up to 1,936 units with an area of 408 acres of new land

7.1 Projected industrial growth

The industrial growth rates are based on land growth in this report, not on the projected percentage of businesses coming to the City. A lot of the new growth is a demand for new space. Urban Systems forecasts commercial growth as follows:

-Annual commercial growth for the next 20 years at 0.4 % is probable and 1% growth is possible.

7.2 Number of older homes versus new developments

As of the end of 2008, there were 3,832 homes in the City. There were 49 homes built in the last year. (Information from the City's tax department)

7.3 Primary drivers of growth

According to Urban Systems, the majority of the City's economy is made up of the forestry industry, oil and gas, tourism, and retail sectors (2006).

8.0 Other Community Initiatives

The City has an Official Community Plan that defines the limitations for future growth. It is available online at: http://www.dawsoncreek.ca/cityhall/departments/documents/3550OfficialCommunity PlanConsolidated_001.pdf.

8.1 Community Groups

The City has two groups that are very concerned about the water situation in Dawson Creek. One of these groups is the Dawson Creek Watershed Society; they recently partnered with the City to create the *Kiskatinaw River Watershed Source Protection Plan*. The group is hoping to hire a watershed steward who would help to ensure that the watershed is being protected.

The Northern Environmental Action Team (NEAT) is also involved in educating the population of the City about water conservation. They have created a water conservation education strategy for the City of Dawson Creek and have begun implementation.

8.2 City Initiatives

Due to the fact that the City undertakes several "green" initiatives involving energy and community development, the people of Dawson Creek tend to be better informed than those in other, less environmentally active cities. The City has already undertaken the following measures:

- Developed a Watershed Conservation Plan
- Developed a Water Conservation Bylaw
- Completed a water pricing study
- Completed a baseline report
- Has begun construction on Bear Hole Lake weir
- Started community education with NEAT programs (75 in attendance)
- Installed low-flow fixtures in all City buildings
- Developed a strategy for industry effluent re-use
- Employs conscientious water treatment staff and good record keeping

9.0 Summary

This report highlights the water situation in the City of Dawson Creek. The most significant findings include:

- Higher than Canadian average consumption per capita
- Consumption in all sectors increases as river flow rates decrease
- Unaccounted for water volumes are slightly higher than Canadian averages
- The Oil and Gas Industry consumes a high volume of fresh water, typically for non-potable uses

Several areas could be targeted for conservation strategies, including reducing both residential and industrial usage. Partnering with the oil and gas industry to reduce the use of fresh water is a key step for the City. Summer usage, as in most communities, can also be targeted for reduction. The Kiskatinaw River will be able to supply the City for their water needs for the foreseeable future, assuming conservation measure are put in place.

The conservation strategy falls under the larger framework of the Community Sustainability Plan, which is available at www.planningforpeople.ca. As part of this strategy, the City has developed a Community Energy Plan, a Carbon Neutral Strategy, and a Community Social Plan. The City is also updating their Official Community Plan by developing a housing strategy. A water conservation strategy that reduces water usage will help to save energy, reduce carbon emissions, and create a secure water future for the citizens of Dawson Creek.

10.0 Recommendations

The City can take immediate steps towards implementing a water strategy. The following items are suggested for implementation immediately:

1. **Adopt a water vision for the City of Dawson Creek:**

   In line with new British Columbia Government legislation, the City of Dawson Creek will meet 50% of its new water needs through conservation measures by the year 2020.

   As a volume target, the City will reduce the current per capita daily consumption by 20% by the year 2020. Going from an average of 584 litres/capita/day (2005-2007) to 467 litres/capita/day by 2020.

In order to meet these targets, the City can show responsible leadership by adopting these Corporate measures:

2. Update current water and provide staff with relevant training to allow for better data management and report generation. Accessing water records is essential for monitoring the effectiveness of the water conservation strategy.
3. Update current water metering system to wireless technology, in order to obtain more accurate water consumption rates and better monitoring and prevention of leakage/loss. This will result

in lower volumes of unaccounted for water in the future- up to 10% of leakage/loss can be due to faulty meters.

The City can also continue with leadership initiatives already underway, including:

4. Further the trend towards xeriscaping in all public spaces, a trend which greatly reduces the demand for irrigation.
5. Update current irrigation practices in order to ensure that they are the most efficient practices possible.

The following measure have been proven as highly effective in other communities for reducing water over-consumption, and should be communicated by the City to the community in order to achieve the conservation targets:

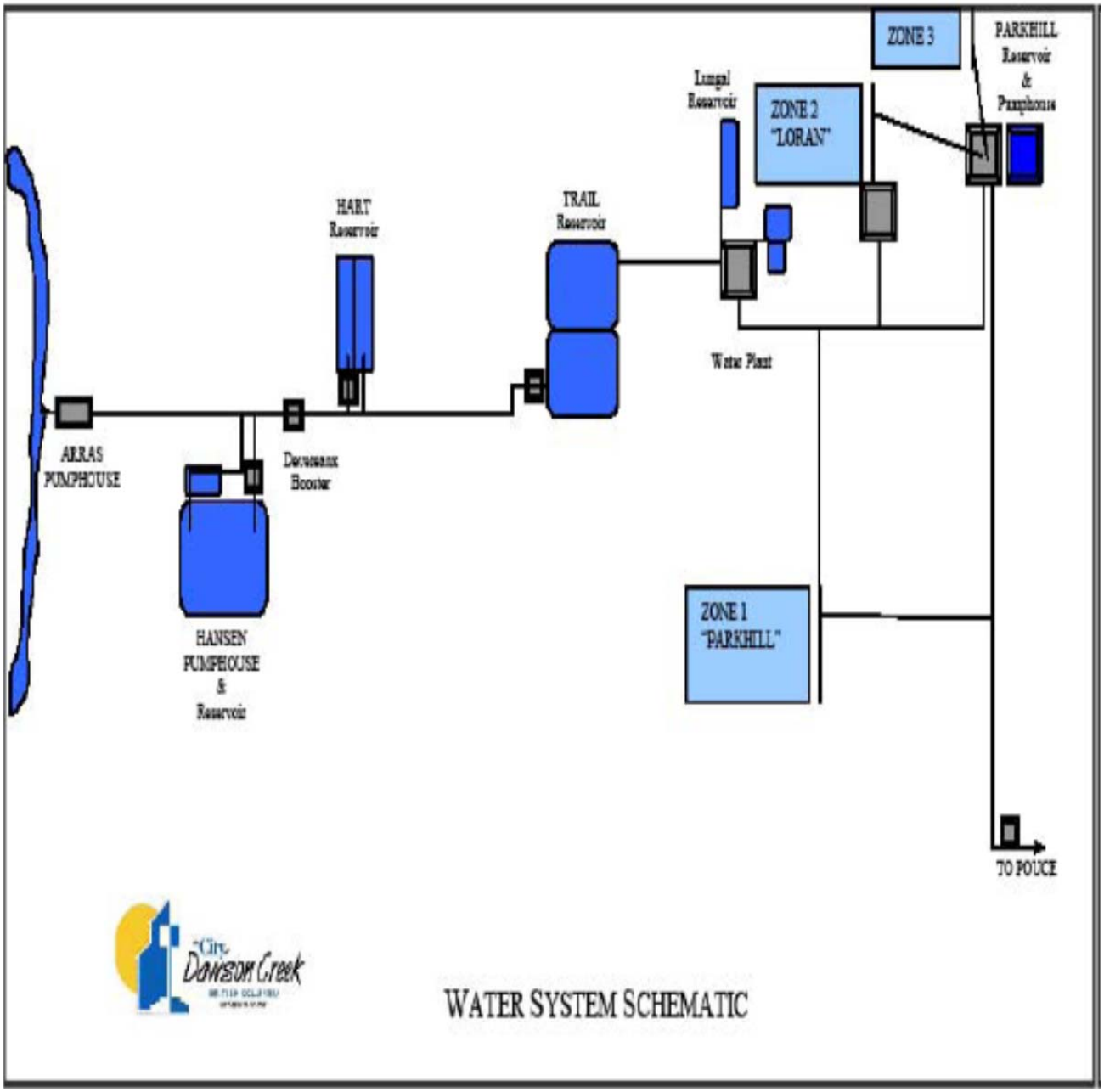
1. Update the pricing structure for water billing, making over-consumption financially undesirable.
2. Continue the development of an effluent re-use station for non-potable water in the Oil and Gas industry (oil and gas is the largest consumer of water in the City's industrial, commercial and institutional sector)
3. Expand upon the current community education initiative – education is essential, not only to convince the community of the value of water conservation, but also to provide them with the tools to do so.
4. Implement a strategy to increase the uptake of low-flow fixtures in homes, such as low-flow toilets and faucet aerators.
5. Promote the usage of grey water reuse systems in new construction and rainwater capture in all homes

A combination of the above strategies will enable the City to meet the conservation targets by 2020.

11.0 Appendices:

Appendix i

Water System Schematic



Appendix ii

Water Licenses on the Kiskatinaw

Licence No	Stream Name	Purpose	Quantity	Licensee	Water District/Precinct	Licence Status
C060532	Sloane Slough	Conserv.-Stored Water	100	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Current
C060857	Wilde Creek	Conserv.-Stored Water	245	ENVIRONMENT LANDS & PARKS MINISTRY OF PARLIAMENT BUILDINGS VICTORIA BC V8V1X4	PEA - DAWSON CREEK	Current
C062752	Cutbank Creek	Conserv.-Stored Water	508	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Current
C062753	Kiskatinaw River	Irrigation	90	HUNTER GERALD A GD ARRAS BC V0C1B0	PEA - DAWSON CREEK	Current
C062766	Wangler Creek	Conserv.-Stored Water	166	ENVIRONMENT LANDS & PARKS MINISTRY OF PARLIAMENT BUILDINGS VICTORIA BC V8V1X4	PEA - DAWSON CREEK	Current
C068859	One Island Lake	Land Improve	1778	PARKS BRANCH 430-1011-4TH AVE PRINCE GEORGE BC V2L3H9	PEA - DAWSON CREEK	Current
C102247	Ruston Spring	Domestic	1000	GUENETTE MARCEL J BOX 141 GROUNDBIRCH BC V0C1T0	PEA - DAWSON CREEK	Current
"	Ruston Spring	Land Improve	5	GUENETTE MARCEL J BOX 141 GROUNDBIRCH BC V0C1T0	PEA - DAWSON CREEK	Current
C102248	Bosch Creek	Stockwatering	1000	JONSSON ALAN S BOX 13 TAYLOR BC V0C2K0	PEA - DAWSON CREEK	Current
C102249	Richardson Pond1	Stockwatering	2000	RICHARDSON GERALD C & RUTH E PO BOX 2266 DAWSON CREEK BC V1G4L1	PEA - DAWSON CREEK	Current
"	Richardson Pond2	Stockwatering	2000	RICHARDSON GERALD C & RUTH E PO BOX 2266 DAWSON CREEK BC V1G4L1	PEA - DAWSON CREEK	Current
C102264	Little Brassey Creek	Domestic	500	FYFE HOWARD R GD ARRAS BC V0C1B0	PEA - DAWSON CREEK	Current
"	Ormandy Spring	Domestic	500	FYFE HOWARD R GD ARRAS BC V0C1B0	PEA - DAWSON CREEK	Current
C102413	Kiskatinaw River	Dust Control	10000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Dust Control	10000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
C102464	Brassey Creek	Dust Control	10000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current

C102934	WEAVER SPRING	Stockwatering	3000	WEAVER KEITH & JANET GD TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Current
C103920	Kiskatinaw River	Irrigation	50	CHIMBUDZI ENTERPRISES LTD PO BOX 908 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Stockwatering	1000	CHIMBUDZI ENTERPRISES LTD PO BOX 908 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
C103921	Kiskatinaw River	Domestic	500	NIMITZ ERNEST & CAROL PO BOX 908 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Irrigation	50	NIMITZ ERNEST & CAROL PO BOX 908 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Stockwatering	1000	NIMITZ ERNEST & CAROL PO BOX 908 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
C104190	Rimstad Creek	Domestic	500	YOUB FREDRICK L & ROBERTA C PO BOX 957 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Pending
C104526	Kiskatinaw River	Irrigation	7	SALISBURY OSCAR EDMOUR GENERAL DELIVERY PROGRESS BC V0C2E0	PEA - DAWSON CREEK	Current
C104880	Coulee Creek	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 10	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 3	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 4	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 5	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 6	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 7	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 8	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 9	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Sunset Creek	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 1	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Colwell Pond # 2	Stockwatering	500	COLWELL WILLIAM & HELEN GD SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
C104905	Dew Creek	Stockwatering	500	BRUUN LUTHER & MADELINE PO BOX 515 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current
"	Willow Creek	Stockwatering	500	BRUUN LUTHER & MADELINE PO BOX 515 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current
"	Mist Creek	Stockwatering	500	BRUUN LUTHER & MADELINE PO BOX 515 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current
"	Willow Creek	Stockwatering	500	BRUUN LUTHER & MADELINE PO BOX 515 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current
C104956	Reed Creek	Irrigation	7.3	SCAFE LOUISE BOX 94 DAWSON CREEK BC V1G4E9	PEA - DAWSON CREEK	Current
"	Reed Creek	Stockwatering	1000	SCAFE LOUISE BOX 94 DAWSON CREEK BC V1G4E9	PEA - DAWSON CREEK	Current
C105317	Willow Creek	Stockwatering	1000	BRUUN TIM PO BOX 385 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current

C105380	Kiskatinaw River	Irrigation	1600	BOREK HOLDINGS (1975) LTD PO BOX 870 DAWSON CREEK BC V1G4H8	PEA - DAWSON CREEK	Current
C105385	Brassey Creek	Stockwatering	2000	DYSERT FARMS LTD PO BOX 984 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
"	Brassey Creek	Stockwatering	2000	DYSERT FARMS LTD PO BOX 984 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
C105702	Reamer Creek	Domestic	1000	HALLIDAY BRIAN & SONJA PO BOX 2065 DAWSON CREEK BC V1G4K8	PEA - DAWSON CREEK	Current
"	Reamer Creek	Stockwatering	1000	HALLIDAY BRIAN & SONJA PO BOX 2065 DAWSON CREEK BC V1G4K8	PEA - DAWSON CREEK	Current
"	Reamer Creek	Stockwatering	1000	HALLIDAY BRIAN & SONJA PO BOX 2065 DAWSON CREEK BC V1G4K8	PEA - DAWSON CREEK	Current
C105704	Reed Creek	Domestic	500	KER CONSULTING LTD 204 4190 LOUGHEED HWY BURNABY BC V5C6A8	PEA - DAWSON CREEK	Current
"	Reed Creek	Stockwatering	500	KER CONSULTING LTD 204 4190 LOUGHEED HWY BURNABY BC V5C6A8	PEA - DAWSON CREEK	Current
C105762	Kiskatinaw River	Irrigation	100	HERRON EDDIE DON PO BOX 984 DAWSON CREEK BC V1G4H9	PEA - DAWSON CREEK	Current
C107310	Kiskatinaw River	Dust Control	6000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
C107548	Brassey Creek	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Buffalo Creek	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Livingstone Creek	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Five Mile Creek	Dust Control	2000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Five Mile Creek	Dust Control	2000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Five Mile Creek	Dust Control	2000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Brassey Creek	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
C108095	Kiskatinaw River	Storage	1740	DAWSON CREEK CITY OF BOX 150 DAWSON CREEK BC V1G4G4	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Waterworks Local Auth	730000 000	DAWSON CREEK CITY OF BOX 150 DAWSON CREEK BC V1G4G4	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Storage	1740	DAWSON CREEK CITY OF BOX 150 DAWSON CREEK BC V1G4G4	PEA - DAWSON CREEK	Current

"	Kiskatinaw River	Waterworks Local Auth	730000 000	DAWSON CREEK CITY OF BOX 150 DAWSON CREEK BC V1G4G4	PEA - DAWSON CREEK	Current
C108658	Mawson Creek	Stockwatering	1000	BRUUN MADELINE BOX 515 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current
"	Madeline Spring	Stockwatering	1000	BRUUN MADELINE BOX 515 DAWSON CREEK BC V1G4H4	PEA - DAWSON CREEK	Current
C111413	Kiskatinaw River	Oil Field Injection	0.5	DUVERNAY OIL CORPORATION C/O MCELHANNEY ASSOCIATES 1550 202-6TH AVE SW CALGARY AB T2P2R9	PEA - DAWSON CREEK	Current
"	Kiskatinaw River	Storage	17	DUVERNAY OIL CORPORATION C/O MCELHANNEY ASSOCIATES 1550 202-6TH AVE SW CALGARY AB T2P2R9	PEA - DAWSON CREEK	Current
C117562	Williams Spring	Domestic	1000	FRIESEN DOUGLAS & BRENDA BOX 807 TAYLOR BC V0C2K0	PEA - DAWSON CREEK	Current
C118180	Cardiff Spring	Domestic	1000	WETHERILL WADE V BOX 191 GROUNBIRCH BC V0C1T0	PEA - DAWSON CREEK	Current
C118568	Kiskatinaw River	Irrigation	70	JANGS JACK 1033 - 102 AVE DAWSON CREEK BC V1G2B7	PEA - DAWSON CREEK	Current
C120406	Sunderman Creek	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Sunderman Creek	Road Maintenance	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Borden Creek	Dust Control	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
"	Borden Creek	Road Maintenance	3000	TRANSPORTATION & HIGHWAYS MINISTRY OF 300 10003 110TH AVE FORT ST JOHN BC V1J6M7	PEA - DAWSON CREEK	Current
C120505	Norrie Creek	Stockwatering	2000	CLAVIER PHILLIP J BOX 255 SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
"	Norrie Creek	Storage	3	CLAVIER PHILLIP J BOX 255 SUNSET PRAIRIE BC V0C2J0	PEA - DAWSON CREEK	Current
Z121301	ZZ Creek (79429)	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 5	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 6	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 2	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 1	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 3	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson	Conserv.-	13.82	DUCKS UNLIMITED (CANADA)	PEA - DAWSON CREEK	Active

	Pond 4	Stored Water		OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0		Appl.
"	Donaldson Pond 7	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 8	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 9	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.
"	Donaldson Pond 10	Conserv.- Stored Water	13.82	DUCKS UNLIMITED (CANADA) OLD EDMONTON HWY(SWAN LK) PO BOX 7 TOMSLAKE BC V0C2L0	PEA - DAWSON CREEK	Active Appl.

Appendix iii
Water Flow Chart – where does the City's water go?

12.0 Data sources

The data in the report, unless otherwise specified by references, comes directly from the Water Treatment Plant, City Utility Billing Department, Village of Pouce Coupe Utility Billing Department, and other City Departments.

Figure Data Sources

1. Maximum (record peak flow) in meters per second, between 1944 and 2004 of the Kiskatinaw River- from Environment Canada.
2. Minimum flow (record low flow) in meters per second, between 1944 and 2004 of the Kiskatinaw River- from Environment Canada.
3. Average river flows for the years 2001 to 2006, with a 6-year total average flow also. Taken from the flow records from Environment Canada.
4. Annual precipitation data for the City of Dawson Creek from 1985 to 2005. Data collected online from the Environment Canada's National Climate Data Archive.
5. Annual average temperature in the City of Dawson Creek from 1985 to 2006. Data collected online from the Environment Canada's National Climate Data Archive.
6. Total Water Treatment Plant production from 2000 to 2007. Water records are collected and kept by the Treatment Plant operator through metering.
7. Sewage records from 2004 to 2008 from the lift station (pumps) and outfall (into the Dawson Creek). Records are collected and kept by the Treatment Plant operator through metering.
8. Total number of registered water utility accounts for the year 2008. Data from the City's Utility Billing Department.
9. Based on billing records and water filling station meter reading for the year 2006. The data from the billing records is from the City's Utility Billing Department, while the data for the water filling stations is from the Water Treatment Plant's meter readings.
10. A detailed analysis of the City's water consumption for 2007, taken from Pouce Coupe billing records, the City's billing records (Utility Billing Department) and Water Treatment Plant meter readings for the water filling stations.
11. Same sources above, however the data was combined into more general categories to better compare with Canadian averages.
12. Municipal water usage by sector 2004 – taken from the Environment Canada website online.
13. Village of Pouce Coupe disaggregation for 2007- manually compiled using print-outs from the Village of Pouce Coupe Utility Billing department.
14. 2000-2007 maximum daily demand and average daily demands records- obtained from the Water Treatment Plant operator.
15. "Water use in the home" graph taken from the Environment Canada website
16. 2000-2007 total water production (taken from meters at Water Treatment Plant) per capita. Three different population numbers were used; scenario "A" is only the City and the Village of Pouce Coupe (Statistics Canada 2006 census), scenario "B" which includes the estimated clients from the water haulers, and scenario "C" – an estimate from the Water Treatment Plant operator which includes the number of people who likely use the water filling stations.

17. Using the same population scenarios as figure 16, the daily per capita usage was determined for 2006-2008.
18. Using residential billing records for the City only, seasonal consumption patterns are shown for the years 2006 and 2007.
19. Average river flows for a 5-year total average flow. Taken from the flow records from Environment Canada.
20. Taken from Utility Billing Department data, 2006.
21. Taken from Utility Billing Department data, 2007.
22. Average river flows for a 5-year total average flow. Taken from the flow records from Environment Canada.
23. Taken from Utility Billing Department data, 2007.
24. Average river flows for a 5-year total average flow. Taken from the flow records from Environment Canada.
25. Taken from Utility Billing Department data, 2006 and 2007.
26. Average river flows for a 5-year total average flow. Taken from the flow records from Environment Canada.
27. Taken from the Water Treatment Plant meter records for the water filling stations, 2007.

13.0 References

A.R.I. Flow Control Accessories (n.d.) *Unmeasured-Flow Reducer.* Retrieved March 9, 2009, from http://www.arivalves.com/PDF/UFRx2.pdf

BC Government. (2008). *Living Water Smart* (p75-79). Retrieved March 9, 2009, from http://www.livingwatersmart.ca/docs/livingwatersmart_book.pdf

BC Government. (2006). *Mountain Pine Beetle Action Plan 2006-2011*. Retrieved March 9, 2009, from http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/actionplan/2006/Beetle_Action_Plan.pdf

BCHydro. (2009). *Save Water Outdoors.* Retrieved March 9, 2009 from http://www.bchydro.com/guides_tips/green-yourhome/water_guide/Save_water_outdoors.html

BC Parks. (n.d.). Kiskatinaw River Protected Area. Retrieved March 9, 2009, from http://www.env.gov.bc.ca/bcparks/explore/parkpgs/kiskatinaw_rv/

Brandes, O. M., Ferguson, K. (2003). *Flushing the Future? Examining Urban Water use in Canada.* (Available from the POLIS Project on Ecological Governance, University of Victoria, University House 4, PO Box 3060, Victoria, BC V8W 3R4).

Brandes, O. M., Maas, T., Reynolds, E. (2006). *Thinking Beyond Pipes and Pumps – Top Ten Ways Communities Can Save Water and Money.* (Available from the POLIS Project on Ecological Governance, University of Victoria, University House 4, PO Box 3060, Victoria, BC V8W 3R4).

City of Dawson Creek. (2001). *Water Quality Assurance Plan*. Retrieved March 9, 2009, from http://www.dawsoncreek.ca/cityhall/departments/documents/WaterQualityAssurancePlan.pdf

Environment Canada. (n.d.) *Water Use in the Home* (Image). Retrieved March 9, 2009, from http://www.ec.gc.ca/Water/images/manage/effic/a6f7e.htm

Environment Canada. (2004). Municipal water use by sector, 2004 (Image). Retrieved March 9, 2009, from http://www.ec.gc.ca/Water/images/manage/effic/a6f2e.htm

Wong, J., Porter-Bopp, S., Brandes, O. M., Edwards, L. (2009, January) *Water Conservation Planning Guide- A Seven Step "How To" for British Columbia's Communities.* (Available from the POLIS Project on Ecological Governance, University of Victoria, University House 4, PO Box 3060, Victoria, BC V8W 3R4).

Statistics Canada. (2006). *Dawson Creek British Columbia.* Retrieved March 9, 2009, from http://www12.statcan.ca/censusrecensement/2006/dppd/prof/92591/details/page.cfm?B1=All&Code1=5955014&Code2=59&Custom=&Data=Count&Geo1=CSD&Geo2=PR&Lang=E&SearchPR=01&SearchText=Dawson+Creek&SearchType=Begins

Statistics Canada. (2006). Pouce Coupe British Columbia. Retrieved March 9, 2009, from http://www12.statcan.ca/censusrecensement/2006/dppd/prof/92591/details/page.cfm?Lang=E&Geo1=CSD&Code1=5955005&Geo2=PR&Code2=59&Data=Count&SearchText=pouce%20coupe&SearchType=Begins&SearchPR=01&B1=All&Custom=

Urban Systems. (2003, January). *Comprehensive Environmental Development Plan*. Kamloops, BC. (Available from the City of Dawson Creek, City Hall 10105-12A Street Box 150 Dawson Creek, BC V1G 4G4).