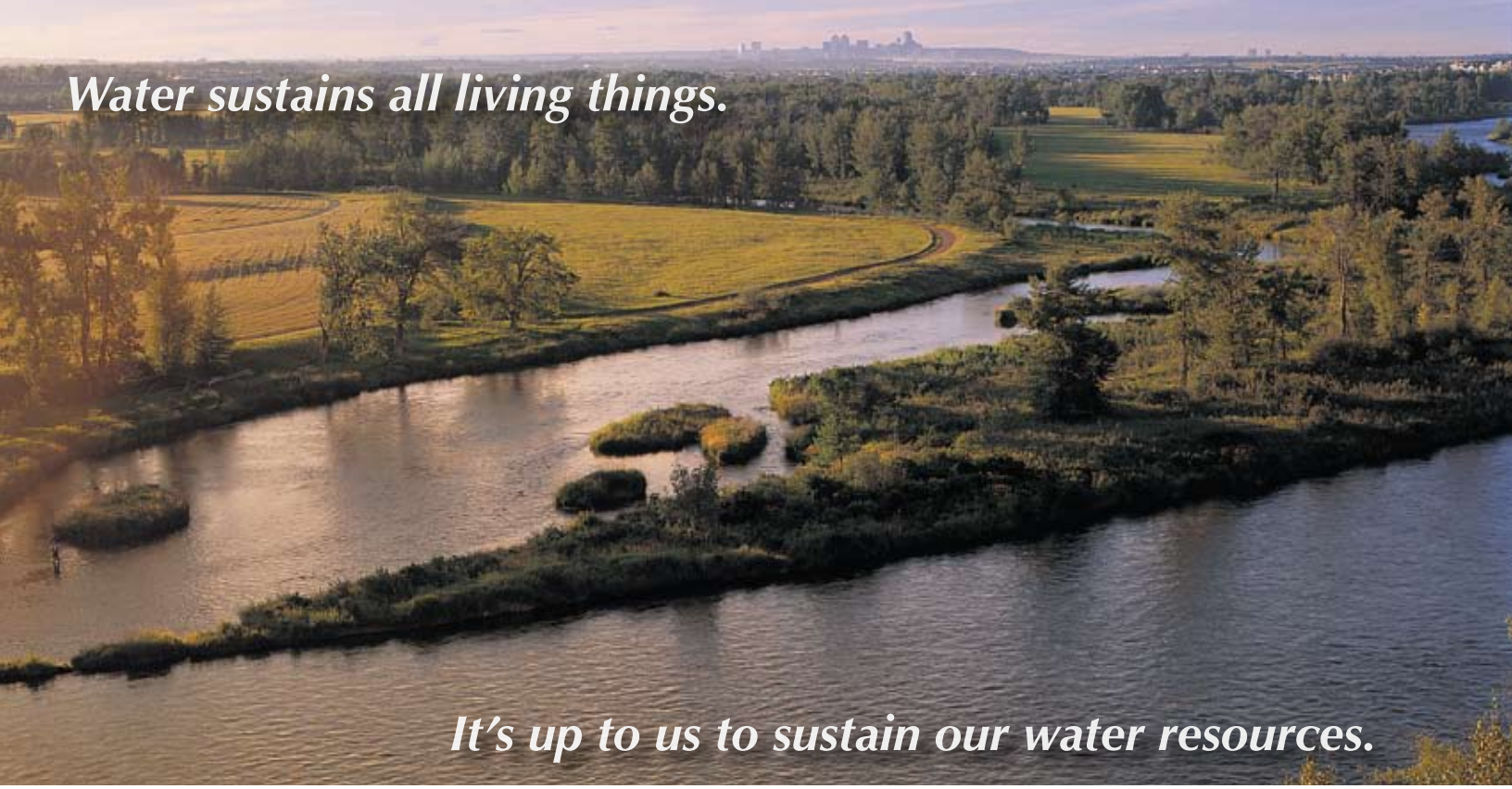
Water Efficiency Plan

30-in-30, by 2033

Council approved December 2005



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Abbreviations

BMPs	Best management practices
CHC	Calgary Housing Company
FTW	Filter-to-waste
ICI	Industrial, commercial and institutional
ISO	International Standards Organization
lpcd	Litres per capita per day
ML	Megalitre (equivalent to one million litres)
MLd	Megalitres per day
TBL	Triple-Bottom Line (policy framework)
WMIP	Water meter incentive program
WTP	Water treatment plant

Executive summary

The situation

Calgarians expect ready access to a safe and reliable fresh water supply. It's essential to our health, the success of our economy and the well-being of our society. Despite our reliance on fresh water resources, we tend to be complacent about water issues, particularly conservation.

The time for change has come.

Calgarians are fortunate to have access to some of the best drinking water in North America, as well as a first-class water treatment and delivery system. However, we're also very large consumers of water. Over the past decade, the amount of water we use per person has remained higher than many other North American and European cities.

As our city grows, so does our demand for water. Calgary's population has increased steadily in the past 25 years with unprecedented growth over the past decade. In fact, Calgary celebrated its one millionth citizen in 2006 — five years ahead of schedule. Servicing the water needs of this population require The City make the most of its current water and wastewater infrastructure and focus intently on sustainable resource planning and policy development. In short, The City must try to curb Calgarians' water-hungry habits and develop a strategic plan to encourage more efficient water use.

> *"The availability and management of fresh water are becoming one of the greatest environmental, social, and political challenges of the 21st century."* [1]
>
> Canada's Commissioner of the Environment and Sustainable Development, 2001

Adding to the challenges posed by rapid urban growth are the impacts of upstream development and climate change. Although the Bow and Elbow rivers flow through our city, we share this limited resource with a diverse set of users – other cities, communities, farmers, ranchers and industrial operators. Cumulatively, all users exert pressure on the water supply. Co-operation is needed from all stakeholders to protect these river systems and watersheds.

The message is clear: it's increasingly obvious that our city's current water use is not sustainable. The environmental health of our water resources is under pressure, our water supply is limited and our demand is increasing. Although The City has taken measures to address the situation, many more opportunities exist in Calgary for significant reductions in water consumption.

1 CESD, 2001

Our commitment

The City of Calgary is committed to protecting the safety and ensuring the long-term sustainability of its water supply. It aims to meet the needs of a growing population while balancing and considering the economic, social and environmental impacts of its decisions, programs and actions. The City recognizes it must continue to make wise choices in managing our water resources so Calgarians can continue to rely on their water system for decades to come.

The City of Calgary is committed to protecting the safety and ensuring the long-term sustainability of its water supply.

Our strategy

The City manages all aspects of the water treatment and distribution process. It strives to be an industry leader in water quality, distribution, resource management, customer service and education. In keeping with these goals, the utility has chosen to create a comprehensive Water Management Strategy. A key component of this strategy is the Water Efficiency Plan.

This Water Efficiency Plan provides a framework for The City's water conservation efforts and outlines the scope, purpose and potential water savings of its programs. It identifies specific targets for demand reduction and outlines how The City's conservation strategies will reduce water use, water loss and wastewater volumes while continuing to meet the needs of Calgarians.

The Water Efficiency Plan also helps guide decision-making by municipal leaders as they address the challenges facing our city's water supplies. It includes recommendations for program implementation and is intended to serve both as a comprehensive inventory of, and action plan for, water conservation in Calgary.

The Plan includes a summary of:

- Calgary's current infrastructure and supply characteristics.
- Water supply challenges facing our community and ways Water Resources aims to address these challenges.
- Benefits and desired outcomes of water efficiency planning.
- Calgary's water-use profile, including consumption data, across multiple sectors.
- Calgary's history of water conservation initiatives, including key milestones achieved to date.
- Programs implemented or considered, as well as their impacts.
- The City's water efficiency goal, strategies and targets.
- Future plans and priorities for water efficiency in our city.

The City's Water Efficiency Plan is intended as a living document that will be evaluated and revised on an ongoing basis to accurately reflect the scope and direction of The City's water conservation efforts.

1 Calgary's water system

The City of Calgary draws water from two surface water sources – the Bow and Elbow rivers – to meet our fresh water requirements. Both rivers originate in the mountains west of Calgary, flow through the foothills and then the city itself.

Water is treated at one of two drinking water treatment plants and then distributed to more than one million residential, business and wholesale customers via a vast network of storage reservoirs, pump stations and underground pipes.

From source to tap, Water Resources aims to provide safe, reliable drinking water that meets the needs of its diverse customer base while balancing the needs of the environment.

2 The case for conservation

Concern about the long-term sustainability of water resources is increasing as issues of scarcity, allocation and quality become more prevalent in our community.

The City of Calgary faces some significant challenges in managing its fresh water resources. These include:

- **Growing demand for water,** resulting from rapid population and economic growth.
- **Increased pressure on our water supply** due to increased demand from other municipal, recreational, industrial and agricultural users, both upstream and downstream of Calgary.
- **A finite supply of fresh water within the Bow and Elbow watersheds.** We currently withdraw about 46 per cent of The City's total annual allotment but projections suggest sufficient water may not be available should The City need to access the unused portion of its allotment in the future.
- **Uncertain impacts of climate change,** which scientists forecast will negatively impact water supplies in our region (i.e. increased droughts and lower water levels).
- **A continued, albeit gradual, decline in water quality** from these watersheds combined with increasingly stringent water quality regulations.

Demand management provides a proven, environmentally responsible and cost-effective opportunity for The City to overcome these challenges and ensure Calgarians continue to have a reliable water supply in the future. By promoting efficient water use, The City can:

- Reduce impacts on the watershed environment.
- Maximize service from existing water treatment and distribution infrastructure.
- Reduce the volume of water and wastewater it must treat and distribute, thereby reducing operating costs.
- Expand its capacity to accommodate increases in population and industry.
- Minimize the need for mandatory water restrictions.
- Foster a "culture of sustainability" among Calgarians.

3 Calgary's water use profile

Residential customers comprise the vast majority (92 per cent) of water service connections in Calgary and account for 52 per cent of demand. Industrial, commercial and institutional users represent only seven per cent of the total customer base but use 34 per cent of the water. The remainder is distributed to wholesale customers, consumed in delivering City services or lost through system leakage.

A very small proportion of the total amount of drinking water produced is used for drinking purposes. The bathroom accounts for 60 per cent of indoor water use and outdoor watering can increase residential demand by as much as 50 per cent in the summer months.

Historical data on water use in Calgary shows that:

- In the past 35 years, total annual system demand for water has nearly doubled.
- Calgary's average day demand continues to rise at a rate of about five per cent annually. This increase is due primarily to population and economic growth.
- Gross per capita demand in our city has averaged 550 litres per person, per day over the past 10 years.
- Calgarians have made significant progress in reducing maximum day per capita demand from a high of 1,732 litres per capita in 1979 to less than half this volume in recent years.
- Sanitary sewage flows in our city are increasing, rising 17 per cent since 1995.

4 Calgary's water efficiency history and successes

The City has created and implemented a wide range of water efficiency programs in an effort to reduce water use in our city and change the way Calgarians think about water. Many of these programs derive from industry "best practices" that have shown to result in significant water savings.

The City's water efficiency initiatives have evolved considerably over the past decade, growing in scope, strategic focus and customer participation. Initially, the emphasis was on universal metering, leak detection and customer education. While these remain cornerstones of Calgary's conservation efforts, a diverse set of voluntary programs, pilot projects, financial incentives and policies are now in place, which address the full spectrum of recommended demand-management practices.

To date, significant water savings have been accomplished through a combination of:

- Seeking efficiencies in The City's operations.
- Promoting water-efficient appliances, devices and services.
- Making conservation technologies accessible by offering rebates and other incentives for installing water-efficient products.
- Educating Calgarians of all ages about wise water use.
- Changing bylaws to make water efficiency a requirement (e.g. universal metering, mandatory water restrictions).
- Helping industrial, commercial and institutional customers realize both the value of, and opportunities for, water conservation.

These efforts have also helped to:

- Increase customer awareness about wise water use.
- Reduce river withdrawals.
- Improve distribution system integrity.
- Maximize The City's use of existing water treatment and distribution infrastructure.

5 Towards sustainability: Calgary's water efficiency future

The City of Calgary is committed to reducing overall water use and ensuring sustainable planning and management of Calgary's water resources for future generations. Its goal is to accommodate future population growth with the same amount of water Calgarians use today.

To achieve this goal, Water Resources identified specific indicators, targets, strategies and action areas for its conservation efforts. Core water efficiency strategies include:

- Setting a positive example for Calgarians by establishing The City as a leader in responsible water use.
- Aligning policy with conservation objectives by exploring regulatory opportunities and pursuing changes that favour water-efficient technologies, standards and procedures.
- Investigating and promoting opportunities to make appropriate use of alternative water sources.
- Encouraging the use of water-efficient technologies and promoting water-smart buildings and operations.
- Providing technical assistance to help customers identify ways to reduce their water use.
- Fostering awareness and a strong ethic of water conservation among all Calgarians through education programs and targeted communication campaigns.
- Partnering with stakeholders to resolve structural, regulatory and market barriers to conservation.
- Continually improving The City's water conservation efforts by monitoring their effectiveness and adapting them accordingly.

6 Water efficiency measures

To maximize its return on investment and best enable The City to reach its conservation objectives, Water Resources continually evaluates water efficiency measures used in other jurisdictions.

Measures are assessed based on their:

- Potential water savings.
- Technology performance.
- Cost-effectiveness.
- Suitability to customer groups.
- Social and environmental impacts.
- Implementation feasibility.
- Recognition as an industry "best practice."

Currently, 11 water efficiency measures have been recommended for implementation in Calgary. All of these are either currently underway or in the pilot stage. They include:

- System leak detection and main replacement.
- Treatment process upgrades.
- Universal metering.
- Emergency watering restrictions.
- Low-flush toilets.
- Low-flow faucets, fixtures, devices and appliances.
- Outdoor audits and tools.
- Outdoor water use campaigns.
- Indoor water use and leak detection campaigns.
- System and process audits.
- Water managed sites certification.

7 Forecasting water demand

Forecasting water demand is critical to planning future water sustainability priorities and programs.

A water demand model was developed to anticipate future water use patterns by considering major influencing factors. These factors included population growth, water rates and the economy, persons per household, housing stock, growth in customer sectors, weather and climate, as well as potential "30 in 30" water programs and policies. A 10-year time frame was examined and analysis of water use was done by customer sector.

Three different scenarios, each with different and clearly stated assumptions, cover possible outcomes for 2015:

- **Scenario A** – demand with no conservation programs, except the completion of universal metering.
- **Scenario B** – above, with the addition of planned water conservation programs.
- **Scenario C** – above, plus widespread marketplace adoption of low water use toilets and washing machines.

Results show that current planned programs will keep us on track to reach our "30 in 30" water sustainability goal. To be on track for "30 in 30," city demand needs to be 443 lpcd by 2015. With a population of 1.16 million by 2015, city demand is forecasted to be 453 lpcd (scenario A), 440 lpcd (scenario B) and 424 lpcd (scenario C).

8 Implementation plan

Water efficiency programs are planned for implementation every three years as part of The City of Calgary's three-year budgeting cycle. Highlights of implemented programs scheduled include:

- Lead by example.
- Align policy with water conservation objectives.
- Water use/matching water quality to water use.
- Water efficient technology (rebates, retrofit, incentives).
- Technical assistance (audits).
- Changing behaviours (education campaigns or outreach).
- Research and program evaluation.

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9 Public engagement

Water sustainability for our city requires the participation of all Calgarians – individuals, businesses and City operations. Partnerships and input from many stakeholders is key to success. As such, the City involved and engaged a variety of individuals and stakeholder groups in the development of this plan and continues to actively engage others in the development of specific programs.

- Each year, The City conducts surveys to measure citizen knowledge and engagement in the water efficiency initiatives.
- In spring 2006, 96 per cent rated water conservation as very important or important, though only 30 per cent indicated they would be using water-wise technology.
- Corporate Knights magazine recognized Calgary as "one of Canada's most elaborate water efficiency strategies with initiatives ranging from an educational campaign, to toilet replacement program, to repairing leaks in city water mains."
- Through the imagineCALGARY campaign, with its 18,000 responses to five questions about life in 100 years, a sustainable water system was recognized as one of several 100-year goals.

10 Conclusions and recommendations

Implementing the Water Efficiency Plan will help The City of Calgary meet the significant challenges it faces in managing our fresh water resources. The City will continue working with all stakeholders to foster a culture of sustainability.

Recommendations include:

- The City monitor demands and report annual progress towards the "30 in 30 by 2033" water sustainability goals and indicators.
- The City continues to implement water efficiencies in our operations and infrastructure.
- The City continues to work towards 100 per cent metering for residential customers.
- The City continues to partner with community groups, industry associations, non-government organizations and local businesses to deliver programs, highlight water saving opportunities, leverage resources and share and celebrate stories of water conservation success.

1 Calgary's water system

Customer profile

The City of Calgary provides safe, reliable drinking water to meet the needs of a diverse customer base. This includes more than 930,000 citizens and over 20,000 industrial, commercial and institutional (ICI) customers. Water Resources also provides drinking water to approximately 30,000 customers in the surrounding communities of Airdrie and Chestermere, as well as those living on properties bordering Calgary's municipal boundaries.

In 2006, The City supplied a total of over 165,000 megalitres (ML) of drinking water to meet the water needs of these customers.

One megalitre equals 1,000,000 litres or 1,000 cubic metres.

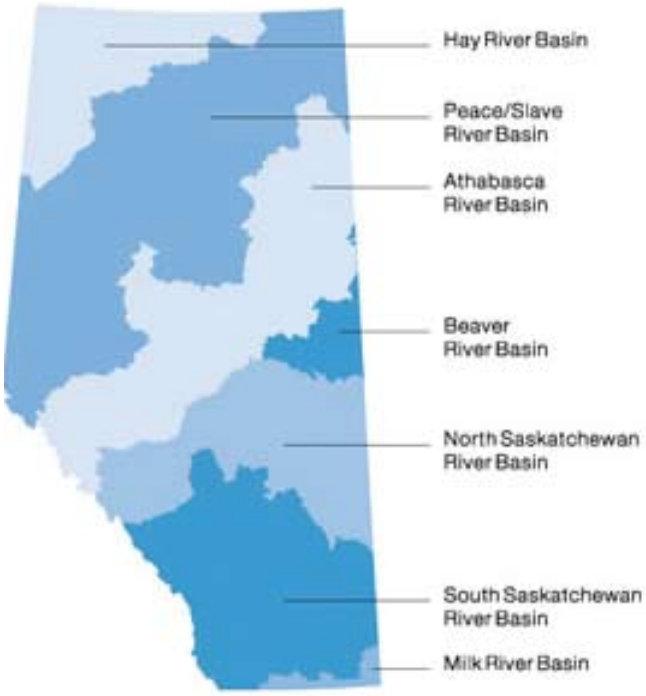
Sources of fresh water

Calgary has two sources of drinking water: the Bow River supplies the Bearspaw Water Treatment Plant and the Elbow River, which flows into the Glenmore Reservoir, supplies the Glenmore Water Treatment Plant. Both rivers originate in the mountains west of Calgary, flowing eastward through the foothills and prairie.

The Bow and Elbow rivers are part of expansive watersheds that cover thousands of square kilometres. The Bow River watershed includes approximately 7,770 km^2 and the Elbow Valley watershed covers an area of 1,210 km^2. Both rivers are part of the South Saskatchewan River Basin, which supports all 13 of our province's irrigation districts.

Figure 1.1

Major river basins in Alberta[2]



The water from the Bow River and Elbow Valley watersheds:

- Provides drinking water for all Calgarians.
- Supports agriculture and other industries.
- Generates recreation and tourism.
- Provides habitat for a diverse array of plant and aquatic life.

2 Image reproduced with permission from Alberta Environment, 2004

Distribution system

Once treated at one of Calgary's drinking water treatment plants, water flows through a large and complex distribution network of reservoirs, pump stations and underground pipes before arriving at customers' taps. Like the treatment facilities themselves, this infrastructure must be operated and maintained continually and expanded in response to municipal growth and the accompanying increases in demand.

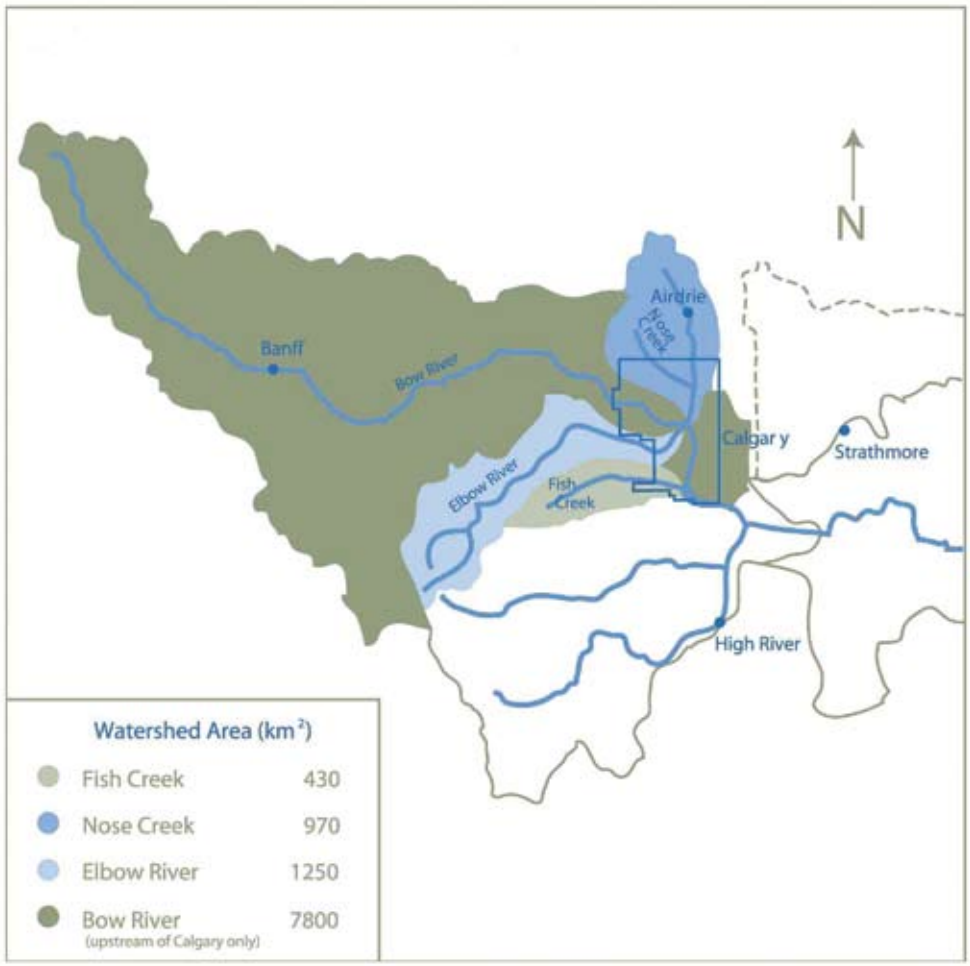
Calgary's distribution system consists of:

- Three raw water pump stations.
- Thirty-nine (39) filtered water pump stations.
- Twenty-four (24) emergency pumps.
- Twenty-four (24) pressure zones.
- Twenty (20) filtered water storage reservoirs (with approximately 645 ML of storage capacity).
- Approximately 4,300 kilometres of pipes.
- More than 260,000 service connections.

High-lift pumps push water through large transmission mains. These mains transport large volumes of water to storage reservoirs and pump stations strategically located throughout the city. This ensures all customers receive water in appropriate volumes and pressure. Water stored in reservoirs is used during periods of high demand and emergencies (e.g. fire fighting). Smaller water mains connected to the transmission mains deliver water directly to fire hydrants and customers' taps.

Figure 1.2

Major watersheds in the Calgary Region



2 The case for conservation

The current context: valuing our water resources

Calgarians, like many Canadians, often take water for granted. We live in a water-rich country. Alberta is fortunate to have a significant fresh water supply as well as the available resources and technology to treat, distribute and protect it. This doesn't make us immune to regional water shortages however, particularly in the southern parts of our province. Alberta Environment reports that 80 per cent of the available water *supply* lies in the northern half of our province, while 80 per cent of the *demand* exists in the south.[3]

Compounding these supply shortfalls is the fact that Canadians are also extremely heavy water users. Our country has the dubious distinction of ranking as the second-highest per capita urban water user in the world, behind only the United States.[4]

The average Canadian's daily residential water use is about 343 litres per person.[5] No exact figures exist for per capita water use in Alberta. However, if one multiplies the national average by the approximately three million people who live in our province, our total daily residential water use is more than one *billion* litres per day (a figure that doesn't even include water used for agricultural or industrial purposes).

The average Canadian uses approximately twice as much water as a person from France, three times as much as the average German, four times as much as the average Swede and almost eight times as much as the average Dane.[6]

The "myth of super-abundance"[7]

So why are we so extravagant in our water use? The answer seems to be that many Canadians are simply unaware of the supply and demand challenges existing with municipal fresh water sources.

A common misconception is that we have an abundance of water, making conservation unnecessary, except possibly during periods of drought. Water is a "renewable" resource, but confusion over what this term means has led many citizens to believe we can use water essentially without limit because it will be constantly replenished. This is simply not the case.

For instance, most water users divert or remove water from its natural source, *consuming* some of it in the process. This means less water is returned to the source than was originally withdrawn. In addition, the returned water is often *lesser quality*. Many in-stream uses also may cause water quality deterioration (e.g. pollution from outboard motors).

The reality is that although water is considered a "renewable" resource, it's also a finite one and continuing to increase our use of a finite resource is not sustainable long-term.

3 Alberta Environment, 2004

4 OECD, 1999

5 Environment Canada, 2004

6 OECD, 1999

7 Brandes and Ferguson, 2004

Targeting wise water use

Concern about the long-term sustainability of water resources is increasing around the world as issues of scarcity, allocation and water quality become more prevalent. In Canada, all levels of government are participating in efforts to better manage our nation's water resources. Increasingly, these efforts are focusing on managing the *demand* for water as opposed to expanding production capacities or seeking new sources of supply.

Supply vs. demand: strategies for water resource management

Seeking new sources of fresh water or expanding existing water and wastewater infrastructure (so-called "supply-side" resource management strategies) has been the conventional approach to meeting the needs of an increasingly water-hungry public. However, municipalities are realizing these "solutions" fail to provide an affordable or sustainable water resource strategy. Besides the costs of financing such projects, supply-side approaches have significant environmental costs.

> *"Everyone assumes that we have an overabundance of water in this country, but we don't…In the areas of Canada where most people live, we're no richer in water than most of the world."* [8]
>
> David Schindler, PhD,
> Killam Memorial Professor of Ecology,

Demand management is an approach involving creating and implementing programs that focus on efficient water use. From a demand-side perspective, *conservation*, not more water, is the answer to meeting a city's water needs.

Demand management is rapidly gaining popularity as a cost-effective way to squeeze more service out of existing infrastructure, thereby delaying or deferring the need for capital expenditures.

> *The concept of 'sustainability' is frequently defined as ensuring that one's actions and decisions "meet the needs of the present without compromising the ability of future generations to meet their own needs."* [9]
>
> World Commission on
> Environment and Development

From a demand-side perspective, conservation, not more water, is the answer to meeting a city's water needs.

This approach recognizes:

- It's possible to influence the demand for water through technological and behavioural changes, ultimately reducing the amount used by individual customers.
- Many of the services water provides our communities can be achieved just as effectively using less water.

It's also more sustainable, less environmentally damaging and less expensive than traditional supply-side strategies.

> *"Most Canadians take municipal water services for granted. Unlimited access to high quality water whenever and in whatever quantities desired, has become an expectation in Canadian communities."* [10]
>
> Tony Maas,
> Urban Water Demand Management Researcher

8 Schindler, 2002

9 orld Commission on Environment and Development, 1987

10 Maas, 2003

Better ways to meet our water needs

The majority of water policy analysts agree that conservation is a worthy goal. The challenge for municipal governments is to create and implement a comprehensive demand management strategy to:

- Achieve significant water savings.
- Ensure long-term sustainability of the city's water supply.
- Balance conservation initiatives with the need to ensure continued economic viability of the utility.

The City of Calgary has actively tried to encourage efficient water use for more than a decade. These efforts target the "headroom" that exists between our maximum supply capacity and current levels of demand and supply. Fortunately, many opportunities exist for improving Calgarians' water use efficiency.

Individuals, businesses and industries all play a part in ensuring Calgary is able to meet both the current and future water needs of our city by:

- Becoming more efficient in how they use water.
- Choosing and installing water-efficient devices such as low-flow toilets.
- Minimizing waste of high-quality drinking water.

Such changes are necessary to meet the many challenges our city faces in effectively managing our shared water resources.

Community involvement

Industry stakeholders and the general public also have an important role to play in helping The City achieve its water conservation goals and ensuring civic plans, programs and policies meet the needs of the community.

Municipalities leading the way in conservation planning suggest that meaningful community involvement can be achieved by:

- Actively consulting with interested parties (e.g. through meetings and focus groups) to develop and refine conservation goals and targets.
- Developing flexible plans that can be adapted based on community input and/or pilot studies.
- Creating formal or informal partnerships with community stakeholders and industry associations.[11]

The City of Calgary's *engage!* Policy recognizes the value of community involvement in improving municipal decision-making.

This policy states, "The City of Calgary assigns a high priority to appropriately informing and involving citizens and other stakeholders."[12]

It further acknowledges City Council and Administration are "committed to transparent and inclusive processes that are responsive and accountable…" In keeping with this policy, The City has been actively incorporating community involvement into its conservation planning processes.

Fundamentally, The City of Calgary believes its citizens should have a voice in shaping our city's water future.

11 National Guide to Sustainable Municipal Infrastructure, 2004

12 The City of Calgary, 2004

Water challenges facing our community

Calgarians have drawn water from the Bow and Elbow rivers for almost a century. In the early 1900s, the "Calgary advantage" was its access to a pristine water supply. Not only did these rivers filter naturally through a virtually uninhabited and pristine watershed, but Calgary was a small town and the Bow and Elbow rivers provided a seemingly unlimited supply of fresh water to meet the needs of the community and the economy.

The reality today is very different. Calgary is one of Canada's largest cities and its rivers don't seem so large anymore. As well, a number of factors are combining to put real pressure on our water resources. Receding glaciers and warmer weather, together with increased demands of a growing population, upstream agricultural development and urbanization within both watersheds have all contributed to an accelerated, ongoing degradation of our source water quality and quantity.

Calgary's continued prosperity depends in part on a secure water supply for our homes, businesses, farms and environment.

It's a problem Calgarians can't afford to ignore, especially since Calgary's continued prosperity depends on a secure water supply. The combination of increasing demand and decreasing supply means we must start using water more efficiently — particularly since these challenges may affect The City's ability to meet future demand.

Growing demand for water

Population growth

Calgary experienced unprecedented growth over the past decade. Its infrastructure and municipal services must continually expand to keep pace with the demands of our rapidly growing city.

Between 1993 and 2003, for example, an average of 93 kilometres of pipe was added each year to meet Calgarians' water needs. Today, The City of Calgary encompasses an area of approximately 720 square kilometres and serves a population of more than one milllion people. This represents approximately 120 per cent growth over the past three decades.

Total water use in Calgary is increasing as a result of growth. This is happening even though the average amount of water used per person is decreasing.

Current estimates indicate Calgary's population could reach 1.5 million by 2033. Accompanying such increases in population are similar increases in economic development, including new or expanded industrial and commercial operations.

Simply put, as Calgary's population grows, so does the demand for water and wastewater treatment.

Figure 2.1

Populaton growth in Calgary, 1969 to 2006

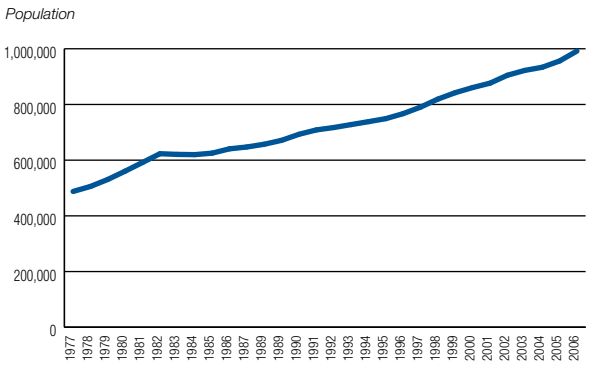
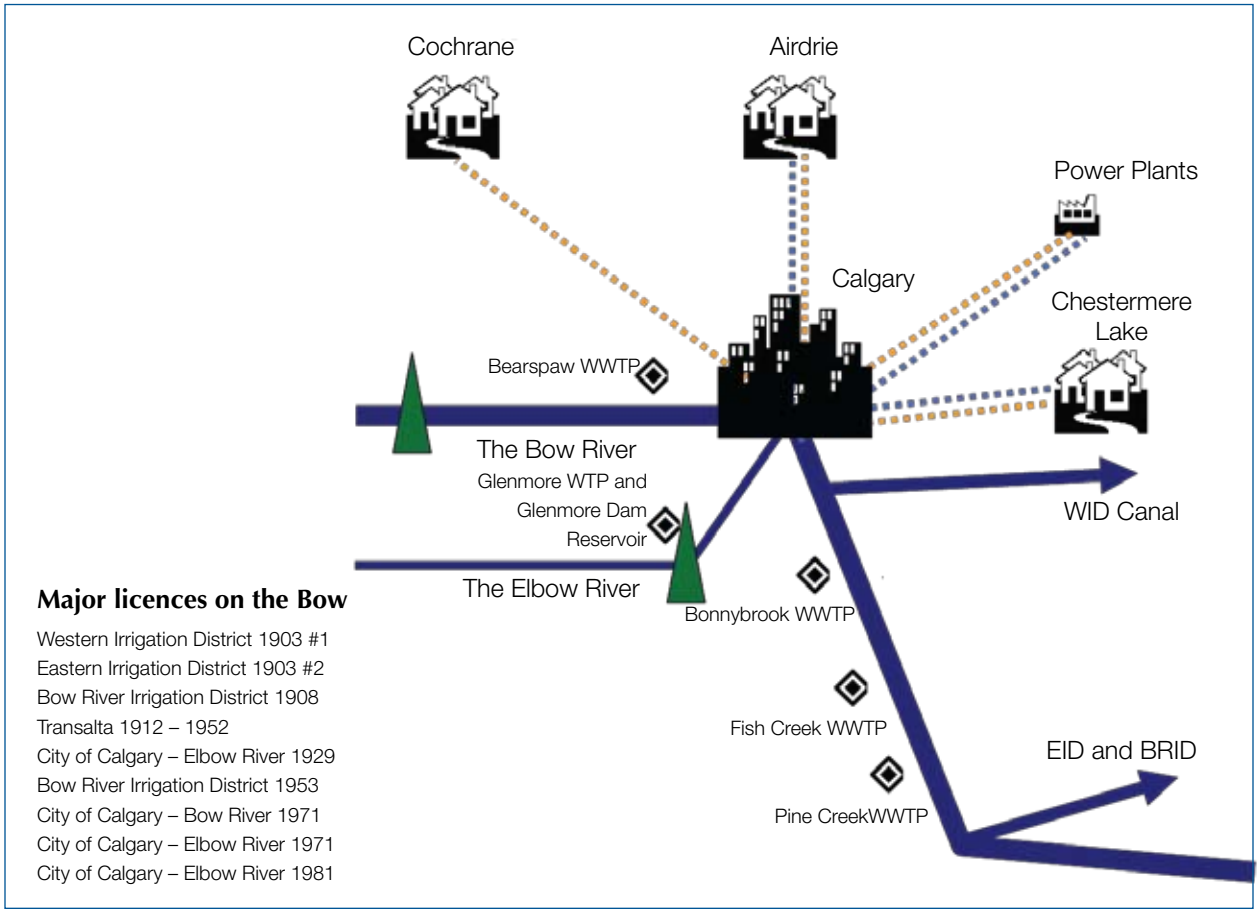


Figure 2.2

Complexity of Calgary's water system, including upstream an downstream users.



Our watershed partners

Meeting our city's growing demand for water poses an immense challenge. However, the reality is that demand for water from the Bow and Elbow rivers also exists beyond our city limits. These rivers are shared by a diverse set of users – other communities, rural populations, industrial users, ranchers, farmers and irrigation districts – all of whom cumulatively exert pressure on the system and add to the complexity of managing this resource (see Figure 2.2).

For instance:

- Downstream of Calgary are several major irrigation districts which have high-priority, high-volume licences to divert water during the growing season (May to September). These months coincide with Calgary's highest consumption period. Although The City's return flows to the rivers balance its extractions most months of the year, a net loss occurs in the summer due to outdoor water use.
- Similarly, TransAlta operates a series of hydro-electric dams and power plants upstream of Calgary. These plants release water to satisfy electrical demands, a condition that may at times conflict with water diversion needs of downstream users.

Demand for water from these and other stakeholders is also growing – both upstream and downstream of Calgary. The province is under continued pressure to approve proposals for new licences and allocations to divert water within the Bow and Elbow watersheds in support of a variety of municipal, recreational, industrial and agricultural activities.

Capacity of water sources

In its November 2003 publication titled *Water for Life: Alberta's Strategy for Sustainability,* Alberta Environment stressed the need for "significant conservation efforts,"[13] suggesting that we are fast approaching the natural limits of watersheds in all regions of Alberta.

If we don't manage and use water more wisely, demand will soon outstrip supply.

The Bow and Elbow watersheds have a limited amount of water that can be withdrawn and still maintain a healthy ecosystem. The availability of water from the Elbow River, for example, will ultimately limit the production capacity of the Glenmore Treatment Plant. Deferring this situation will require Calgarians to become more conservation-minded in their water usage.

Because Calgary shares the Bow and Elbow rivers with a variety of upstream and downstream users, a finite amount of water is available for our city's use. Calgary currently uses about 46 per cent of the total annual volume allowed under our provincial water licences. However, it would be short-sighted to rely on the remaining portion of The City's allotment to accommodate projected increases in demand, particularly given future projections for Alberta's fresh water resources. The unused portion of Calgary's water allocation is valid *only* if there is sufficient water available in the rivers to divert.

Climate change

A close relationship exists between climate and the hydrologic cycle. Although many uncertainties surround the impacts of climate change, current data suggests that total water availability may decline with a warming climate. In southern Alberta, scientists believe global climate change will compound existing supply limitations and source water degradation in our region.[14] Some even argue these effects are already being felt in Calgary and other western Canadian cities.[15]

Scientists believe that global climate change will compound existing supply limitations and source water degradation in our region.

And why is Calgary's drinking water supply vulnerable to climate change? The Bow and Elbow rivers, both surface water sources, are fed from snowpack and meltwater from Rocky Mountain glaciers, so their volumes vary year to year. Long-term models indicate the overall volume of glacial meltwater will decrease, causing lower river levels in the future.[16] This decrease would challenge our city's water supply on two fronts:

- Calgary does not have extensive reservoir storage. (The Glenmore Reservoir has a storage capacity of approximately 20 days at current consumption rates.) As a result, system reliability depends heavily on consistent river flows.
- The Bow River, in particular, relies on glacial meltwater for a substantial portion of its total volume, especially during dry years. As Table 2.1 illustrates, glacial runoff can account for nearly half of the total river flows under these conditions.

13 Alberta Environment, 2003

14 The City of Calgary, 2004

15 Schindler, 2003

16 Stewart, Cayan, and Dettinger, 2004

Table 2.1

Contribution of glacial meltwater to the Bow River[17]

Month	Average *(1970-1998)*	1970 *(a dry, low-flow year)*
July	4.6%	28.3%
August	7.5%	47.4%
September	5.0%	35.1%

Analysts further suggest that drought periods may also increase in frequency, duration and severity due to climate change.[18] The gradual warming is also likely to cause an earlier snowmelt and spring runoff, which could further lengthen the summer drought that typically characterizes prairie regions. A longer summer drought would mean lower river flows in August and September, when water use in Calgary is at its peak.

Water quality deterioration

Virtually all of the ways we use water rely to some extent on the watershed's environmental condition. Any use potentially degrading water quality limits future ways water can be used.

In Calgary, we are fortunate that the condition of our upstream river systems is still relatively good. However, experts are starting to question the long-term health of the Bow and Elbow rivers in light of the cumulative effects of upstream development and urban growth. Whether these activities divert natural river flows, require land clearing, generate pollution or simply increase access (e.g. recreational uses, oil and gas exploration), collectively they pose a risk to the health of our watersheds. Similarly, Calgarians affect water quality for downstream users.

> *"Climate warming will affect the availability of water, the timing of river flows, and water yields from mountain snowpacks and glaciers. These events may well lead to the disappearance of many wetlands and a reduction in habitat for coldwater fishes and other organisms."* [19]
>
> David Schindler, PhD,
> Killam Memorial Professor of Ecology,

Long-term monitoring of Alberta's river systems shows continued gradual decline in water quality from these watersheds. In some cases, changes are happening faster than our ability to resolve them. Calgary's treatment facilities have a strong record of compliance with both regulatory and industry standards for water quality. Our performance can be attributed, in part, to ongoing investments in plant upgrades, treatment technologies and process optimization. The other factor has been The City's ongoing efforts to protect the watershed and safeguard water quality from source to tap.

Why water efficiency?

Despite the prevailing belief that Calgary has access to an abundance of fresh water, pressing reasons exist for The City to encourage greater water use efficiency. The forecasted decrease in regional water supply due to climate change – combined with increasing demand associated with population growth and development in the watershed – constitutes an unsustainable scenario. We must make water efficiency a priority in our city to avoid creating a water deficit.

It's important to use water wisely today, so we will have water for tomorrow.

Programs promoting efficient water use not only help ensure Calgarians have a reliable water supply in the future, they provide an environmentally responsible, cost-effective solution to some of the growth issues facing Calgary.

Key benefits of water efficiency planning are outlined below and summarized in Table 2.2.

17 Alberta Environment, 2004

18 Stewart, Cayan, and Dettinger, 2004

19 Schindler, 2002

Reduced environmental impacts

Using water wisely is good for the environment. Urban water withdrawals and wastewater returns tend to be geographically concentrated, which amplifies their impact on the environment. Reducing our water consumption decreases the stress put on natural waterways by reducing the total volume of water we withdraw from the rivers, as well as the total volume of water that must be treated, distributed, heated and then treated again as wastewater. Doing something as simple as installing a low-flow showerhead or repairing a leaky faucet can lessen the impact we have on our watersheds and help to maintain their productivity.

Positive outcomes include:

- Reducing overall disruption to the natural water system.
- Improving the quantity and quality of water in the rivers.
- Protecting fish and aquatic habitat, including fragile ecosystems.
- Reducing the amount of chemicals and energy used in the treatment and distribution of drinking water.
- Reducing greenhouse gas emissions (i.e. those generated when pumping treated water and heating water with fossil fuel sources).

These outcomes are consistent with The City's Environmental Policy Guidelines. Calgary's civic administration has adopted a "Triple-Bottom Line" (TBL) policy framework to ensure that economic, environmental and social issues are appropriately addressed and integrated into all municipal decision-making.[20] Among the core policy themes is a commitment to protect our city's water resources, improve air quality and reduce Calgary's overall environmental footprint.

Uncertainty about the effects of large-scale environmental changes (e.g. global warming and population growth) on the water supply adds to the case for conservation. Learning to use less water now improves our ability to adapt to climate change uncertainties by helping sustain our water sources and providing an opportunity for us to prepare for future instances of water scarcity.

Improved infrastructure utilization

Economically, it makes sense to conserve water. As demand goes up, there is more need for water treatment, storage and distribution, which customers ultimately pay for through their utility bills.

Historically, in Calgary and many other Canadian municipalities, growth in demand has translated into a need to expand or replace water and wastewater treatment facilities, storage reservoirs and feedermains. Such projects require huge capital funding and often result in higher operating costs. By contrast, investments in conservation planning and demand management strategies are considerably lower, more diversified and incremental.

By reducing overall demand, The City can maximize its use of existing water and wastewater infrastructure.

In Calgary, the potential savings from water conservation measures are significant. About 61 per cent of The City's infrastructure exists for the purpose of treating and distributing water and wastewater. By reducing the overall demand for water, The City can make the most of existing water and wastewater infrastructure to ensure it's used to maximum efficiency – during both peak and off-peak periods.

More efficient utilization will enable The City to extend the longevity of current facilities, an outcome that adheres to core sustainability principles and supports The City's efforts to balance the economic, social and environmental impacts of its decisions, programs and actions.

[20] The City of Calgary, 2004

Financial savings

Consider that every drop of water we use has to be collected, treated and distributed before we get it, and then treated and/or transported again before it goes back into the river. If Calgarians use less water, the absolute costs of withdrawing water, treating and testing it, and delivering it to customers will decrease (i.e. fewer chemicals and energy used in treatment and distribution processes). This saves The City money in the short-term by reducing annual expenditures and also in the long-term by reducing pressure on our city's infrastructure. These savings can be passed on to customers or used to help ensure the future viability of the water supply by investing in watershed protection and treatment plant upgrades.

Fewer constraints to city growth

A reality faced by rapidly growing municipalities is the constraint to growth created by a finite or dwindling water supply. We already know Calgary is located in an arid part of Alberta and has limited water resources. Reducing demand for water helps overcome this natural barrier to growth by expanding The City's capacity to accommodate an increasing population and a growing economy. Essentially, the water saved through conservation can be used to meet the needs of additional customers without having to increase supply, storage or treatment facilities.

Reducing demand for water will expand The City's capacity to accommodate an increasing population and growing economy.

From a regulatory perspective, reducing demand enables The City to service a growing population within its existing water licenses. It also reduces the likelihood of emergency water restrictions and their associated inconveniences for customers. These outcomes fit with The City's economic priorities to "promote an environment conducive to economic development" and "create a city where people want to live and do business."

A "culture of sustainability"[21]

Encouraging water use efficiency and communicating the benefits of responsible water use to the broader community not only raises awareness of these issues, but can also foster a "culture of sustainability" – a kind of enhanced social and environmental consciousness – that can have widespread and enduring benefits for a municipality.

Citizens and businesses in communities where such a culture exists may:

- Use natural resources more wisely and hold one another accountable for one's choices.
- Help raise awareness about sustainable resource use.
- Actively participate in community issues and decision-making.
- Develop better relationships among stakeholders by working together.
- Seek opportunities to reduce the environmental footprint of the community while continuing to promote economic growth.
- Commit to living with future generations in mind.
- Share a sense of improved quality of life.

These outcomes align with key sustainability principles and are highly conducive to helping achieve a community's water conservation goals.

[21] National Guide to Sustainable Municipal Infrastructure, 2004

Table 2.2

Summary of water efficiency benefits in Calgary[22]

Who benefits?	How?
Customers	■ Save money on their water bills by decreasing their water consumption. ■ Develop greater awareness of water issues and the value of water resources. ■ Are less likely to face inconvenience of emergency watering restrictions.
Community at large	■ Maintains affordability of water and wastewater services by making the most of current infrastructure. ■ Shares responsibility for reducing infrastructure load with all who benefit from service. ■ Fosters "culture of sustainability" among citizens. ■ Expands capacity to accommodate population and economic growth. ■ Promotes economic development and prosperity by creating a city where people want to live and do business. ■ Contributes to the "common good," feels good about conserving.
Water utility	■ Is able to maximize efficient utilization of existing infrastructure, thereby extending its longevity. ■ Reduces operating and maintenance costs for water treatment and distribution over the long-term. ■ Creates more predictable patterns of demand, improving long-term planning and reducing the risks of demand uncertainty. ■ Improves ability to adapt to uncertainties such as climate change.
Environment	■ Reduces total water withdrawals, lessening disruption to natural waterways. ■ Reduces stress on watersheds and the associated degradation of both water quality and habitat for fish and aquatic organisms. ■ Reduces the amount of chemicals used to treat drinking water as well as the energy required to distribute it. ■ Reduces greenhouse gas emissions (i.e. those generated when pumping and heating water with fossil fuel sources).
Business and industry	■ Save money by reducing operating costs (e.g. fuel, chemicals, labour). ■ Improve competitiveness by increasing process and operational efficiencies.

22 Adapted from Rocky Mountain Institute, 2004

3 Calgary's water use profile

This chapter summarizes current customer and demand data for drinking water in Calgary.

Drinking water production

Calgary's growth has increased pressure on The City's drinking water plants to treat more water. Production, however, cannot increase indefinitely. Calgary is limited both by our license requirements (i.e. allocation limits and water quality regulations) as well as by the design and operational capacities of our existing treatment facilities.

Nonetheless, Water Resources has managed to slightly increase the total combined production of its treatment plants over the past decade (see Figure 3.1). This increase was achieved largely by accessing previously unused capacity at the Bearspaw treatment plant, which treated approximately 66 per cent of Calgary's drinking water in 2002.

Average daily production and peak production day are shown in Figure 3.2. The average day production shows a slight increase due to population growth and the resulting increases in demand. Peak production varies with peak use, for which weather can cause significant variation. For instance, Calgary experienced a wet, unseasonably cool summer in 2005 whereas 2001 was a much warmer, drier summer.

Figure 3.1

Total combined production of Calgary's drinking water treatment plants, 1996 to 2005.

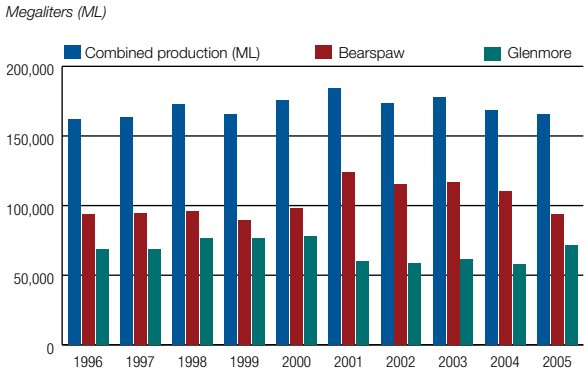
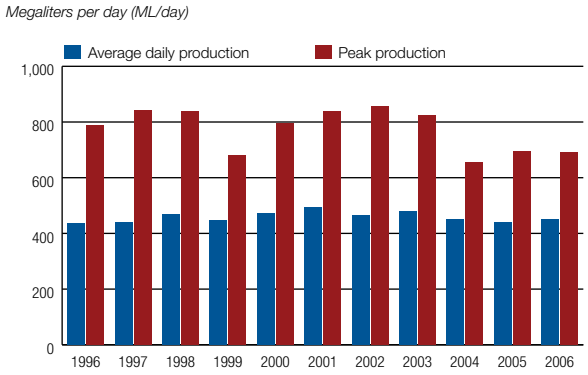


Figure 3.2

Average and peak combined production of Calgary's water treatment plants, 1996 to 2006.

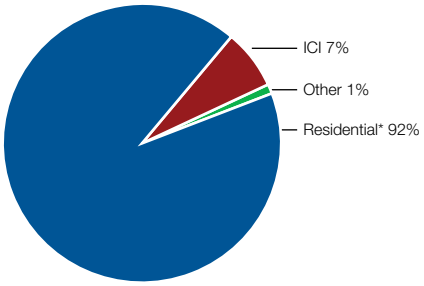


Customer accounts by sector

In 2006, Calgary had **312,396** active customer accounts and service connections. About 92 per cent of Calgary's customers fall within the "residential" customer class, which includes both low-volume accounts (e.g. single family and duplex housing) as well as high-volume accounts (e.g. multi-unit buildings). Industrial, commercial or institutional (ICI) customers comprise seven per cent of The City's water accounts and the remaining one per cent includes City of Calgary departments and wholesale customers (i.e. customers outside the city, including Airdrie and Chestermere).

Figure 3.3

Calgary's water accounts by sector.



*Includes both single-family and multi-unit housing.

In Calgary, the average person uses about 7,000 litres of water a month.

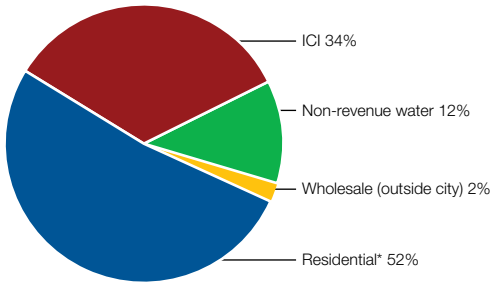
Water use by sector

Calgary's residential customers use approximately 52 per cent of the total annual water treated and distributed in our city. Although ICI customers represent only a small fraction of The City's customer accounts, they use considerably higher volumes than residential customers, accounting for 34 per cent of total demand. This usage pattern is consistent with those of other cities, where the ICI sector typically accounts for between 20 and 40 per cent of urban water demand.[23]

Non-revenue water is a term used to describe water that's treated and distributed, but not billed to a customer. This includes water lost through system leakage and main breaks and water used for delivery of City services (e.g. street cleaning, fire fighting).

Figure 3.4

Calgary's water demand by sector (as percentage of total demand).



*Includes both single-family and multi-unit housing.

23 Environment Canada MUD Database (Cited in: Brandes and Ferguson, 2003).

Residential sector

The City's data on residential water use applies only to single-family domestic uses (indoor and outdoor). In Calgary, the average person uses approximately 7,000 litres of water a month. This includes both indoor and outdoor water use. Although indoor water use remains relatively constant throughout the year, outdoor use peaks in spring and summer when Calgarians irrigate their lawns and gardens. This seasonal variation is significant: lawn and garden watering can increase daily residential use by up to 50 per cent (see Figure 3.5).

Calgarians are fortunate to have drinking water that's among the best in the world. However, this high-quality water is predominantly used for purposes other than drinking.

Calgarians are fortunate to have drinking water that's among the best in the world. However, this high-quality water is predominantly used for purposes other than drinking. For instance, 30-34 per cent of water in an average Calgary household or apartment is literally flushed down the toilet (see Figure 3.6). In fact, a full 60 per cent of residential indoor water use occurs in the bathroom. And while no local data is available on water used specifically for food preparation and drinking purposes, experts suggest it represents less than three per cent of the water treated at municipal water treatment plants.

Figure 3.5

Calgary's total system water demand, 2006.

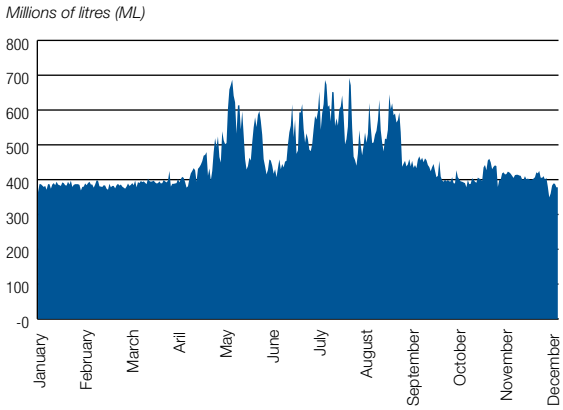
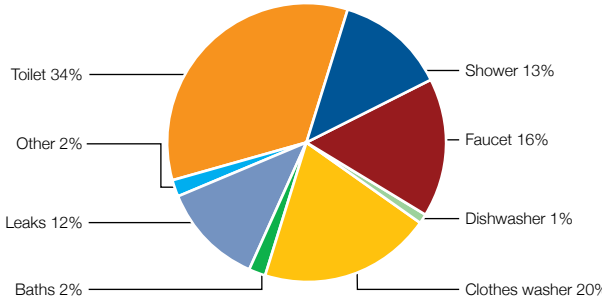


Figure 3.6

Water use in a typical apartment building.



ICI sector

Grouped within the ICI customer class are a wide variety of operations including schools, hotels, hospitals, restaurants, office buildings, retail centres, government buildings, oil and gas operations and manufacturing or processing plants. Commercial and institutional customers use water primarily for heating and cooling, sanitation and landscape irrigation, whereas industrial uses typically centre around washing and processing, heating and cooling or using water as an ingredient in the manufacturing process.

Given the diversity of this customer class, it's not surprising that no "typical" water use scenario exists. Different ICI customers have widely different water requirements, consumption rates and water efficiency challenges depending on the nature of their business. However, in many cases financial and environmental savings can be realized by implementing conservation measures.

Demand data and trends

Water Resources tracks demand using several key measures, including:

- Total annual system demand.
- Average day demand.
- Per capita demand.
- Annual peak day demand.
- Maximum day per capita demand.

Total annual system demand

Total annual system demand represents the total volume of water used by all customers in a calendar year.

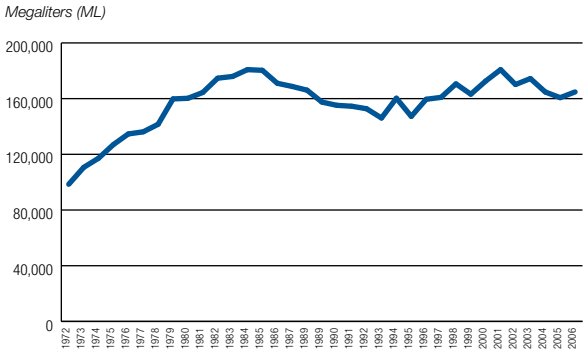
In Calgary, total annual system demand includes:

- Customers outside city limits (Airdrie and Chestermere).
- Water used in the delivery of City services (e.g. fire-fighting, street cleaning, parks irrigation, etc.).
- Water lost through system leakage.

As Figure 3.7 shows, the total annual system demand for water in Calgary has nearly doubled over the past 35 years, reaching 164,812 ML in 2006, compared to 98,496 ML in 1972.

Figure 3.7

Total annual system demand (all customers), 1969 to 2003.



In the past 35 years, the total annual demand for water in Calgary has nearly doubled.

Although Calgary's total annual system demand increased steadily in the 1970s and early 1980s, this pattern reversed from 1985 to 1995, and total system demand decreased. This reduction can be attributed in part to The City's efforts to reduce system leakage and main breaks (see Chapter 4).

From 1995 to 2002 The City's total annual system demand has been steadily increasing again, in large part due to Calgary's recent economic and population growth.

Average day demand

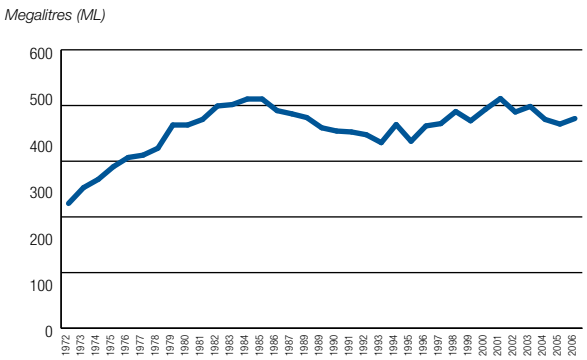
Average day demand represents a water system's average daily use over a one-year period.

It is calculated based on the total volume of water pumped into the distribution system from The City's storage reservoirs. The total volume supplied in a year is divided by 365 days.

In 2006, Calgary's drinking water treatment plants provided an average of 487 ML/day to service its entire customer base.

Figure 3.8

Average day demand, 1969 to 2003.



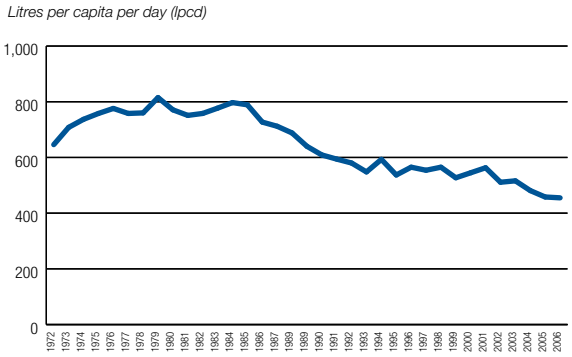
Per capita demand

Per capita demand is calculated based on average day demand (i.e. the average volume per day is divided by the total population served).

Over the past ten years (1996-2006), the average day per capita demand in Calgary averaged 517 litres per person, per day (see Figure 3.9). Note, this figure represents *gross* per capita demand as it includes total volume of water used divided by the total population served. In other words, it includes all customer classes as well as non-revenue water.

Figure 3.9

Gross per capita demand (all users), 1969 to 2003



Annual peak day demand and peaking factor

Peak day demand is the highest total water use experienced by a water supply system during a single calendar year.

Like average day demand, it's calculated based on the total volume of water produced on a single day.

In 2006, Calgary's peak day demand was 692 ML. This represents a volume 50 per cent above The City's average day demand in the same year.

Peaking factor is the ratio between a city's annual peak day demand and average day demand for the same year.

Changes in peaking factor are largely dependent on weather conditions and their influence on seasonal outdoor water use. This measure is commonly used in municipal infrastructure planning because it affects the operational requirements and design capacity necessary to meet demand year-round. Table 5.2 shows the peaking factors for Calgary's water system over the past ten years.

Table 5.2

Peaking factor, 1996 to 2006.

Year	Annual Peak Day Demand (ML)	Average Day Demand (ML)	Calgary Peaking Factor
2006	707	464	1.52
2005	711	450	1.58
2004	666	459	1.45
2003	840	451	1.86
2002	871	474	1.84
2001	850	503	1.68
2000	807	481	1.68
1999	690	455	1.52
1998	889	474	1.88
1997	885	448	1.98

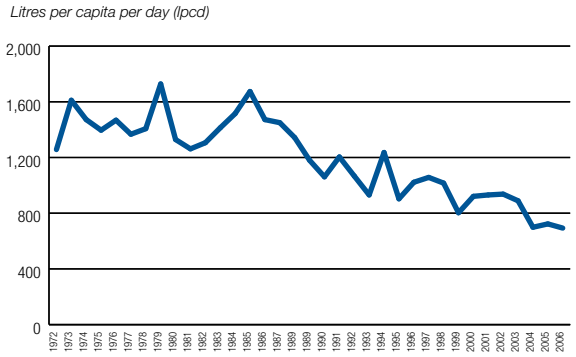
Maximum day per capita demand

Maximum day per capita demand is calculated by taking the annual peak day demand and dividing it by the total population served.

In recent years, Calgarians have made significant gains in reducing maximum day per capita demand from an all-time-high of 1,732 lpcd in 1979 to less than half this level (see Figure 3.10). This decrease is largely due to The City's annual outdoor water use campaigns (see Chapter 4).

Figure 3.10

Maximum day per capita demand, 1972 to 2006.



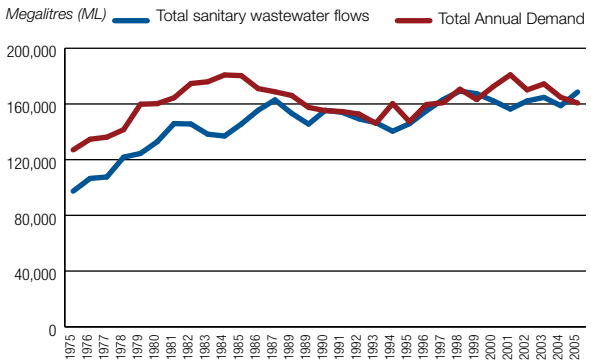
Wastewater flows

Industry experts estimate that approximately 70 per cent of the total volume of water treated and supplied in a year returns to the system as wastewater. The remaining 30 per cent is "consumed" through irrigation, evaporation, manufacturing processes and leakage.

Figure 3.11 shows Calgary's sanitary sewage flows from the past 30 years as well as the total combined production of The City's drinking water treatment plants.

Figure 3.11

Wastewater flows and total combined production in Calgary, 1975 to 2005.



During this period, sanitary sewage flows have increased by 82 per cent, rising 17 per cent since 1995. When compared to total annual demand for treated drinking water, sanitary sewage flows represent 93 per cent of this volume. This suggests that a relatively small proportion of water is consumed in our city and as a result, the "net loss" to our river system is relatively low. For water users downstream of Calgary, this is good news from a supply perspective, but it also means that The City will face increasingly high wastewater treatment volumes and costs as demand for water increases.

4 Calgary's water efficiency history and successes

History of conservation planning in our city

The City strives to be a leader in developing programs promoting water efficiency and wise use of Calgary's water resources. These programs have evolved over the past decade, growing in scope, strategic focus and customer participation.
A diverse set of voluntary programs, pilot projects and policies are now in place, all of which are aimed at incrementally reducing the overall demand for water in our city. (See Appendix A for an overview of existing programs.)

The City has taken a multidimensional approach to reducing demand. It includes seeking efficiencies in The City's operations, making conservation technology accessible, educating Calgarians on wise water use behaviours, making water efficiency a requirement when appropriate and helping businesses realize the value and opportunities of water conservation (see Table 4.1).

Looking back at the history of water efficiency planning in Calgary, The City's approach has been to target the cornerstones of successful water conservation strategies:

- Universal metering
- System leak detection and repair
- Customer education

Table 4.1

Summary of The City of Calgary's water efficiency initiatives over the past decade.

Seeking Operational Efficiencies
■ System Leak Detection/Water Loss Program ■ Efficiency Upgrades at Treatment Plants ■ Creation of Resource Management Team ■ ISO 14001 Certification ■ Parks Water Management Strategic Plan
Making Water-Efficient Technology Accessible
■ Indoor/Outdoor Water Saver Kits ■ Rain Barrel Promotion and Sponsorship of Clean Calgary Association's Annual Sale ■ Toilet Replacement Rebate ■ Water Managed Sites Certification
Educating Calgarians on Wise Water Use
■ Advertising and Education Campaigns (indoor, outdoor, leak) ■ Youth Programs ■ Print Materials and Website ■ Outreach at Community Events (e.g., Home Show) ■ Team Water-Wise Irrigation Audits
Making Water Efficiency a Requirement
■ Universal Metering ■ Mandatory Watering Restrictions ■ Mandatory Low Water Use Fixtures
Helping Businesses Realize Opportunities for Conservation
■ ICI water audits ■ Team Water-Wise Irrigation Audits

Universal metering

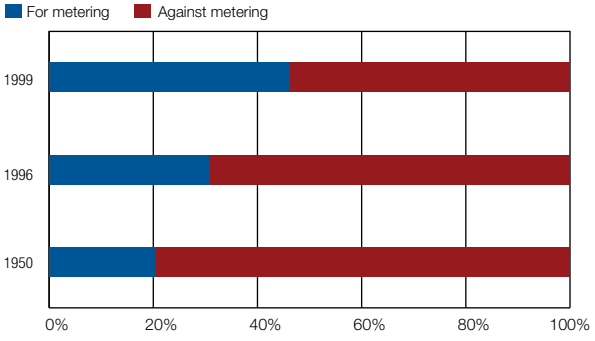
Calgary differs from many other North American municipalities in that it's not yet a fully metered city. In fact until the mid-1990s, *most* residential customers were on a flat rate. Flat rates still exist for some longstanding residential accounts. Since the residential sector accounts for about 47 per cent of municipal water demand, it represented a logical first target for The City's demand-management efforts.

Early opposition to metering

In the 1950s and 1960s, two separate plebiscites were held in Calgary on whether to mandate water meters. In both cases, the matter was defeated resoundingly (see Figure 4.1). By 1985, only 20 per cent of residential customers were on a water meter.

Figure 4.1

Results of Calgary's plebiscites on universal water metering.



In 1989, universal metering again resurfaced as an issue in the lead-up to the fall election. City Council identified water conservation as a priority and directed then the Waterworks department administration to hold a third plebiscite on the matter. At the time, Water Resources (Waterworks at that time) was unable to present a convincing business case to Calgarians and the result was a third consecutive defeat for universal water meters (albeit by a closer margin).

Water meter incentive program

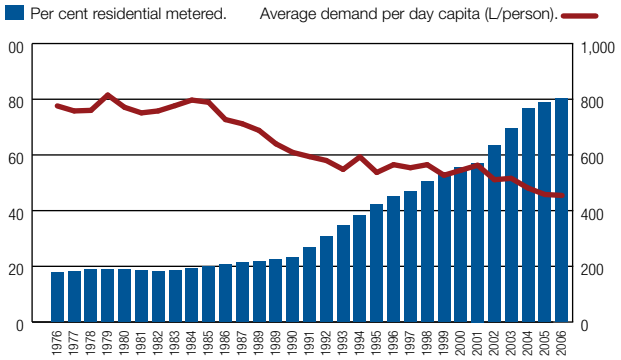
At the time, voters expressed concern about potential financial risk. Would they pay more with a meter than a flat rate? This proved to be a significant factor in their opposition. To address this issue, Water works created the "Water Meter Incentive Program" (WMIP). The program eliminated any risk for customers by enabling them to try a meter for one year. At the end of the year, if they paid more on a meter than they would have on a flat rate, The City would rebate the difference and remove the meter from their home.

Water Resources launched this program in 1991 and promoted it to Calgarians at home shows and via other marketing methods. At the time, Water Resources estimated the water savings from installing about 10,000 to 12,000 meters per year would approximately equal the increased demand from Calgary's growing population, essentially creating "zero net impact" on The City's demand for fresh water.

As Figure 4.2 shows, the WMIP had a significant effect on residential metering in our city. Calgarians responded favourably to the initiative and nearly 40 per cent of flat-to-metered conversion orders came on a voluntary basis. Between 1991 and 2001, the percentage of metered residential customers rose from 22 to 57 per cent, an average of three per cent annually.

Figure 4.2

Growth and impact of residential water metering in Calgary.



Once interest in water meters started, Water Resources built on this momentum by fine-tuning policies and elements of the program to make it easier for Calgarians to become metered customers. For instance, Water Resources:

- Established water meters as the default option if the customer did not express a preference when setting up a new account.
- Stopped removing the meters from customers' homes, even if the customer switched back to a flat rate after the trial period ended.
- Created a policy to pre-install meters in all new homes.

Bylaw amendments

Once two thirds of residential accounts became metered, The City believed it would have enough support to win a fourth plebiscite. However, revisions to Alberta's *Municipal Government Act* enabled City Council to direct the change once a 10-year grace period had passed since the last plebiscite. On January 16, 2002, Water Resources proposed a strategy to The City's Operations and Environment Committee recommending that all Calgary homes be placed on a water meter. City Council approved the recommendation and passed amendments to the Water Utility Bylaw 22M82 on March 18, 2002. It required all residential customers to be metered by December 31, 2014. The amendments also included a requirement that water meters be installed in all new homes and when new utility accounts are established (i.e. when properties are bought or sold).

These amendments have helped to further boost the relative proportion of residential metered accounts At the end of 2006, 79 per cent of customers were metered, compared to 58 per cent when the metering bylaw was passed and 23 per cent when the WMIP began.

System leak detection and repair

In 1980, following a detailed water audit, Water Resources began to monitor and investigate non-revenue water in its distribution system. Besides representing lost revenues, non-revenue water is a combined indicator of system leaks and losses, meter inaccuracies, non-metered uses and theft.

Water Resources now actively strives to detect leaks in its distribution system and has created a system-wide main replacement program to replace water mains with structural integrity issues or with a multi-break history in order to prevent other leaks likely to happen. In 2006, Water Resources replaced over 20 km of water mains.

Customer education

Another flagship component of Water Resources' water efficiency programs has been customer education. Since 1995, Water Resources has looked for opportunities to provide information to help bring customers' perceptions and behaviours in line with conservation principles.

Changing our water use habits means changing the way we think about water.

Residential Customers

Critical to the successful reduction of per capita consumption in recent years has been the strong educational program that teaches Calgarians about water issues in our city and the personal actions they can take to reduce their water consumption. Water Resources monitors public perception about water conservation and partners with community groups who educate adults and youth (e.g. Clean Calgary Association, The Calgary Horticultural Society, Evergreen Theatre and the Science Alberta Foundation). It's also developed a variety of professional communications materials including television commercials, brochures, customer newsletters and web content regarding efficient water use.

Initially, Water Resources' educational programs focused on managing peak demand during the summer months. The goal was to educate Calgarians about outdoor water use, so Water Resources used education campaigns and marketing efforts to encourage rain barrel use and promote water-efficient landscaping and watering practices. While continuing to address outdoor water use, in 2003 Water Resources has since expanded its programming to include information about indoor water efficiency as well as leak detection and repair.

Industrial, commercial and institutional (ICI) customers

Water Resources offers programs aimed at helping businesses realize the value of water conservation and become more aware of opportunities to reduce water use. Pilot studies conducted with ICI customers demonstrated the potential cost savings of water-efficient operations. Water Resources currently collaborates with ICI customers to gain a better understanding of their water use patterns, issues and requirements. It shares success stories on its website and in selected industry newsletters so other customers may benefit. In 2005, program research and pilots were conducted with multi-family customers (apartment buildings and condos) to extend the reach of ICI programs.

Other programs and actions

The City of Calgary, Water Resources has piloted a variety of other programs to encourage wise water use and in some cases, make water efficiency a requirement. Some examples are listed below.

Financial incentives

Water Resources has offered financial incentives to make conservation technology accessible to its customers. For example, Water Resources promotes and sells indoor and outdoor Water Saver Kits at discounted prices. These kits contain devices Calgarians can use in and around their homes to reduce water use.

In October 2003, Water Resources also launched a program offering rebates to encourage single-family residential customers to replace high-volume toilets with water-efficient, low-flow models. In 2006 the program was expanded to apartment buildings and condos. The program entitles residential metered customers to a $50 rebate when they purchase and install an eligible six-litre toilet.

Mandatory watering restrictions

In addition to customer education and incentive programs, The City has also used regulations to achieve its conservation objectives. For example, The City invoked water restrictions in both 2001 and 2006 due to the temporary shutdown of one of its water treatment plants for large-scale upgrades and maintenance.

The Water Utility bylaw was revised in 2002 to enable a four-stage approach for issuing water restrictions depending on the severity of the water shortage. Initial stages are less restrictive and the higher, more restrictive stages are invoked only if the seriousness of the situation heightens.

Although watering restrictions are a viable strategy for reducing peak day water use, The City's policy is to:

- Implement such restrictions only in the event of an emergency water shortage (i.e. due to a water quality or infrastructure problem).
- Impose the stage that will minimize impacts of the restrictions while still achieving the necessary reductions in demand.

Organizational changes

Water Resources created the Resource Management section in 1995 to better focus and expand its water conservation efforts. This business subgroup is responsible for water efficiency planning and programming. In the past nine years, the team has grown from one resource analyst to six full-time staff.

ISO 14001 Certification

Water Resources became ISO 14001 certified in 2002. ISO 14001 is an internationally recognized environmental management system. Registration provides evidence of The City's commitment to responsible environmental management and conservation. The City of Calgary, Water Resources is one of only a few publicly-owned utilities in Canada to receive this designation.

The City of Calgary, Water Resources is one of only a few publicly-owned utilities in Canada to be ISO 14001 registered.

Other City of Calgary water conservation initiatives

In addition to the water efficiency programs developed by Water Resources, several other City departments have followed suit and implemented water conservation initiatives. For example:

Parks

- Since 1992, Parks has been seeking ways to improve its water use efficiency. Parks uses about 2.1 per cent of The City's treated water production for irrigation. This amounts to 3,600 ML of water annually, enough to supply 15,859 households with water for a year.
- In 1997, Water Resources partnered with the Parks department to meter the 2,000 existing irrigation services in City parks as well as all new park developments. This was completed in 2006.
- Parks has developed a Water Management Strategic Plan.
- Parks has a centralized control.

Calgary Transit

- In 2003, the Transit department purchased a bus wash that recycles 95 per cent of its water.

Corporate Engineering

- Corporate Engineering created and implemented a Sustainable Building Policy in 2003 to ensure that all new City-owned buildings are designed, developed and operated according to environmentally responsible and sustainable practices, including water efficiency.

Calgary Housing Company (CHC)

- Water Resources piloted a program that provides CHC a rebate to replace existing appliances (toilets and washing machines) with water-efficient models.

Timeline

As Table 4.2 shows, Calgary has made significant headway in its conservation efforts and has reached some key milestones.

By most measures, The City's water efficiency programs have translated into significant water savings.

Table 4.2

Timeline of Calgary's water efficiency milestones

1959	First plebiscite on universal water metering (defeated).
1966	Second plebiscite on universal water metering (defeated.)
1980	First study focused on assessing opportunities to reduce water use in Calgary.
1989	Third plebiscite on universal water metering in our city (defeated).
1991	Water Meter Incentive Program launched to encourage voluntary water metering.
1992	Calgary reaches 30 per cent metering among residential customers.
1995	Waterworks creates Resource Management group to develop programs focused on improving water use efficiency.
1998	Calgary reaches 50 per cent metering among residential customers. Waterworks launches first summer watering campaign.
1999	Calgary achieves a 35 per cent reduction in per capita demand relative to maximum levels observed two decades earlier.
2000	Water use study conducted in community of St. Andrew's Heights shows residential flat-rate customers using 50 per cent more water annually than metered customers.
2002	■ Bylaw amendment to phase-in universal water metering for all Calgary residences. Meters now mandatory for all new homes and accounts. Emergency section of bylaw also amended to create new process for issuing water restrictions. ■ Waterworks production and process, metering, and laboratory services sections achieve ISO 14001 registration.
2003	Waterworks launches several new conservation programs, including outdoor water saver kits, toilet replacement rebates, and ICI water audits.
2004	Calgary reaches 70 per cent metering among residential customers.
2005	■ City Council adopts "30-in-30 by 2033" water consrvation goal. ■ Bylaw change requires low water use plumbing fixtures in all new developments.
2006	79 per cent metering among residential customers.

Impacts of past planning

While many challenges still lie ahead, there is also good news on Calgary's water conservation front. Over the past decade, The City's efforts have translated into significant water savings through a combination of metering, distribution system maintenance, incentive programs and customer education. These impacts are described below and summarized in Table 4.3.

Table 4.3

Impacts of past water efficiency planning in Calgary.

Per capita demand continues to decline
■ Calgarians used about 451 lpcd in 2006, compared to 800 lpcd in 1984.
Slowed growth in average day demand
■ Average day demand is increasing but at a rate less than Calgary's population growth.
Significant reductions in maximum day per capita demand
■ Maximum water use in a single day was 692 lpcd in 2006, compared to 1,732 lpcd in 1979.
Improved customer awareness and interest in water conservation
■ More conservation-related inquiries, and improved recall of core communication messages.
Growing interest in and adoption of water-efficient technologies
■ Strong participation in Toilet Replacement Rebate Program and purchase of Water Saver Kits.
Slowed growth in river withdrawals (with potential to reduce in the future)
■ River withdrawals have increased, but not as fast as population growth.
Improved system integrity
■ 50 percent fewer main breaks in the last 10 years and less system leakage.
Deferred infrastructure expansions
■ Several feedermain upgrades deemed unnecessary or deferred for more than 10 years.

It is Water Resources' intent to build on these successes over the long term to ensure a sustainable water supply for our city.

Declining per capita demand

Although total water use in Calgary is increasing as a result of growth, the total amount of water used *per person* is dropping. This decrease can be directly attributed to public education programs, metering of residential accounts, main replacement and leak detection.

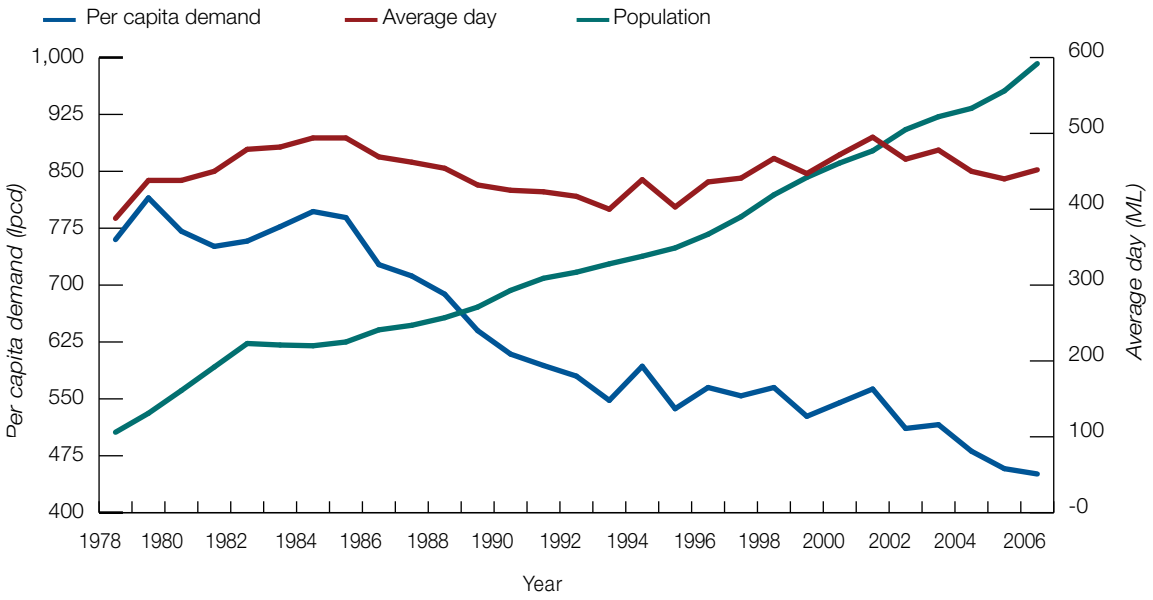
Figure 4.3 highlights trends in Calgarians' water use over the past two decades. Gross per capita demand continues to decrease from almost 800 litres per person per day in 1984 to less than 451 litres per person per day in 2006. Note that these figures include water use by all customers (e.g. ICI, residential, wholesale), as well as all non-revenue water (e.g. system leakage).

Metering continues to contribute towards an ongoing drop in per capita demand.

Metering has played a particularly significant role in reducing residential water use in Calgary. As Figure 4.2 showed (see page 31), growth in metered residential accounts in our city has paralleled a significant reduction in per capita demand.

Figure 4.3

Calgary's per capita demand, population, and average day demand, 1980 to 2006.



Currently, enough of the previously non-metered customers have reduced their water consumption that the savings are sufficient to enable The City to supply water to additional households without increasing system capacity. These examples represent a significant step forward and demonstrate that meaningful improvements in water use are possible in our city.

Slowed growth in average day demand

Despite the reductions in per capita demand overall water use in Calgary – expressed as average day demand – continued to increase between 1993-2002 approximately five per cent per year as a result of population growth. Despite the increase, this trend represents a partial success for The City as the rate of increase in average day demand has been significantly lower than the rate of population growth. Between 2002-2005 average day demand decreased.

The rate of increase in average day demand has been significantly lower than the rate of population growth. Between 2002-2005 average day demand decreased.

Reduced demand during peak periods

Over the past two decades, Water Resources has achieved significant reductions in maximum day per capita demand. For example, despite a 53 per cent increase in Calgary's population since 1987, peak summer water use has decreased by 14 per cent.

Residential customers have reduced the amount of water used during the summer months.

This reduction is arguably Calgary's greatest water conservation "success story" to date as these improvements can be attributed largely to customer education programs focusing on responsible outdoor water use. Residential customers have responded positively to Water Resources' programs, adapted their behaviours and in some cases adopted water-efficient technologies to reduce the amount of water they use during the summer months. The result: maximum day per capita demand in our city continues to decline.

Increased customer awareness

Calgarians' level of interest in water conservation continues to grow as a result of public education initiatives, communication campaigns and marketing strategies. Evidence of this is seen in calls to The City's customer call centre, advertising campaign recall (including tips followed) surveys and customer participation in water efficiency programs.

For example:

- Seventy-two per cent of Calgarians were able to recall key messages from the 2003 summer watering campaign in a survey conducted two months after the campaign.
- In 2006 49 per cent of Calgarians are concerned about long-term water supply and feel there is an urgent need to reduce the amount of water they use.
- Sixty-five per cent of Calgarians have participated in or used tips from City conservation programs.

Growing adoption of water-efficient technology

Water Resources has also been successful in encouraging adoption of water-efficient devices through its technology rebate pilot projects and marketing programs.

To date, the most successful of these has been its Residential Toilet Replacement Program. In its first nine months (October 2003 to June 2004), 900 rebates were awarded. Information brochures for the program are also the top conservation-related service request at The City's customer call centre. Current estimates suggest that The City is already saving 150,000 litres of water *each day* as a result of this initiative.

Calgarians have also taken advantage of the indoor and outdoor Water Saver Kits promoted by Water Resources. In 2003, The City sold more than 2,000 indoor kits and over 1,500 outdoor kits.

In 2003, The City conducted a public opinion survey to gauge interest in low-flow toilets, mandating water-efficient fixtures in new developments and water conservation education. Eighty-one per cent of respondents supported the idea of requiring new homes to have indoor water conservation devices and 76 per cent expressed interest in rebates for purchasing and installing low-flow toilets.

Reduced river withdrawals

Demand for water in Calgary is currently at 42 per cent of the total annual allocation permitted under The City's provincial water licenses. Water Resources operates on a 2:1 margin of safety, meaning it aims to manage municipal water demand so our city's total water use never exceeds 50 per cent of our total allocation. Although this may seem a conservative limit, it provides The City with sufficient room to accommodate the future decreases in water supply expected as a result of climate change (estimated at 20 to 30 per cent of current levels).

In recent years, The City's river withdrawals have increased, although again not as fast as population growth. In 2006, we extracted a combined total of 197,000 ML from the Bow and Elbow rivers. Only 179,000 ML of this water was treated and distributed to Calgarians' taps. The remaining 18,000 ML was spilled back to the rivers as filter-to-waste and backwash water, both by-products of the treatment process.

Water treatment plant upgrade program planned for 2005-2011 will enable this wastewater to be fully recycled. The resulting water savings are significant. These upgrades provide a win-win solution in terms of reducing downstream environmental impacts and supporting The City's water efficiency goals.

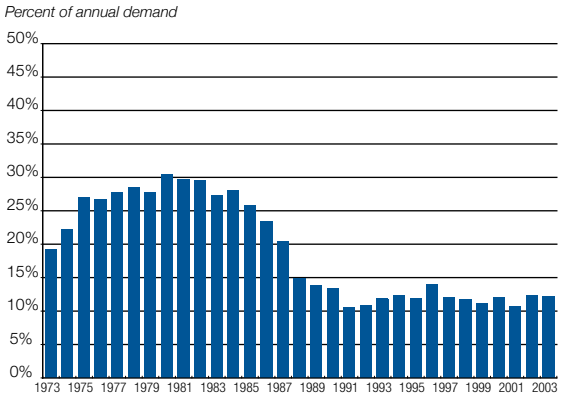
Improved system integrity

The number of water main breaks in Calgary has decreased by 50 per cent in the past 10 years as a direct result of The City's efforts to replace and repair underground pipes before breaks occur.

Although leakage is an estimated system parameter (due to inherent uncertainties associated with flat-rate consumption and other losses), The City estimates its leak detection and main replacement efforts have reduced leakage in Calgary's distribution system by more than 50 per cent since 1980 (see Figure 4.4). For instance in 2003, Water Resources surveyed over 1000 km of pipe and repaired leaks, saving an estimated 39.5 ML of water per day.

Figure 4.4

System leakage as percentage of annual demand, 1973 to 2003.



Deferred capital projects and expenditures

Calgary's water conservation efforts have also enabled The City to forestall infrastructure expansions and upgrades for its water treatment and distribution facilities. These decisions have come as a direct result of decreases in per capita demand and they translate into dramatic savings for all Calgarians.

For instance, in 1990 several major capital projects were thought to be required early in the new millennium based on projected increases in water use at that time. These included four major feedermain upgrades to increase water distribution capacity to both the north and south ends of Calgary. Figure 4.5 shows the location of these projects as well as their projected implementation dates.

Figure 4.5

Past projections for distribution system expansion. (All projects have been deferred for at least 10 years.)

The view from 1990:
1998 - 10th Ave South Feeder
2003 - Nose Hill Feeder
2006 - 112th Ave NE Feeder
2012 - New South Feeder

All four of these projects are now entirely off the books or have been deferred for more than 10 years (e.g. current forecasts now suggest the Nose Hill Feeder will be required in 2014). These decisions have come as a direct result of The City's water efficiency measures.

In 1985, forecasts indicated that Calgary's peak day demand in 2025 would be 1,900 lpcd (litres per capita per day). This forecast was reduced to 1,400 lpcd in 1994. Currently, Calgary's peak day demand in 2025 is estimated at 800 lpcd. This is an ambitious target considering our city previously reached 1,050 lpcd – the biggest water use day on record – in 1985 when our population was only about 700,000. However, it demonstrates the confidence Water Resources has in Calgarians' ability to curb their water use.

Due to these demand reductions and the resulting deferral of expansion projects, The City is able to direct capital funds at upgrades addressing drinking water *quality*. For instance, The City is currently upgrading its water treatment plants, which were originally designed to 1930s (Glenmore WTP) and 1970s (Bearspaw WTP) standards.

Increasingly stringent standards for drinking water quality have sometimes limited the ability of Calgary's treatment facilities to operate at maximum capacity. For instance, during spring runoff when poor source water conditions pose treatment challenges, total production at the Glenmore plant decreases to about 150 MLd. With the planned upgrade program, the estimated combined production capacity will be 950 MLd.

How we compare to other cities: results of program benchmarking

Despite past successes, The City of Calgary, Water Resources continues to seek ways to enhance its water efficiency programs. In developing its Water Management Strategy, The City has looked to detailed program assessment and industry "best practices" to evaluate what measures will provide the greatest water savings.

History of program assessment

Calgary's conservation efforts have a proud history of program assessment. This has involved focus groups as well as peer reviews by third-party experts in water efficiency planning. Feedback from these assessments has helped Water Resources refine its conservation programs by identifying strengths, weaknesses and opportunities for improvement.

- The first of these studies was conducted in 1980 when Water Resources commissioned a benchmarking evaluation comparing Calgary's water use to that of other cities. Based on the results of this study, Water Resources launched its leak detection and main replacement program.
- In 1995, The City created an inventory of its existing conservation programs, which was peer reviewed and compared to programs in other cities. This study led to organizational changes within Water Resources – namely, the creation of staff positions dedicated to water efficiency.
- Another peer review came in 1997 when Calgary organized a blue-ribbon panel to evaluate The City's long-range planning efforts, including the direction of its water conservation strategy.
- Program reviews have also come in the form of self-assessments. For example, the Resource Management group launched a thorough review of its conservation programs in October 2002 to gain fresh perspective about program efficacy and ensure it was "headed in the right direction."

Recent evaluation and benchmarking

In 2003, Water Resources hired an independent consulting firm, Economic and Engineering Services Inc. (EES), to critically review The City's water efficiency programs. Part of the study involved benchmarking Calgary against other utilities that have launched similar conservation initiatives.

Calgary's water conservation efforts were compared to those of six comparable North American cities: Seattle, Vancouver, Winnipeg, Denver, Ottawa and Edmonton. These utilities were selected because:

- They're each well respected within the water conservation community due to successful efforts to reduce water use.
- Their programs, water system, customer profile and demand have similar characteristics to those in Calgary.

Calgary generally rated favourably against the other utilities based on the following criteria:

- Water loss.
- Per capita demand.
- Conservation services available to customers.
- Water rates and charges.
- Percentage of metered residential customers.
- Water conservation regulations.

Calgary's suite of conservation programs was considered similar to those in the other cities, relying on a mix of "soft" programming (i.e. education) and "hard" programming (i.e. technology rebates) to achieve its goals of reducing peak demand and average day demand. Key findings from this study are highlighted below.

Metering

Calgary differed from most of the other utilities in that not all its customers are metered.

Regulations

Unlike some of the other utilities, at the time Calgary had no regulations requiring the use of low-flow technologies or efficient watering practices unless a water emergency was decreed.

Education

In general, Calgary's education program compared "very favorably to the most well-respected programs when counting overall number of programs offered." (Note: the level of service provided for these programs was not assessed.)

In its final report, EES concluded that

"Calgary's conservation program favoured well when compared to the water conservation programs of Seattle, Vancouver, Winnipeg, Denver, Ottawa and Edmonton, except in the areas of legislation of low-flow fixtures and conservation programming for average day reduction … Therefore, it is recommended that Calgary:

- ***Encourage adoption of local or provincial legislation mandating low-flow volumes for water fixtures.***
- ***Expand conservation services which provide tools for customers to reduce average day demand."***

Since the EES report, The City of Calgary, Water Resources addresses these issues.

Comparisons to industry best management practices

Water Resources has also used industry best management practices (BMPs) as a benchmark for evaluating its water conservation programs and planning. In 2004, Canada's National Guide to Sustainable Municipal Infrastructure (known as InfraGuide) published a series of BMPs for creating and implementing a municipal demand management strategy. These guidelines were developed by a national network of industry practitioners, researchers and other experts, and based specifically on Canadian experience and research.

Table 4.4 highlights how The City's existing water efficiency programs compare to InfraGuide's demand management BMPs. Overall, The City of Calgary has established programs and services that address the full spectrum of recommended practices.

Table 4.4

Comparison of The City of Calgary's water efficiency programs to InfraGuide demand management BMPs.

Types of infraguide best management practices[24]	**Examples from The City Of Calgary's existing water efficiency programs and services**
Communication and education	■ Outdoor/indoor water use and leak detection campaigns. ■ Educational presentations with industry associations and on water wise gardening. ■ Television and print advertisements. ■ Website information, bill inserts and Waterways customer newsletter. ■ One-on-one education with customers at various public and industry special events. ■ Water Efficiency School Program.
Technical assistance	■ Landscape irrigation audits (Team Water-Wise). ■ ICI water audits. ■ Water Managed Sites certification. ■ Education program for irrigation industry practitioners.
Pricing	■ Cost-of-service study.
Financial incentives and disincentives	■ Low-flow devices in indoor and outdoor Water Saver Kits sold at cost. ■ Toilet replacement rebates. ■ Support for Rain Barrel Sale.
Regulation	■ Strategy and bylaw in place to be fully metered by 2014. ■ Emergency outdoor water use restrictions. ■ Low-flow Fixtures and Water Wastage Bylaw.
Market transformation	■ Low-flush toilet demonstrations as part of special event displays. ■ Research studies on toilet performance.
Structural change	■ Distribution system leak detection program. ■ Main replacement program. ■ Treatment plant process upgrades.

24 National Guide to Sustainable Municipal Infrastructure (InfraGuide), 2004

5 Towards sustainability: Calgary's water efficiency future

The City looks to build on past successes, capitalize on current opportunities, and continue to advance its vision for sustainable water use. By setting specific goals, targets, and strategies for water conservation, The City of Calgary, Water Resources and Water Services aims to:

- Provide clear and consistent direction for its water efficiency efforts.
- Prioritize program activities and action areas.
- Ensure efficient program implementation and delivery.
- Establish a benchmark from which to evaluate the impacts of these programs.
- Incorporate water conservation into its broader planning processes.

This chapter identifies the core elements of The City's Water Efficiency Plan, all of which are guided by The City's vision for water conservation planning and sustainable resource management.

Calgary Conservation Mission Statement

"We will promote an approach to water conservation which is consistent with the principles of environmental, social, and economic sustainability. We will develop and promote a progressive water conservation program that enables and inspires both the utility and our customers to conserve water. We will encourage partner and community participation to protect and preserve our water resources."

Our Vision: Sustainable Management of Calgary's Water Resources

The City of Calgary is committed to environmental leadership in its water conservation programs. The central focus for each of these programs is to **reduce overall water use and achieve more sustainable management of our water resources** for the benefit of all Calgarians, both now and in the future.

What constitutes "sustainable management" of municipal water resources? It's perhaps best characterized as "planning and management of water resources to provide an adequate supply of high-quality water while providing for the economic, environmental, and social needs of current and future generations."[25] This includes seeking opportunities to reduce resource use by:

- Respecting the natural capacities of aquatic ecosystems.
- Limiting pollution and water waste.
- Encouraging citizens to adopt water-efficient technologies, behaviours and processes.
- Maximizing service, productivity and cost-effectiveness of existing water treatment and distribution infrastructure.
- Seeking and substituting alternatives for treated potable water resources where possible (e.g. rain barrels, re-use of water in industrial processes).

25 Kenel, 2004

- Exploring regulatory opportunities that favour water use efficiency.
- Raising awareness of water conservation in the community and seeking input from stakeholders in regards to conservation planning, policy development and decision-making.
- Considering the long-term needs of future citizens in all resource management decisions.

These sustainability objectives are consistent with the themes outlined in The City of Calgary's "Triple-Bottom Line" (TBL) Policy Framework. This Framework provides a set of economic, environmental and social policies intended to guide all civic decisions. Together, these policies reinforce The City's ongoing efforts to conserve its water resources, protect local watersheds, take an environmentally responsible approach to business and engage interested stakeholders in realizing Calgary's water conservation goal.

Sustainable management of water resources aims to deliver "an adequate supply of high-quality water while providing for the economic, environmental, and social needs of current and future generations."

Our goal: maintain Calgary's total water use at current levels

In promoting demand reduction and sustainability, The City of Calgary is pursuing a "water-neutral" model for municipal water use.

The goal is to accommodate Calgary's future population growth with the same amount of water we removed from the river in 2003.

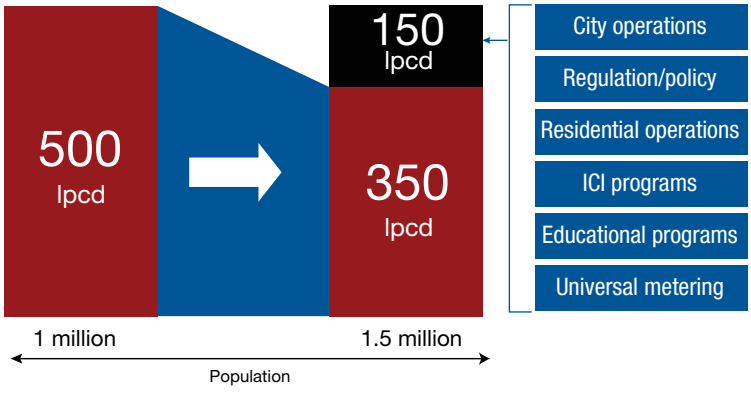
To achieve this objective, per capita water consumption must drop at a rate that corresponds to the rate of population growth. If Calgary's population grows to 1.5 million people by 2033, a 33 per cent reduction in the average per capita demand would be required to offset growth.

The City is committed to ensuring that future generations of Calgarians will be able to meet their water needs with the same amount of water we use today.

As Figure 5.1 shows, The City of Calgary intends to target all customers and explore a wide range of options to achieve this level of demand reduction.

Figure 5.1

The City's per capita demand reduction target and planning tools.



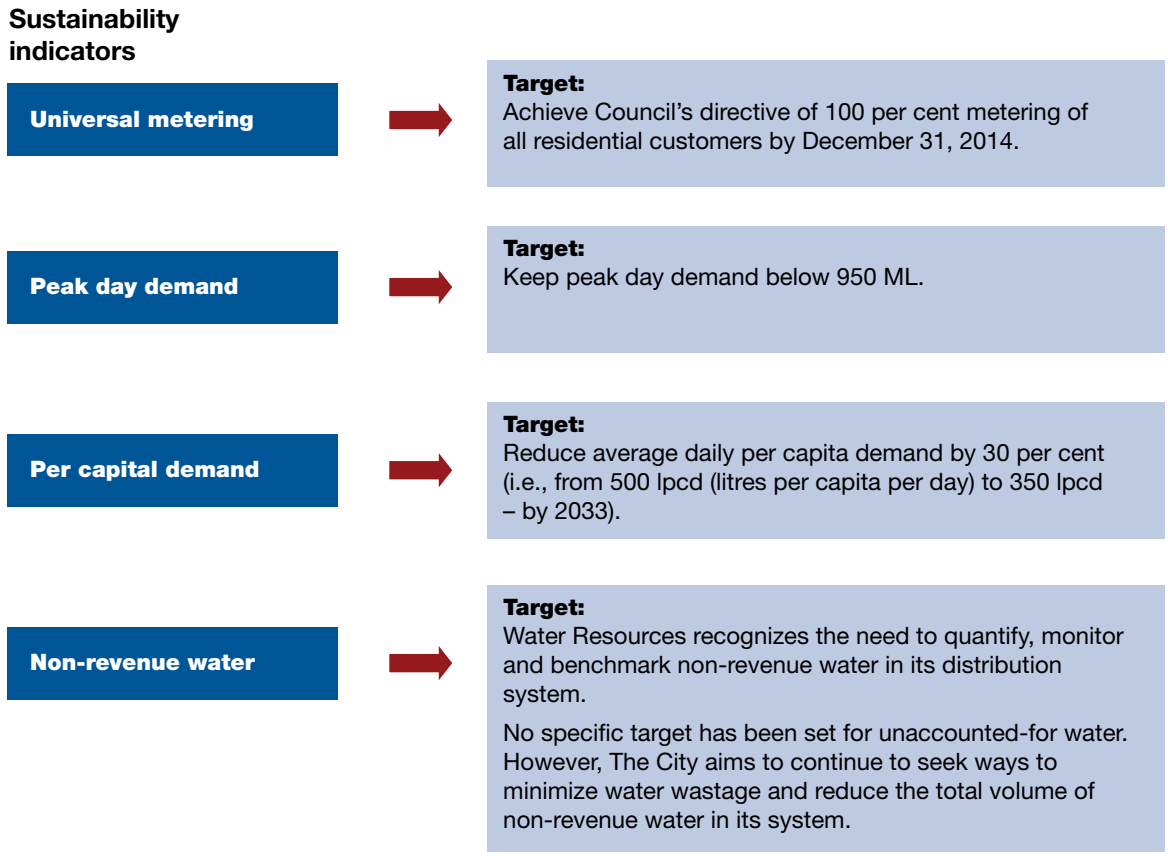
Sustainability indicators

In developing this Water Efficiency Plan, Water Resources has identified specific, measurable targets for its conservation efforts (see Figure 5.2). These targets are based on an approximately 30-year time horizon and address four key "sustainability indicators" of municipal water use efficiency:

- **Universal metering** – The metering of all residential customer accounts. All commercial customers I are metered.
- **Peak day demand** – The largest total water use in a single day, on the one day in a year which Calgary requires the most drinking water.
- **Per capita demand** – The average volume of water used in the city per person per day. This is calculated by dividing total demand (including residential, commercial and municipal use) by total population served.
- **Non-revenue water** – Any water "lost" as a result of system leakage, main breaks, non-metered uses, fire fighting or operational flushing.

Figure 5.2

The City of Calgary's sustainability indicators and targets for municipal water use efficiency.

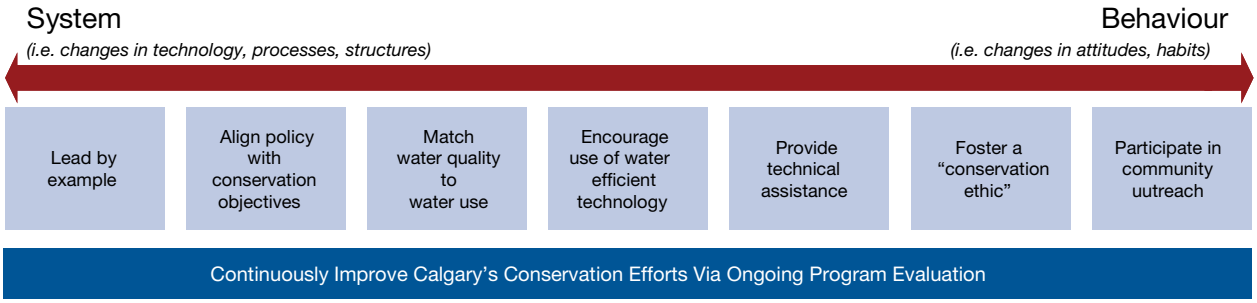


Core water efficiency strategies

Sustainable management of our shared water resources is the driving force behind every conservation initiative The City pursues. To effectively allocate resources and implement programs that support The City's sustainability objectives, Water Resources has developed several core strategies. These were developed using the National Guide to Sustainable Municipal Infrastructure (InfraGuide), 2004,best practices from water wise districts like Australia and California in addition to our own history and experience in water conservation in Calgary. These strategies are target structural and system changes (i.e. technologies and processes), as well as behavioural and attitudinal change. Figure 5.3 highlights these core strategies, which are further explained below.

Figure 5.3

Water Resources' core water efficiency strategies.



Lead by example

To effectively motivate Calgary residents and businesses to find efficiencies in their water use, The City's water utility must first look to its own system-wide operations and processes. The City aims to set a positive example for customers by ensuring The City is a leader in responsible water use.

Action areas

- Upgrade existing drinking water treatment plants to enable process changes that will reduce the total amount of water our city withdraws from the Bow and Elbow rivers.
- Engage in ongoing leak detection and proactive distribution system maintenance and repair.
- Optimize the efficiency of Calgary's water utility infrastructure.
- Continue to improve and evaluate Calgary's water system and use data to accurately track non-revenue water.
- Encourage efficient water use in all areas of The City's operations and work jointly with City departments to reduce overall water use.
- Support the adoption of water-efficient technologies in City buildings.

Align policy with conservation objectives

Policy and regulatory changes can be a powerful way to influence behaviours and technology choices. They can also sometimes be controversial. When policies fall within the City's jurisdiction, this approach often means revising water utility bylaws (e.g. requiring low-flush toilets), but it also includes collaborating with industry and other levels of government to promote higher standards for water efficiency.

A key regulatory component of The City of Calgary's overall water efficiency strategy is to implement universal water metering. Metering provides a significant and long-term opportunity to reduce demand as it a. shows customers how much water they consume and b. enables them to pay strictly for what they use. Research demonstrates that residential metering can yield significant water savings. For example, a City of Calgary study conducted in the neighbourhood of St. Andrew's Heights found that metered residential customers used 30 per cent less water than those on a flat rate when measured over a one-year period.

Action areas

- Provide information and encourage flat-rate customers to switch to a water meter.
- Monitor the percentage of customers on a meter and use this information to evaluate program progress and timelines.
- Continue to require low-water-use devices in new residential and commercial developments or when conducting building renovations.
- Research and consult with the local and national plumbing industry to promote and encourage wider use of water-efficient products, standards and procedures.
- Collaborate with other municipalities to identify barriers and promote conservation at provincial and national levels (e.g. WaterStar program).

Match water quality to water use

An emerging and exciting area for conservation planning will be to find and make appropriate use of alternative water sources. To this end, The City of Calgary plans to investigate and promote potential opportunities for the safe use on non-potable water sources. This includes the use of:

- stormwater
- greywater (wastewater from domestic sources)
- wastewater effluent from treatment plants

Action areas

- Provide information and support opportunities for Calgarians to collect and use rainwater for irrigation.
- Improve communication between City departments and other agencies.
- Increase City facilities using non-potable water for irrigation, construction and tree watering.
- Conduct local pilot projects.
- Celebrate local success stories and work with partners to increase awareness and acceptance.
- Consider reuse infrastructure and regional planning.
- Develop reuse guidelines and approval requirements where no federal or provincial code exist.

Encourage use of water-efficient technologies

Low-water-use appliances and devices are present and cost-competitive in the marketplace. Examples include low-flow showerheads, ultra-low-flush toilets and faucet aerators. However, the mere availability of these products in the marketplace is not sufficient to garner their widespread adoption.

Water Resources aims to accelerate wider installation of some water-efficient technologies by providing financial incentives to customers.

Action areas

- Offer financial incentives to make water-efficient technologies appealing (e.g. toilet replacement rebates to encourage customers to replace high-volume toilets with low-flush toilets).
- Demonstrate the use of innovative, water-saving technologies and highlight their benefits.
- Promote use of water-efficient irrigation technology through Water Managed Sites certification.
- Support metering of The City of Calgary Parks.
- Conduct retrofit pilot projects with partners like Calgary Housing Company.

Provide technical assistance

The City aims to encourage water conservation in the workplace and the use of water-efficient technologies and operations. Industrial, Commercial and Institutional (ICI) customers account for slightly more than one third of Calgary's demand for treated water. Although the volume and nature of water use varies widely across different industries, considerable potential exists in this sector for reducing water use.

Low-flow technologies are continually improving and emerging. The City tracks these developments, supports research and can provide technical assistance that will help customers achieve measurable water savings.

Action areas

- Promote water-efficient products and services to all customers by providing information and technical assistance to customers.
- Work with ICI customers to better understand their water use patterns and identify opportunities to minimize waste, recycle water and use water more efficiently.
- Tailor programs to meet the needs of individual sectors (e.g. water audits for ICI customers) and thereby facilitate adoption of water conservation behaviours, measures and technologies.
- Research the effectiveness of water-efficient methods, innovations and technologies (e.g. flush valves, cooling tower operation, sensor-operated faucets and toilets).
- Share experiences about water-efficient operations in Calgary with other ICI customers (including actual costs and benefits of investing in water-saving technologies).
- Develop programs directly addressing potential barriers to water conservation in particular industries.

"The culture of urban water use in Canada has evolved such that unlimited access to high quality water is an expectation. As a result, water users [and others] simply may not be cognizant of the levels of inefficiency associated with common technologies and practices, or that more efficient alternatives exist." [26]

Tony Maas,
Urban Water Demand Management Researcher
University of Victoria, 2003

Foster a "conservation ethic"[27] among Calgarians

Education campaigns that raise awareness of water efficiency goals, methods and technologies are important mechanisms to change water use behaviour. For instance, some customers may be unaware of devices or methods they can use to reduce water consumption. Others may be reluctant to try unfamiliar technologies such as low-flow showerheads because they perceive they'll be inferior. Still others may fail to recognize how their individual actions and water consumption relate to broader water issues in our province.

The City believes that one of the most effective ways to encourage efficient water use is to provide people with the knowledge and skills to take responsibility for their own actions.

[26] Maas, 2003

[27] The State of Victoria Department of Sustainability and Environment, 2003

By continuing to build upon a sound education and marketing strategy, The City can incrementally build awareness of the value of water, make personally relevant both the challenges and opportunities for change and ultimately give Calgarians tools to become stewards of our collective water resources.

Action areas

- Develop programs for all customers promoting both the benefits of, and opportunities for, water conservation.
- Provide opportunities for residential and ICI customers to better understand their water use (e.g. bill inserts, media, website).
- Enhance education programs to ensure they identify and address potential customer concerns or barriers to adopting water-wise behaviours and technologies (e.g. cost, inconvenience, false perceptions).
- Develop campaigns that encourage Calgarians to adopt sustainable water use practices for irrigation, gardening and other outdoor applications and inside their homes (e.g. detecting and repairing leaks).
- Measure the effects of education and marketing programs on Calgarians' water use behaviours and attitudes toward water conservation.
- Support water education opportunities for youth, who can act as change catalysts in their homes and communities in the future.

Engage in community outreach

The City recognizes the value of partnering with stakeholders and the broader community to influence customers' water use behaviours. Effectively addressing market influences and systematic barriers to conservation calls for ongoing collaboration with a wide range of businesses, industry associations, non-profit organizations, consumer advocates and other stakeholders.

Action areas

- Promote efficient water use by participating in community outreach and capacity building activities (e.g. home shows, special events, workshops).
- Participate in conservation initiatives with the building industry (e.g. Built Green™ Alberta, Calgary Regional Home Builders Association).
- Encourage community involvement in conservation planning and in the development and evaluation of specific conservation initiatives.
- Partner with non-profit educational organizations on water conservation initiatives and school programs (e.g. Yellow Fish Road Program™).

Continuously improve Calgary's water conservation efforts

Data collection and analysis are integral elements of Calgary's water efficiency efforts. Comprehensive monitoring of demand levels enables a more complete understanding of Calgary's water system. It also provides Water Resources with the information needed to assess Calgary's current water requirements and plan responsibly for the future. In addition, monitoring the effectiveness of The City's existing conservation efforts makes it possible to adapt and improve them as necessary.

Action areas

- Continue to collect and analyze water use data and use it to evaluate current and future conservation initiatives.
- Pilot programs and ensure evaluation methods are built into the design of all conservation measures.
- Seek feedback from customers about low-water-use appliances and products and adapt conservation programs accordingly.
- Support the research of new and emerging water saving technologies and practices.

6 Water efficiency measures

Water efficiency measures are defined as any action, behavioural change, device, technology or process improvement that measurably reduces water use, loss or waste.[28] Also known as "conservation" or "water saving" measures, these practices and technologies go beyond simply raising customer awareness about water conservation – they measurably reduce demand.

Evaluation process

The City reviews measures on an ongoing basis to help establish priorities for its water efficiency programs and best enable The City to attain its conservation objectives. This process involves:

- Identifying water efficiency measures used in other jurisdictions.
- Researching each measure's implementation as well as its effects on municipal water use.
- Applying specific criteria to critically and objectively evaluate the measure's potential applicability to our city.

Evaluation criteria

Water efficiency measures are analyzed using the following criteria:

Water savings

Measures must have potential for significant demand reductions and a proven track record of water savings in other jurisdictions. New practices may be considered provided research papers, independent engineering studies or pilot projects are available and can support demand reduction projections. Measures must also address the demand components of concern in Calgary (e.g. average day demand) or offer the greatest saving opportunities for specific customer sectors.

Technology performance

Measures relying on specific tools or devices must be based on proven, reliable technology that delivers significant water savings as well as a favourable customer experience. Emerging technologies may be considered provided that additional research or resources are available to effectively pilot the product.

Cost-effectiveness

To maximize The City's return on investment and make best use of available resources, measures must be cost-effective and meet budget requirements. Costs are assessed in dollars to the utility per megalitre of water saved.

28 Vickers, 2001

Suitability to customer groups

Measures must satisfy customer performance expectations and enable customers to have acceptable alternatives and choice within the marketplace. Customer feedback is collected on an ongoing basis and as part of The City's public engagement processes. Measures must also be appropriate for the Calgary area and climate.

Social impacts

Measures must not negatively impact community safety, health or quality of life. They should not unduly inconvenience customers or require a significant time commitment. Measures must also align with The City's social values and be inclusive across customer demographics (i.e. age, culture and economic background).

Environmental impacts

Measures must have a cumulative net positive impact on the natural environment. This requires considering not only rivers, watersheds, ground water and aquatic habitat in the Calgary region, but also land and air quality beyond municipal borders.

Implementation feasibility

Measures must fall within The City of Calgary's jurisdiction and be enforceable. They should be consistent with The City's mandate and relate directly to its scope of responsibilities. All measures must comply with current legislation. In some cases, measures may be deemed impractical due to limited availability of service providers or other conditions that restrict their current feasibility within the Calgary market.

"Best practices"

Measures that constitute widely accepted "best practices" within the water industry (e.g. see Table 4.4) and meet all other screening criteria are given priority consideration. Overall, The City's full suite of conservation programs should address a broad range of demand management BMPs.

Recommended measures

Based on this analysis, a preliminary list of 11 principal water efficiency measures is recommended for implementation by The City of Calgary. All of these measures are either currently underway or in the pilot stage.

Table 6.1 lists the recommended water efficiency measures according to their target. Note, some measures target more than one customer group. These measures are also described briefly below. Measures evaluated but *not recommended* at this time are outlined in Appendix D.

Table 6.1

Water efficiency measures by target

Water efficiency measure	City Infrastructure	Customer Group			
		Municipal (i.e. other City business units)	Single-family residential	Multi-family residential	ICI
System leak detection and main replacement	●				
Treatment process upgrades	●				
Metering		●	●	●	●
Emergency watering restrictions*		●	●	●	●
Low-flush toilets		●	●	●	●
Low-flow faucets, fixtures, devices and appliances			●	●	●
Outdoor audits and tools *(water saver kits, rain barrels)*		●	●	●	●
Outdoor water use campaigns			●	●	
Indoor water use and leak detection campaigns			●	●	
System and process audits		●			●
Water managed sites certification		●	●	●	●

* Note: The City of Calgary intends to use watering restrictions only in emergency situations.

System leak detection and main replacement

Water lost through leakage and main breaks is wasted water. Cities that invest in proactive leak detection and main replacement can realize significant water savings, lower production costs and reduced incidence of emergency infrastructure repairs.

Water Resources operates an extensive main replacement program as well as an annual leakage survey. Together, these measures have helped reduce total system losses and improve the operational efficiency of Calgary's drinking water infrastructure.

Treatment process upgrades

Upgrading and optimizing water treatment facilities and processes can lead to major improvements in water efficiency. Work is currently underway to upgrade Calgary drinking water treatment plants to minimize water wastage and improve solids removal efficiency. The upgrades target a "zero discharge" operation, meaning that water used during the treatment process will be *recycled* rather than *discharged* to the river as wastewater. A zero discharge operation will also measurably benefit downstream aquatic environments.

Metering

Universal metering is widely accepted as an industry "best practice" and is a cornerstone of most water conservation strategies. Metering is proven to achieve significant, long-term water savings. Meters not only benefit municipalities environmentally, but also help to improve demand forecasting.

The City of Calgary is on track to meter all customers by 2014. In December 2006, 79 per cent of all residential customers in Calgary were metered. Industrial, commercial and institutional customers remain 100 per cent metered.

Emergency watering restrictions

The City of Calgary uses outdoor watering restrictions as a means of reducing seasonal (not long-term) water demand. In other words, The City issues restrictions *only* in emergency situations (i.e. during a water shortage).

Calgary's watering restrictions apply a four-stage approach designed to minimize customer inconvenience while still achieving the necessary demand reductions.

Low-flush toilets

Toilet flushing can account for 30 per cent of all indoor residential water use. Incentive programs that accelerate the installation of low-flow (six-litre) toilets can yield significant water savings, particularly since low-flow toilets use about 70 per cent less water *per flush* than many conventional models. Programs offering customers a financial incentive (e.g. rebate) to switch to low-flow toilets have been implemented in other Canadian municipalities with considerable success.

The City of Calgary introduced a residential toilet replacement program in the fall of 2003 and is expanding this program to other customer groups.

Low-flow faucets, fixtures, devices and appliances

Many Calgary homes and businesses have fixtures that use water inefficiently. These include showerheads, faucet aerators, top-loading washing machines and spray valves (a device used in commercial kitchens to remove food from dishes, utensils and pans before dishwashing).

Although the marketplace is changing and water-efficient devices are becoming more readily available and cost-competitive, The City hopes to accelerate installations of water-efficient models. To encourage customers to replace their older technology, The City plans to employ – where appropriate – one-time measures such as rebates, discounts, technology demonstrations and customer education about paybacks. Combined with regulatory changes mandating water-efficient technologies in new buildings, these measures are expected to result in *cumulative, long-term* water savings.

Outdoor audits and tools

Landscaping audits and programs promoting efficient outdoor watering are both proven means of reducing peak demand during the summer months.

Water Resources piloted its first audit program ("Team Water-Wise") in 2003. The team inspected in-ground irrigation systems and then recommended ways to improve watering efficiency. It found customers with in-ground sprinklers typically used four times more water than needed.

The City also encourages sustainable watering practices through its sale of outdoor Water Saver Kits (various devices to reduce overall water use) and through its partnership with The Clean Calgary Association to promote the sale and use of rain barrels. Both products are available to consumers at discounted prices.

Outdoor water use campaigns

Like many municipalities, The City of Calgary uses a wide variety of education and communication techniques to promote water use efficiency, its benefits and ways customers can conserve water.

These efforts include targeted communication campaigns aimed at reducing peak demand during Calgary's hot, dry summer months (May through August). The campaigns promote sustainable outdoor watering practices and typically involve television, radio and/or newspaper advertisements, community outreach, brochures, "how-to" facts sheets, bill inserts, The City's website and participation at special events.

Indoor water use and leak detection campaigns

The City also carries out communication and education activities aimed at helping customers make water-efficient choices to reduce indoor water consumption and detect and repair leaks in their homes. These campaigns are conducted during the fall and winter months using the same communication techniques as for the outdoor campaigns.

System and process audits

Audit programs provide a valuable opportunity to teach customers about water efficiency principles and opportunities to reduce water use. Water Resources has piloted an audit program aimed at helping Calgary's largest ICI customers conserve water while minimizing waste stream surcharges. Auditors assess current water uses and effluent discharge systems at the customers' business premises, then recommend ways they can improve their water use efficiency and reduce over-strength effluent.

Water managed sites certification

The City also provides an opportunity for residential or ICI properties to become certified as "water managed sites." Certification requires properties use water-efficient irrigation technology (i.e. in-ground sprinkler systems that use either climatic or historical weather data to set watering schedules). Because properties designated as "water managed sites" irrigate efficiently, certified customers would be less restricted and therefore be less impacted in the event of outdoor watering restrictions.

7 Forecasting water demand

Instrumental to effective water resource planning and management is the ability to forecast future water demand. A water demand-forecasting model was developed for use as a tool in planning, understanding potential program impacts, and the analysis of policy impacts.

Forecasting is a simulation of the future. In addition to understanding historical water demand patterns, it's prudent to anticipate future water use patterns by considering the major influencing factors. Factors directly affecting water demand are often difficult to predict and include social, economic, political and environmental issues.

Water Demand Factors

Key factors that could affect Calgary's water demand have been reviewed and included in the model where appropriate.

Population

Calgary's population is estimated to grow at a rate of 1.7 per cent over the next 10 years. This equates to approximately 18,000 persons per year.[29]

Water rates and economy

Calgary's residential rate structure is uniform and general services will become uniform in 2008. A uniform rate structure means there's no rate increase or discount when a customer uses an increasingly larger amount of water. An inclining block rate structure, where rates increase as volumes increases, would not likely be effective in a city that is not fully metered. In Calgary's strong economy, current water rates have not been shown to be a major disincentive for water use. However, many commerical customers are looking to reduce water use to decrease water costs in their operations.

Persons per household

The persons per *dwelling* is estimated at three persons per unit, and 2.9 person per unit from 2010-2014.[30] This is a weighted average (1.7 people in multi-family housing and 3.2 in single-family housing.)

Housing stock

The number of older single-family dwellings with inefficient water fixtures and larger lot sizes impacts water demand. It's estimated there will be 10,000 new housing starts for the next 10 years.[31] The distribution ratio of housing types (single-family versus multi-family types) has been stable for the past five years and is not projected to change for the next five years. [32]

General services sector

This includes all industrial, commercial, institutional and multi-family dwellings. Water use varies widely depending on the type of industry or manufacturing present or being attracted to the City. For example, an increase in the service-based industry would have a lower impact on water demand than an increase in industrial or manufacturing facilities would.

Weather and climate

Year-to-year variations in temperature and precipitation will primarily affect outdoor water consumption. A study of historical climate and stream flow trends and future water demand in the Calgary region was completed in 2005 by the Geological Survey of Canada. Their analysis showed there was an increase in the annual means, minimum and maximum temperatures in Calgary in the last century. There was an increasing number of days with rain and a decrease in precipitation variance. [33]

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29 From SUBURBAN RESIDENTIAL GROWTH 2006-2010 report (estimating 1.7 per cent growth per year).

30 "Accommodating Growth: A Framework for Coordinating Municipal Capital Investment 2005-2024."

31 "Calgary and Region Economic Outlook 2005 – 2015."

32 "Suburban Residential Growth 2006 – 2010."

33 Chen Z., Grasby S and Osadetz K. 2005. *Historical Climate and Stream Flow Trends and Future Water Demand Analysis in the Calgary Region, Canada.* Geological Survey of Canada.

Regional water sales

Calgary currently supplies water to the cities of Airdrie and Chestermere. In 2005, their water demand was 3.2 per cent of our city's annual demand. Each year the percentage of regional sales has increased. Regional alignment with Calgary's conservation programs could be ensured through their service agreements with The City.

Calgary's "30-in-30" Plan

This plan outlines numerous programs to bring overall water demand down to 350 lpcd in the next 30 years, an additional 30 percent drop from where Calgary was in 2003.

Flat Rate Residences Converted to Meters

It's a fact that most houses on flat rate billing consume more water. Calgary has mandated all houses have meters installed by January 1, 2015. Currently there are 61,000 houses on flat rate, which require meter installations.

System Water Loss

Calgary is committed to a having a well-run utility though numerous initiatives in distribution control. These include leak detection, district metering and a proactive water surveys or audits.

Water Bylaw

A low-flow plumbing fixture amendment was made to Calgary's Water Bylaw for all new construction and permit-based renovations on August 1, 2005. This includes, but is not limited to, toilets that have no greater than a six-litre flushing volume and restrict once-through cooling.

Customer Programs

With a growing awareness of the environment and our impact on it, people are becoming more receptive to educational and water efficiency programs. Sixty five per cent of Calgarians say they have taken advantage of a City-offered water saving program or water conservation tip. Twice yearly quantitative studies are conducted to measure the effectiveness of conservation campaigns (such as the percentage of people who followed a particular educational tip), to measure trends in the use of water-wise devises (such as the per cent of front load washers or underground irrigation systems) and changes in attitudes related to water (such as the importance of reducing water use in one's personal home).

Environmental Management System

This will entail using ISO 14001 to strategically align all water reduction initiatives within City operations.

Forecasting methodology

Timeframe

There are three major time frames a forecasting model can use: short-, medium- and long-term. Short-term forecasts range from one to two years. Medium-term forecasts ranges from one to ten years. Long-term forecasts look forward greater than ten years. The further one moves away from the present-day situation and the factors influencing water demand, the more difficult it becomes to predict events and hence, the larger the margins of error can be. [34] A medium-term forecasting model was chosen for the Water Efficiency Plan as it supports The City's need to examine the impact of policy (e.g. metering), the impact of water conservation programs, as well as alternative assumptions about growth.

Analysis of water use by customer sector

In addition to choosing a medium-term forecasting model, the demand patterns by customer group were examined separately. The majority of cities report their annual water consumption on a per capita basis. Annual trends in the per capita use rate can disguise various influencing customers, factors and can show great variability. By breaking down water use patterns by customer class, trends within certain sectors can be observed more easily. This should result in more accurate information and understanding of water demand patterns and improved forecasting. Due to the structure of Calgary's billing system, the sectoral model was divided into three main categories: residential metered, residential flat rate and general service accounts. General service accounts included all industrial, commercial, institutional and multi-family dwellings.

[34] R. Bruce Billings and Clive V. Jones. 1996. *Forecasting Urban Water Demand*. American Water Works Association, Denver, Colorado.

A sectoral water demand model is best suited to Calgary's needs because, firstly, the development of water conservation programs is designed primarily on a customer-by-customer basis and it fosters a good business relationship by knowing one's customer. Secondly, it is necessary to configure the impact of converting the last remaining residences to meters by 2015. Thirdly, an overall system water balance should incorporate and highlight a system's inherent leakage.

Water demand forecast

Three different scenarios were run through the water-forecasting model to estimate Calgary's system demand for water by 2015:

- **Scenario A** – Demand with no conservation programs, except the completion of universal metering and leak detection.
- **Scenario B** – Above, with the addition of planned water conservation programs.
- **Scenario C** – B, with widespread marketplace adoption of low-water use toilets and washing machines.

The scenarios were chosen to represent different variations on what might happen. A true "business as usual" scenario is difficult as many elements are not within the City's control.

Table 7.1 Three Scenarios

	A	B	C
Leak Detection Programs	●	●	●
Water metering by 2014	●	●	●
Toilet rebate program		●	●
Washing machine rebate program		●	●
Low water use plumbing fixtures		●	●
Commercial water audits		●	●
Spray valve replacement program		●	●
Education programs		●	●
New technology incentives		●	●
Marketplace change			●

To achieve our "30-in-30" water conservation goal, per capita demand needs to reduce from 500 lpcd to 350 liters per capita per day by 2032. To be on track to reach that goal, per capita demand should be at 443 lpcd by 2015, where our forecast model ends.

Scenario A – Metering only

A number of key assumptions were made in forecasting Calgary's future demand for water. These include:

Leakage. Calgary's system leakage remains constant at 12 per cent. This assumption takes into account The City's ongoing leak detection and main replacement programs.

Outdoor water use. Water used indoors remains constant for metered customers at 88 per cent and outdoors 12 per cent. This is the average of the last ten years.

Types of customers. The growth rate for different types of accounts is similar to recent years. It is estimated the city's surrounding growth will be two per cent, residential accounts three per cent and general service accounts 1.8 per cent. This aligns with current forecasts.

Occupancy. People per single-family household will decline from three to 2.9 by 2015.[35]

Metered water use. By the end of 2014, the last remaining unmetered residential customers will be metered. Expectations are that newly metered customers use water like existing metered customers.

Scenario B – Current programs

The impact of water conservation programs can last for a year or several years depending on the technology implemented or behaviour targeted. Programs included in this scenario apply to all Calgarians, including residential home and apartment owners as well as well as industrial, commercial and institutional customers.

35 Accommodating Growth: A Framework for Coordination Municipal Capital Investment. 2005-2024.

Residential technology programs

Leak Campaign. Annual leak campaigns yield water savings expected to last for one year. Water savings are calculated based on households that report hiring a plumber or buying replacement parts to repair leaks in their homes. It's estimated that 45 cubic meters of water is saved per household a year.[36]

Toilet Rebate Program. Water savings are calculated for the number of homes replacing a 13 or 20 litre toilet through participation in The City's rebate program. Water savings for both six litre and dual flush replacements were calculated based on eight flushes per toilet per day.[37] Replacement with an eligible six-litre toilet yields an estimated 10.5 litres per flush savings and dual flush model yields 12.2 litres per flush.[38]

Water savings for toilet replacements in apartments and condominiums is based on an average of the observed saving from a 2005 Calgary pilot project and savings typically found in this type of program in other municipalities. This is estimated to be 67 m3 per toilet a year.

Washing Machine Rebate Program. Each high performance front load washer that replaces an older style washing machine is estimated to save 33,000L of water per year.[39]

Utility Bylaw. Effective August 2005, low-flow plumbing fixtures were required in new, single-family homes. Water savings are based on the forecasted number of new homes[40] and a 30 per cent reduction in water use compared to a non-conserving home.[41] This includes single- and multi-family units.

36 Yee, 2000. Vickers, 2001. The City of Calgary, 2006.

37 The City of Toronto, 2002. The City of Waterloo, 2004.

38 The City of Toronto, 2002. The City of Waterloo, 2004.

39 Vickers, 2001.

40 "Calgary and Region Economic Outlook 2005-2015" and "Suburban Residential Growth 2006-2010."

41 Vickers, 2001.

Non-residential technology programs

System and process water audits. Experience conducting water audits with Calgary businesses has helped identify a number of industry-specific water saving opportunities. On average, local businesses realized a 20 ML water savings per year by implementing the recommendations in their operations. Audits are done on a pilot basis to share the learning with other customers in the same industry.

Technology retrofit pilots. These include one-time retrofit partnerships with different City departments and institutions such as The University of Calgary or local school boards. Past programs, such as timed flush urinal replacements, realized four ML of water per year.

Washing machine replacement. Industry is moving towards high efficiency front-loading models. On-going education with multi-family owners and managers resulted in a change in the types of washing machines purchased. A 13 ML reduction in water demand a year is estimated.

Spray Valve Replacement Program. Savings are based on a 2005 pilot study and the City-wide program being offered in 2007. On average, 130 m^3 per valve, per year is seen. Savings are expected to last five years.

Utility Bylaw (Once-Thru Cooling). Savings are realized by preventing new systems from being installed. Savings of 7.9 ML are estimated each year.

Education programs

Each year the number of households and businesses that report following tips after an education campaign is measured. However, it can be difficult to quantify the direct link of education to overall water reduction in water use. Tips include watering lawns only one inch over the week, using a rain barrel and running dishwashers only when full. Some municipalities have directly measured the impact of summer watering education programs in controlled studies and found 200 litres a day saved[42] per household during the outdoor watering season.

42 Region of Durham, 2006.

To account for education impacts in this forecast scenario, a reduction of two litres per person a day per year was included. This seems reasonable given that:

- Peak day demand in Calgary reduced by an average of 40 litres per person each year since 1998 when summer education campaigns were launched.
- The demand forecast (which uses actual data up to 2005), without any adjustments for the impact of education programs, showed demand was four lpcd higher than the actual data for 2006.

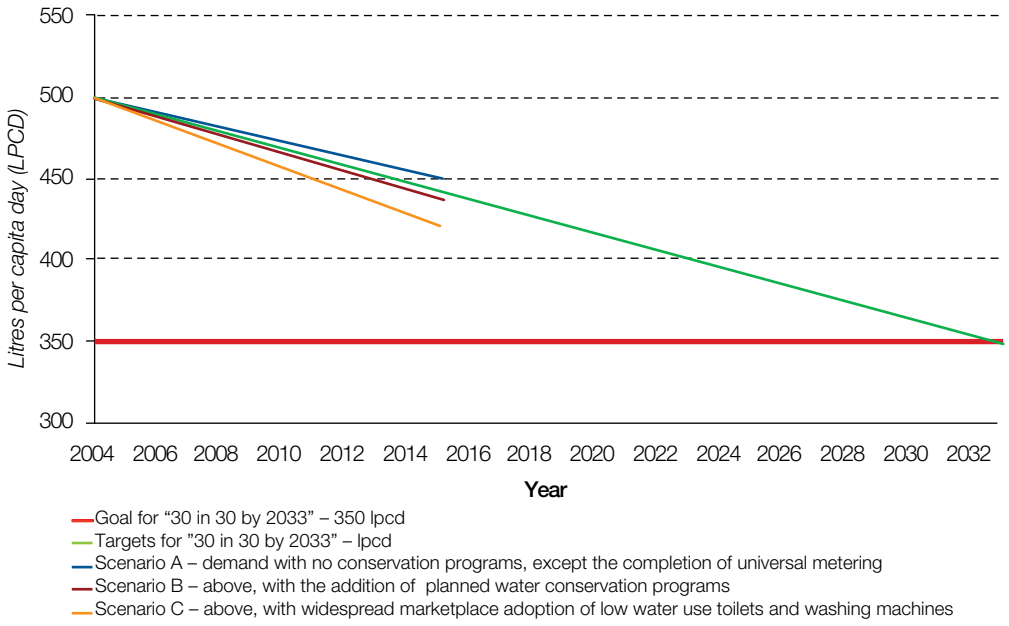
Scenario C – Widespread marketplace change

Increasingly, Calgarians are able to choose from a wide variety of high efficient technology for their homes and workplaces. The marketplace is changing. For example in 2003, only 13 high performing low-flush toilets were available in the Calgary and in 2007 over 135 are available. It is recognized not all newly installed water efficient technology replacing old and outdated models in Calgary will be tracked through City-run programs such as the toilet rebate program. This scenario estimates the impact of the replacement one third of all older style toilets and washing machines to water efficient models over a thirty-year time. This is a conservative estimate, as a toilet typically lasts for 10-20 years and a washing machine for 15-20.[43]

Forecasting results

The following graph shows the system demand divided by the population projections to 2015. The population in 2015 is estimated to be 1,162,000 people. The projected liters per capita day (lpcd) is estimated to be 453 in 2015 if only metering is completed. If current water conservation savings continue, then it's estimated demand will be 440 lpcd. With the widespread marketplace adoption of low-water use toilets and washing machines, demand could be as low as 424 lpcd by 2015.

Figure 7.1 Forecasted per capita demand for Calgary using different scenarios.



43 AWWA, 2006. Water Conservation Programs – A Planning Manual.

8 Implementation plan

Water Efficiency programs are planned for implementation every three years as part of The City of Calgary's three-year budgeting cycle. It is recognized that some programs require a long-term and ongoing commitment (for example summer watering education campaigns), while others will be implemented over a shorter period of time (for example the one time replacement of spray valves in food service establishments).

As each three-year program implementation schedule is planned, a review of water efficiency measures will be conducted as outlined in Chapter 6. This regular review is required as changes in the marketplace (i.e. number and types of plumbing fixtures available) and the adoption of water-wise behaviours by businesses and homeowners continuously evolve.

Table 8.1 Implementation Schedule

Strategy Program Name	Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014
Lead by Example										
System leak detection and main replacement.	Municipal									
Treatment process upgrades.	Municipal									
IWA water audit.	Municipal									
Civic fixture retrofit program.	Municipal			pilot						
Align Policy with Water Conservation Objectives										
Metering.	Residential									
Low-Flow Plumbing Fixture Bylaw.	All									
Review of New Policy Opportunities.	All									
Water Reuse/Matching Water Quality to Water Use										
Rain Barrel Promotion.	Residential									
Water Reuse Pilots.	Commercial									

Strategy Program Name	Sector	2006	2007	2008	2009	2010	2011	2012	2013	2014
Encouraging Water Efficient Technology										
Low-Flush Toilet Replacement.	Residential									
	Multi-Family	pilot								
	Commercial							pilot		
Washing Machine Replacement.	Residential									
Spray Valve Replacement.	Commercial	pilot								
Water Managed Sites Certification.	All									
New Technology Incentives.	TBD									
Technical Assistance										
System and Process Audits.	Commercial									
Retrofit Pilots.	Commercial									
Outdoor Audits – Irrigation.	All									
Changing Behaviors (education campaigns or outreach)										
Outdoor Water Use.	All									
Leak Awareness and Detection.	Residential									
Indoor Water Use Programs.	All									
Curriculum and Special Events.	Youth									
Research and Program Evaluation										
Customer Attitude and Behaviour Research.	All									
Water Efficiency Measure Research/review.	All									

9 Public engagement

In the development of this plan, The City of Calgary informed, listened, learned and consulted with internal and external stakeholders [44]. This was done on our water efficiency goal, best practice approach and criteria for choosing water saving measures.

Stakeholders included:

- Citizens in general (via survey).
- Bow River Basin Council (BRBC).
- Environmental Advisory Committee (EAC).
- Canadian Water and Wastewater Association (CWWA) water conservation network.
- City employees in Water Resources and Water Services.
- Other City business units including Parks and Environmental Management.
- Calgary Regional Home Builders Association (CRHBA).
- Provincial colleagues in Alberta Environment and Municipal Affairs.
- The Calgary Regional Partnership.

Summary of stakeholder engagement

Each year, Water Resources conducts two telephone surveys to measure the impact of several water conservation initiatives. The surveys are part of a longitudinal study that measures water conservation behaviours and attitudes. In the spring 2006 survey, 96 per cent of respondents indicated that it is “very important” or “important” that The City of Calgary promotes water conservation among Calgarians. (This is opposed to “not very” or “not at all” important.)

While the surveys shows that awareness has grown and has remained high over the last several years, many Calgarians still need to personally make a commitment to water conservation. For example, in 2006 only 30 per cent of home owners indicated they were planning to use more efficient water saving devices, fixtures or appliances.

Overall, reaction to the Water Efficiency Plan has been positive.

In addition, periodically focus groups are held to determine the barriers and benefits Calgarians experience and perserve regarding water conservation behaviors and technology. This info helps prioritize and develop programs.

Overall, reaction to the Water Efficiency Plan has been positive. Engagement techniques included meetings, presentations and input gathering, emails with requests for input and several one-on-one discussions.

This plan generated new questions and enabled further exchange of ideas and discussion. While, some stakeholders did not feel the goal was set high enough, many stakeholders were impressed with the overall presentation and the appropriate level of detail in the plan.

Stakeholder feedback has been very positive with regards to The City’s comprehensive strategy. For example, this plan was recognized and featured as an example of a best management practice for demand management by the National Guide to Sustainable Municipal Infrastructure (Infraguide) in 2006.

44 The City of Calgary, engage, 2004.

In addition, a Corporate Knights magazine recognized The City of Calgary's approach in both 2005 and 2006 as "one of Canada's most elaborate water efficiency strategies with initiatives ranging from an educational campaign, to toilet replacement program, to repairing leaks in city water mains." Stakeholders stressed and the utility concurred, there is need for both residential and commercial programs.

Stakeholders stressed the importance of continued consultation as specific programs are developed. As expected, stakeholders are most concerned when a particular program or water saving technology impacts their operations and interests. As in the past, consultation continues to be conducted on each specific program as they are considered and developed.

"30-in-30" approved by Council

In December of 2005, the "30-in-30 by 2033" water conservation goal outlined in this plan was adopted by City Council. Since that time The City led a community initiative called imagineCALGARY. imagineCALGARY was a City-led, community-owned initiative to create a 100-year vision and plan for a sustainable Calgary in order to ensure a prosperous economy, clean environment and high quality of life for the people who live here in the decades to come.

Between May and November 2005, 18,000 Calgarians answered five questions about what they value about Calgary and what they hope for the future of our city. With 18,000 responses, it was one of the largest scale citizen involvements in a visioning process to occur in any city, anywhere in the world.

The 100-year goal is that our water supply system is sufficiently secure, flexible and adaptable to changing conditions and circumstances.

Through the extensive engagement process,the importance of water was recognized. Calgarians agree that water is necessary for life. Calgarians value this precious resource and guarantee equitable access for all living things. Calgarians recognize they are stewards of water, protecting its quality and maintaining the integrity of the hydrologic cycle.

10 Conclusions and recommendations

Implementing the Water Efficiency Plan will help The City of Calgary meet the significant challenges it faces in managing our fresh water resources. The City aims to reduce impacts on our watershed, maximize service from our existing infrastructure, accommodate a growing population, ensure economic growth and continue to work with partners to create a culture of sustainability. Recommendations build on recent success and align with best practices.[45]

Recommendations:

1. The City implement the Water Efficiency Plan, aligning and co-ordinating with other City environmental programs.
2. The City monitor water demands and report annual progress towards the "30-in-30 by 2033" water sustainability goals and indicators.
3. The City continue to take a leadership role implementing water efficiencies in our operations and infrastructure.
4. The City pilot, tailor and revise programs based on water savings and customer feedback, behaviour and barrier research.
5. The City revisit the water demand forecast model (Chapter 7) as the City becomes 100 per cent metered.
6. The City recognize that the widespread adoption of some water savings measures will be generational in nature and thus require long-term investment of resources and educational efforts.
7. The City research and prioritize water efficiency measures at a minimum every three years (Chapter 6).
8. The City value, pilot and enable innovative ways to use non-potable water sources such as stormwater, greywater and wastewater effluent.
9. The City monitor the effectiveness of current policies and recommend amendments to bylaws when appropriate.
10. The City integrate water conservation and reuse into infrastructure, stormwater, wastewater and land use planning.
11. The City share and celebrate stories of water conservation successes and local water-wise champions and leaders.
12. The City continue to engage Calgarians, water customers, home builders, irrigators, the plumbing industry and other key stakeholder as programs are considered and developed.
13. The City continue to partner with community group, non-government organizations and businesses to deliver programs, highlight water saving opportunities, leverage resources, share skills and build momentum.

[45] Brandes et al, 2006.

Appendices

Appendix A: Overview of existing water efficiency programs

The City of Calgary, Water Resources has implemented a wide range of water efficiency initiatives in its ongoing efforts to reduce water use. These initiatives can be classified as follows:

- Operational strategies.
- Regulations.
- Public education programs.
- Product promotion and financial incentives.

In preparing this Water Efficiency Plan, The City reviewed and evaluated a wide variety of conservation measures for suitability, technical feasibility, applicability and potential return on investment. Table A-1 provides an at-a-glance summary of the programs and services Water Resources has chosen to implement in Calgary. Detailed descriptions of these measures are available as an addendum to this document. Water efficiency measures reviewed but not implemented at this time are listed in Appendix B.

Table A-1

Summary of Calgary's existing water efficiency programs and initiatives

Water efficiency initiatives	Partner(s)	Target
Operational Strategies		
System leak detection and water main replacement.		City infrastructure
Water treatment process upgrades to achieve zero discharge.		City infrastructure
Metering and water management strategy for city.	Parks	Municipal customers
Parks and sports fields.		
Regulations		
Universal metering program.		Residential customers
Outdoor water use restrictions.		All customers
Low-flow Fixtures and Water Wastage Bylaw		All customers
Education		
Print publications (e.g. brochures, bill inserts, calendar) and online materials.		All customers
Participation in special events: ■ Booths at the Home and Garden Show and Mayor's Environmental Expo.		All customers
Advertising and information campaigns: ■ Summer water conservation, leak detection, indoor water use.		All customers
Team Water Wise irrigation audits		All customers
Youth programs: ■ Water efficiency school program. ■ "The Dripper" model treatment process. ■ Virtual online tour of water treatment. ■ School plays.	Science Alberta Evergreen Theatre	Residential customers
Product Promotion & Financial Incentives		
ICI water and wastewater audits.	Wastewater	ICI customers
Indoor and outdoor water saver kits.	Clean Calgary Association	Residential customers
Rain barrel promotion and annual sale sponsorship.	Clean Calgary Association	Residential customers
Residential toilet replacement rebate program.		Residential customers
Multi-family appliance retrofit pilot project (toilets and washing machines).	Calgary Housing Company	Residential customers
Washing machine replacement rebate pilot.	Climate Change Central	Residential customers
Residential Water Managed Site certification.	Parks	Residential customers
ICI Water Managed Site certification.	Parks	ICI customers
Spray Valve Replacement Program Pilot.		ICI customers

Appendix B: Water efficiency measures not recommended at this time

The following water efficiency measures were evaluated but are not recommended for full implementation by The City of Calgary at this time. The rationale for this decision varies and is noted briefly below for each measure.

Mandatory car wash water reuse

Many opportunities exist to recycle and reuse water for purposes other than drinking. One option is to mandate water reuse by commercial car washes. Such applications pose no health risk and can significantly reduce net water consumption by customers in this industry. However, limited public acceptance and implementation issues (e.g. installation, maintenance and cost of water reuse systems) currently pose barriers to this initiative.

Dishwasher rebates

As with low-flow toilets and front-loading clothes washers, water-efficient dishwashers are now widely available. These units can result in significant water savings compared to conventional models. Purchasing trends indicate water-efficient units are gaining market share, so The City opted to defer rebates while installations are being strongly market-driven. The City will, however, continue to promote use of these and other water-efficient appliances as part of its indoor water education campaigns.

Garburator prohibition

Garburators grind solid food waste into small particles and use water to carry the waste down the sewer drain. In many cases, these devices are unnecessary and some jurisdictions have gone so far as to ban garburators completely. Since no details are currently available about the extent of garburator use in Calgary or the potential water savings of a garburator ban, The City plans to address garburator use as part of its indoor water education campaigns.

Humidifier standards

All humidifiers add moisture to the air, but these appliances vary widely in terms of their operation and water use efficiency. Closed-loop systems for example, are generally more water- and energy-efficient than pan humidifiers. While some regions have issued minimum efficiency standards for humidifiers, The City of Calgary has decided to hold off on such action until more research is available on market trends and potential water savings of newer humidifiers. The City will address humidifier use as part of its indoor water education campaigns. Any future standards or restrictions regarding humidifier use in Calgary will need to satisfy public concerns, particularly given our region's dry climate.

Odd/even watering

Odd/even outdoor watering schedules (i.e. those based on numbered street addresses) exist in many North American cities but they have not consistently yielded significant water savings. In fact, experience in many regions has shown that odd/even schedules often lead to over-watering and can actually increase demand. While relatively simple to implement and easy for customers to remember, odd/even watering schedules limit flexibility for municipal water utilities during drought conditions and in other circumstances when water use restrictions are necessary.

Personal restrictions on indoor water use

In much the same way they use outdoor watering restrictions, some utilities have set personal limits on indoor water use as a viable means of reducing demand. However, such actions are unlikely to garner widespread public acceptance, due to perceived inconvenience, interference with personal freedoms and quality of life issues. Since the social impacts of personal water use restrictions are largely negative, they can be expected to pose significant implementation challenges.

Personal, business or landscape water allocations

Some cities have attempted to resolve rising demand by establishing specific water budgets for residential, ICI and municipal customers. In some cases, these allocations apply only to outdoor water use (e.g. landscaping, watering cycles) and in others, to both indoor and outdoor applications. Although this approach tries to be more proactive than is typically the case for water use restrictions, utilities still face significant public opposition given the perceived negative impacts on quality of life.

Pressure reduction

Adequate water pressure is needed to facilitate water distribution and meet the needs of a diverse customer base. On the other hand, lowering distribution system pressure can help reduce leakage and wasted water. Some municipalities have installed pressure-reducing valves and similar devices as a water efficiency measure to restrict pressure in areas where it's higher than necessary. This approach requires careful monitoring and system management and is feasible only if excess pressure exists within the system. This is not typically the case in Calgary, where continued urban expansion and development at the city's perimeter is creating a need for additional water pressure to meet distribution requirements for these areas.

Residential water audits

Water audits are a common element of municipal water efficiency programs and can yield significant, cumulative water savings. The City of Calgary offers system and process audits to ICI and municipal customers. In 2003, Water Resources piloted an irrigation audit program (Team Water-Wise), which was also available to residential customers. This program focused exclusively on outdoor water use. Due to implementation issues as well as the relatively high cost-to-water savings ratio of residential audit programs, The City chose to focus its current audit resources and programs on high-volume water users. However, information is available to assist customers who wish to conduct their own audit and detect leaks in their home.

Sub-metering

Installing individual water meters for each unit within multi-family buildings or apartments is becoming increasingly common, particularly in new buildings. Some utilities and building owners support sub-metering as a means of promoting water use efficiency. However, in many multi-family situations, sub-metering is problematic given the cost of installing, maintaining and reading meters. The City plans to research these issues further and develop pilot projects to better understand both the barriers of sub-metering and its potential water-saving opportunities.

Time-of-use billing

Time-of-use billing has been widely explored as a conservation initiative in the energy sector. In this context, electricity rates are higher during peak hours – a pricing structure that better reflects the actual costs of power generation and transmission. A similar approach is possible for water use and is being tried in some jurisdictions with universal water metering. However, the logistical, data and implementation requirements of time-of-use billing are complex and not something The City of Calgary intends to pursue at this time.

Water softener standards

Many customers use water-softening systems to reduce the hardness of Calgary's water. Softeners typically employ an automatic recharge process that flushes the system and discharges excess salts. For some models, this process occurs at regular time intervals regardless of water use. More efficient units recharge only after a specific volume of water passes through them. In general, newer softeners use less water and release less salt into the wastewater system. To encourage customers to replace or retrofit older units with more-efficient technologies, some utilities are offering rebates or setting minimum standards for water softening systems. More research is needed, however, to quantify the potential water savings of such standards. As such, The City of Calgary plans to continue to promote water-efficient systems as part of its indoor education campaigns.

Xeriscaping rebates

Water-efficient landscaping ("xeriscaping") can produce healthy, visually appealing landscapes while dramatically reducing outdoor water use, particularly during peak summer months. Xeriscaping typically involves choosing drought-resistant plants (i.e. those native or well-adapted to the local climate), incorporating non-living elements into the landscape design (e.g. decks, stone) and using horticultural techniques that maximize water use efficiency (e.g. adding mulches to help conserve moisture and moderate soil temperature). Although some municipalities have established turf reduction ("cash for grass") programs, most promote xeriscaping as part of their ongoing customer education efforts. Similarly, The City of Calgary provides information about water-wise landscaping as part of its outdoor water use campaigns.

Glossary

Allotment

The total volume of water a user is authorized to withdraw, divert or otherwise use from a natural waterway. Also called an “allocation,” this limit is specified in the provincial water licences issued by Alberta Environment. The licence may also stipulate other terms and conditions for water use such as the rate and timing of water withdrawal.

Average day demand

The total volume of water The City pumps to the distribution system from its storage reservoirs in a year, divided by 365 days. This measure represents a water system’s average daily use over a one-year period.

Backwash water

The wastewater produced when water is forced backwards through water treatment filter tanks during routine cleaning of the filter beds.

Benchmarking

A process of comparing a program to other similar programs in order to evaluate strengths, weaknesses and opportunities for improvement. It provides an opportunity to evaluate current products, services and processes relative to other programs of known high quality.

Best management practices

A set of clear and widely accepted practices and principles that may serve as guidelines for municipal water utilities. These practices have typically been proven to be cost-effective and beneficial by industry experts.

Conservation pricing

Rate levels and pricing structures that encourage customers to use water wisely by providing a financial incentive that rewards conservation. It may also include pricing that reflects the true costs of water provision (including environmental impacts) and/or charges that increase in peak season.

Demand management

An approach to water resource management involving planning and implementing programs that focus on efficient water use. From this perspective, conservation, not more water, is the answer to meeting a city’s water needs.

Design capacity

Refers to the maximum volume of water a treatment plant, storage facility or distribution pipe is designed to accommodate.

Drought

A temporary or prolonged shortage of precipitation (rainfall and/or snow), which may create low-water levels in surface waters.

Ecosystem

A dynamic natural system of interacting components that includes plant, animal, fungal and microorganism communities as well as the physical, non-living environment in which they exist.

Faucet aerator

An attachment that screws onto a faucet and uses a fine metal screen to reduce water flow by adding air to it. Less water comes out with no noticeable change in pressure.

Filter-to-waste water

Water that passes through drinking water treatment filter beds but is discharged from the plant as wastewater. This occurs immediately after the beds have been cleaned (through a process called backwashing). The water is discarded because it's generally not of sufficiently high quality to meet regulatory guidelines.

Flat-to-metered conversion

The process of switching a customer from a flat rate to a residential water meter.

Global warming

Also known as "climate change," this refers to a gradual warming of the earth's surface caused by greenhouse gases in the lower atmosphere.

Gross per capita demand

The total volume of water used per day (based on average day demand) divided by the total population served. This includes all customer classes (ICI, single- and multi-family residential, wholesale), as well as all non-revenue water.

Habitat

The native environment where a plant or animal grows, lives and relies on for food, shelter and water.

Hydrologic cycle

The continuous circulation of water from oceans and other bodies of water to the atmosphere, land and back to the oceans through various processes including precipitation, run-off, infiltration, percolation and evaporation.

ICI

A customer class for water utilities that includes all industrial, commercial and/or institutional users. This includes, schools, hotels, hospitals, restaurants, office buildings, retail centres, government buildings, oil and gas operations and manufacturing or processing plants.

In-stream use

Any use of water within a stream or river system. The water is used, but not withdrawn, from the source water. This includes many recreational uses such as boating or fishing.

Irrigation

The process of artificially supplying water to land to encourage crops, plants or gardens to grow.

Low-flow devices

Appliances and fixtures such as showerheads and toilets that use less water than conventional devices. Low-flow devices are also sometimes called "water smart" or "water efficient" devices.

Maximum day per capita demand

The largest per capita water use in a single day, as measured within a single calendar year. It is calculated by dividing the annual peak day demand by the total population served and measured in litres per capita, per day.

Megalitre (ML)

The unit of measurement used by municipal water suppliers for expressing total water production and demand. One megalitre is equivalent to one million litres of water.

Municipal sector

Water users that do not fall into other customer classes. In Calgary, this includes City departments and wholesale customers (i.e. communities outside the city, such as Airdrie and Chestermere).

Non-revenue water

A term used to describe water that's treated and distributed, but not billed to a customer. This includes water lost through system leakage and main breaks as well as water used for delivery of City services (e.g. street cleaning, parks irrigation, fire fighting, etc.).

Peak day demand

The largest total water use experienced by a water supply system within a single calendar year. Like average day demand, it's calculated based on the total volume of water produced on a single day.

Peaking factor

The ratio between a city's annual peak day demand and its average day demand for the same calendar year.

Per capita demand

The average amount of water used per person, per day. It is calculated based on average day demand (i.e. the average volume of water used per day) divided by the population served. Municipalities typically express per capita demand as either gross per capita demand or residential per capita demand, depending on the population they're describing.

Pressure zone

An area within municipal water utility's distribution system in which the water pressure in the pipes is maintained within certain limits. This is achieved by high-lift pumps, which force the water through transmission mains to strategically located storage reservoirs and pump stations. This system ensures all customers receive water of adequate volume and pressure. Distribution systems like Calgary's, which have large variations in elevation and many kilometers of pipes, typically require multiple pressure zones.

Rain barrel

A device to collect rainwater from a home's eaves troughs. The collected water is subsequently used for watering lawns and gardens.

Renewable resource

A natural resource whose supply is naturally and continuously replenished. Water is considered a renewable resource due to its continual circulation through the hydrologic cycle. However, this does not mean that water can be wasted or polluted and still provide an adequate supply to meet demand or be of sufficiently high quality to serve as a drinking water source. Irreparable damage to water systems is still possible even though water is a renewable resource.

Retrofit

To modify, add or substitute parts for existing (usually older) plumbing fixtures or appliances. This is typically done to save water and/or make the fixtures or appliances operate more efficiently.

Runoff

The portion of rain or melted snow that is not absorbed into the soil, but flows into streams and rivers.

Source water

Also called "raw water," it refers to water that has not yet been treated to make it drinkable. Calgary's source water comes from the Bow and Elbow rivers.

Supply-side management

The traditional approach to water resource management that involves seeking out new sources of supply and/or expanding existing water and wastewater infrastructure capacity to meet increased demand for water.

Surface water

All water naturally open to the atmosphere. For example, rivers, lakes, reservoirs, streams, seas and estuaries.

Sustainability

Frequently defined as “the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.” (World Commission on Environment and Development, 1987)

Total annual system demand

The total volume of water used by all customers, for all purposes, in a calendar year. This includes customers outside Calgary city limits, water used in the delivery of City services (e.g. fire fighting, street cleaning, parks irrigation, etc.), as well as water lost through system leakage.

Total combined annual production

The total volume of water treated at Calgary’s two drinking water treatment plants, measured in megalitres. Production is measured based on the volume of water that leaves the plants and is pumped into the distribution system.

Unaccounted-for water

The total volume of water that cannot be accounted for in Calgary’s water balance. This includes any water “lost” as a result of system leakage, main breaks, non-metered uses, water used through hydrants for fire fighting and operational flushing.

Wastewater

Water that carries waste from homes, businesses and industries to wastewater treatment plants.

Water audit

An on-site survey and assessment of a customer’s water use efficiency. This may include observing water use behaviours as well as evaluating the potential for low-flow devices and water-efficient irrigation systems.

Water conservation

The act of using less water. For example, turning off the tap when brushing one’s teeth.

Water consumption

A volume of water withdrawn from a water system, used and not fully returned to the source water. The net loss represents the amount of water consumed.

Water efficiency

The act of using a minimal amount of water to accomplish a function, task, process or result. For example, using less water when taking a shower.

Water meter

A device for measuring and recording the amount of water supplied to a house or business.

Watershed

The entire land area or region that catches precipitation and drains into a river, river system or other body of water. Calgary is gets its water from both the Elbow and Bow river watersheds.

References

Executive summary

1. CESD (Commissioner of the Environment and Sustainable Development). (2001). *Report of the CESD.* Chapter 1, Section 3. Ottawa: Office of the Auditor General of Canada, Minister of Public Works and Government Services. p. 23. Available at: http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c101sec3e.html [October 29, 2004].

Chapter 1: Calgary's water system

2. Alberta Environment. (2004). Water for Life Backgrounder – "Watersheds in Alberta." Available at: http://www.waterforlife.gov.ab.ca/html/background3.html [February 6, 2004].

Chapter 2: The case for conservation

3. Alberta Environment. (2004). "How much water do we use?" Cited on web site. Available at: http://www3.gov.ab.ca/env/water/Conservation/uses.cfm [October 14, 2004].

4. OECD (Organization for Economic Cooperation and Development). (1999). *Environmental Data Compendium 1999,* Paris: OECD. *Cited in:* Boyd, D.R. *Canada vs. the OECD: An Environmental Comparison.* (2001). Victoria: University of Victoria, Eco-research Chair of Environmental Law and Policy. Available at: http://www.environmentalindicators.com/htdocs/execsum.htm [October 14, 2004].

5. Environment Canada. (2002). "Water Conservation – Every Drop Counts." Environment Canada Green Lane Fact Sheet, Freshwater Series A-6. Ottawa: Minister of the Environment. Available at: http://www.ec.gc.ca/water/en/info/pubs/fs/e_fsa6.htm [October 29, 2004].

6. OECD (Organization for Economic Cooperation and Development). (1999). *Environmental Data Compendium 1999,* Paris: OECD. *Cited in:* Boyd, D.R. *Canada vs. the OECD: An Environmental Comparison.* (2001). Victoria: University of Victoria, Eco-research Chair of Environmental Law and Policy. Available at: http://www.environmentalindicators.com/htdocs/execsum.htm [October 14, 2004].

7. Brandes, Oliver M. and Keith Ferguson. (2004, April). *The Future in Every Drop.* Victoria: University of Victoria, The POLIS Project on Ecological Governance. p. 11. Available at: http://www.waterdsm.org. [October 29, 2004]

8. Schindler, David. (2002, March 7). [Interview cited in article by Valerie Shore]. "Water, water everywhere…or is it?" *The Ring.* Victoria: University of Victoria. Available at: http://ring.uvic.ca/02mar07/schindler.html [October 24, 2004].

9. World Commission on Environment and Development. (1987). *Our Common Future.* Chairman: Gro Harlem Brundtland. Oxford: Oxford University Press. p. 8.

10. Maas, Tony. (2003). *What the Experts Think: Understanding Urban Water Demand Management in Canada.* Victoria: University of Victoria, The POLIS Project on Ecological Governance. p. 2.

11. National Guide to Sustainable Municipal Infrastructure (InfraGuide). (2004). *Demand Management: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* Ottawa: Government of Canada, National Research Council, and Federation of Canadian Municipalities. p. 23.

12. The City of Calgary. (2004). *"engage!* Policy Statement." Calgary: The City of Calgary.

13. Alberta Environment. (2003). *Water for Life: Alberta's Strategy for Sustainability.* Edmonton: Government of Alberta. p. 21.

14. The City of Calgary. (2004, June). *Corporate Climate Change Program: Action Plan 2004.* Calgary: The City of Calgary, Environmental Management.

15. Schindler, David. (2003). "Chapter 2: The effects of climate warming and cumulative human activity on Canada's freshwater in the 21st century." In: Patricia Gallagher and Laurie Wood [Eds.], *Water and the Future of Life on Earth.* (2003). An edited proceedings from the workshop and think tank, May 22-24, 2002. (p. 2-1 to 2-13). Burnaby: Simon Fraser University, Continuing Studies in Science. p. 2-1.

16. Stewart, Iris T., Daniel R. Cayan, and Michael D. Dettinger. (2004). "Changes in snowmelt runoff timing in western North America under a 'Business as usual' climate change scenario." *Climatic Change* 62:217-232.

17. Alberta Environment. (2004, October 5). [Data cited in presentation titled "Water Conservation" by Beverly Yee, Director of Alberta Environment].

18. Statistics Canada. (2003). "Fresh water resources in Canada." Cited in: Statistics Canada. *"Human activity and the environment: Annual statistics."* The Daily (2003, December 3). Available at: http://www.statcan.ca/Daily/English/031203/d031203a.htm. [September 13, 2004].

19. Stewart, Iris T., Daniel R. Cayan, and Michael D. Dettinger. (2004). "Changes in snowmelt runoff timing in western North America under a 'Business as usual' climate change scenario." *Climatic Change* 62:217-232.

20. Schindler, David. (2002). [Excerpt from lecture titled "The Combined Effects of Climate Warming and Other Human Activities on Freshwaters and Wetlands of Western Canada." Delivered as Alberta Wilderness Association's Annual Lecture, November 2, 2001]. Cited in: Bow River Basin Council (2002, February). *Preserving Our Lifeline,* 2 (1), p. 3.

21. The City of Calgary. (2004, July). *Triple Bottom Line Policy Framework.* Calgary: The City of Calgary, Corporate Studies and Economics, Community Strategies, and Environmental Management.

22. National Guide to Sustainable Municipal Infrastructure (InfraGuide). (2004). *Demand Management: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* Ottawa: Government of Canada, National Research Council, and Federation of Canadian Municipalities. p. 14, 18.

23. Rocky Mountain Institute. (2004). Cited on web site. Snowmass: Rocky Mountain Institute. Available at: http://www.rmi.org/sitepages/pid280.php. [October 29, 2004].

Chapter 3: Calgary's water use profile

24. Environment Canada MUD Database. *Data cited in:* Brandes, Oliver M. and Keith Ferguson. (2004, April). *The Future in Every Drop.* Victoria: University of Victoria, The POLIS Project on Ecological Governance. p. 11. Available at: http://www.waterdsm.org. [October 29, 2004].

Chapter 4: Calgary's water efficiency history and successes

25. National Guide to Sustainable Municipal Infrastructure (InfraGuide). (2004, July). *Demand Management.* Issue No. 1.0. Ottawa: National Guide to Sustainable Municipal Infrastructure. p. 27. Available at: http://www.infraguide.ca/bestPractices/PublishedBP_e.asp#ep. [February 20, 2005].

Chapter 5: Towards sustainability – Calgary's water efficiency future

26. Kenel, Pam. (2004). "Water Supply Planning for Sustainability." *Water Resource Alternatives: The Future of Sustainable Utility Practices.* AWWA Teleconference, November 4, 2004.

27. Maas, Tony. (2003). *What the Experts Think: Understanding Urban Water Demand Management in Canada.* (2003). Victoria: University of Victoria, The POLIS Project on Ecological Governance. p. 15.

28. The State of Victoria Department of Sustainability and Environment. (2003). *Securing Our Water Future. Green Paper for Discussion.* Melbourne: The Victorian Government, Department of Sustainability and Environment. p. 8.

Chapter 6: Water efficiency measures

28. Vickers, Amy. (2001). *Handbook of Water Use and Conservation.* Amherst, Massachusetts: Waterplow Press. p. 435.

Chapter 7: Forecasting water demand

29 From SUBURBAN RESIDENTIAL GROWTH 2006-2010 report (estimating 1.7 per cent growth per year).

30 "Accommodating Growth: A Framework for Coordinating Municipal Capital Investment 2005-2024."

31 "Calgary and Region Economic Outlook 2005 – 2015."

32 "Suburban Residential Growth 2006 – 2010."

33 Chen Z., Grasby S and Osadetz K. 2005. *Historical Climate and Stream Flow Trends and Future Water Demand Analysis in the Calgary Region, Canada.* Geological Survey of Canada.

34 R. Bruce Billings and Clive V. Jones. 1996. *Forecasting Urban Water Demand*. American Water Works Association, Denver, Colorado.

35 Accommodating Growth: A Framework for Coordination Municipal Capital Investment. 2005-2024.

36 Accommodating Growth: A Framework for Coordination Municipal Capital Investment. 2005-2024.

37 Yee, 2000. Vickers, 2001. The City of Calgary, 2006.

38 The City of Toronto, 2002. The City of Waterloo, 2004.

39 The City of Toronto, 2002. The City of Waterloo, 2004.

40 Vickers, 2001.

41 "Calgary and Region Economic Outlook 2005-2015" and "Suburban Residential Growth 2006-2010."

42 Vickers, 2001.

43 Region of Durham, 2006.

44 AWWA, 2006. Water Conservation Programs – A Planning Manual.

Chapter 9: Public engagement

45 The City of Calgary. (2004). *"engage!* Policy Statement." Calgary: The City of Calgary.

Chapter 10: Conclusions and recommendations

46 Brandes et al, 2006.

Appendix B: Water efficiency measures not recommended at this time

47 Brands, O, Tony Mass and Ellen Reynolds (2006). *Thinking Beyond Pipes and Pumps, Top 10 Ways Communities Can Save Water and Money.* Victoria: V of V, The POLIS Project.