2010 state of the environment report

4TH EDITION

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THE CITY OF CALGARY
ENVIRONMENTAL & SAFETY MANAGEMENT

Acknowledgements

ENVIRONMENTAL & SAFETY MANAGEMENT WOULD LIKE TO ACKNOWLEDGE THE CONTRIBUTIONS OF THE FOLLOWING CITY BUSINESS UNITS AND OTHER ORGANIZATIONS:

City of Calgary business units:

Calgary Transit

Customer Service & Communications

Land Use Planning & Policy

Parks

Transportation Planning

Waste & Recycling Services

Water Services & Water Resources

Other Organizations:

Alberta Environment

Alberta Transportation

ATCO Gas Alberta Built Green

Calgary Horticultural Society

Canadian Green Building Council

Clean Air Strategic Alliance (CASA)

Calgary Regional Airshed Zone (CRAZ)

ENMAX Energy Corporation

Environmental Advisory Committee

Published January 2011

LETTER FROM ENVIRONMENTAL & SAFETY MANAGEMENT

I am pleased to present The City of Calgary's fourth State of the Environment Report (SOER). The 2010 report, developed as a web-based reference, represents our commitment to periodically track and report progress on long-term environmental goals and challenges facing our city. It aims to provide a clear picture of environmental trends in Calgary as they relate to land, air and water.

Since the 2006 report, City of Calgary business units have made significant progress on initiatives that are essential building blocks for community environmental sustainability. Some highlights include:

- The adoption of an integrated Municipal Development Plan and Calgary Transportation Plan, which integrates ecological protection goals into the long-term direction for sustainable growth in Calgary.
- The launch of the Blue Cart recycling program to approximately 300,000 homes and converting Community Recycling Depots to co-mingled recycling. Recycling has been expanded to include additional materials, and residents are no longer required to sort recyclables.
- The City's signing of the World Energy Cities Partnership Calgary Climate Change Accord, committing The City to support actions that will reduce municipal greenhouse gas (GHG) emissions by 20 per cent from a 2005 baseline by 2020.
- The full commissioning of the Pine Creek Wastewater Treatment Centre in 2009. This new plant uses the latest technology to treat wastewater to above current standards. It was built to meet the immediate need for additional wastewater treatment capacity for Calgary and surrounding area.
- Continued commitment by The City to meet our target of reducing total per capita water demand to 350 litres per day by 2033. In fact, our 2009 water demand of 429 litres per person per day (lpcd) surpassed our 2009 goal of 469 lpcd.

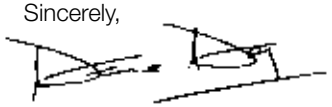
These are important city-wide advances; however, much remains to be done.

- The city's population continues to grow and, with growth, come increasing stresses on our environmental capital. Since our last report, community GHG emissions have increased by almost five per cent. To address this trend, The City is developing a community GHG plan to help citizens reduce their GHG emissions.
- Calgary's overall energy footprint continues to grow as energy consumption related to mobility and goods and services increases. The City continues to work with citizens and businesses to help reduce the size of Calgary's energy footprint.
- Although Calgary Transit has become the most common commuting method to downtown during rush hour, and walking and cycling have increased, Calgarians continue to rely on their vehicles for most trips throughout the city.

The City's Ecological Footprint project and imagineCALGARY community targets provide a basis for increased corporate and citizen action to protect and enhance Calgary's environment. Working with the community, examining the trends presented in the SOER can help The City make more informed decisions about tackling environmental priorities. As we continually strive to improve, future reports will aim to strengthen that link.

I hope that community groups will use this report as a resource for their own programs. The new website is meant to connect the community in sharing reporting and progress on improving environmental conditions in Calgary.

Sincerely,



David L. Day
Director, Environmental & Safety Management

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REPORT AT A GLANCE

Land

- Calgarians' ecological footprint is higher than the Canadian average, and energy use continues to make up the largest portion of Calgarians' ecological footprint at 71 per cent. Between 2008 and 2010, the overall energy footprint grew by 15 per cent, primarily due to an increase in energy consumption related to mobility and goods and services.
- In 2009 Calgary adopted an integrated Municipal Development Plan (MDP) and Calgary Transportation Plan (CTP), which supports sustainable growth of our city over the next 60 years. The new MDP and CTP support an increased focus on transit oriented development and communities where public amenities are located within walking distance and pedestrian, cycling and transit connections provide access to wider employment, retail, leisure and cultural destinations.
- The overall amount of natural areas in Calgary increased between 2005 and 2007. There are more than 693 natural areas that make up over 50 per cent of the park space in Calgary. In addition to developing local biodiversity indicators, The City's Parks department is changing the way natural areas inventories are reported in the future. This will improve the methods of accounting for core natural area assets.
- The City's Blue Cart recycling program was launched in 2009 to approximately 300,000 single family homes. The program is expected to increase the amount being recycled by Calgarians by 75 per cent.

Air

- Air quality in Calgary can usually be described as good. Monitoring of ozone, particulate matter and other air contaminants has generally shown decreasing or relatively stable levels with occasional spikes (exceedences). However, new provincial and federal standards are under development for air quality, and new objectives may result in more rigorous standards for air quality in Calgary.
- Community greenhouse gas (GHG) emissions increased almost five per cent between 2005 and 2009, while per capita emissions have remained fairly stable between 16 and 18 tonnes per person. With a community GHG plan currently under development, The City will work with Calgarians to help reduce community emissions.
- The increase in transit ridership over the last 15 years is significant, given the rapid population growth during this time. Calgarians also began to reduce their reliance on the car for the commute to work. In 2006, 23.8 per cent of Calgary commuters used walking, cycling or public transit to commute. Calgary Transit has become the most common commuting method to and from downtown during the weekday rush hours. However, Calgarians continue to rely on their vehicles for most trips throughout the city.

Water

- The City of Calgary is on track to meet a target of reducing total per capita demand to 350 litres per day by 2033. Calgary's per capita water demand was 429 litres per day in 2009, surpassing the 2009 target of 469 litres per capita per day (lpcd). To help achieve this goal, Council approved universal water metering to be completed by the end of 2014.
- Between 2005 and 2009, Calgary regional watersheds have shown a range of good to poor ratings throughout various sampling stations according to the Canadian Council of Ministers of the Environment's (CCME) Water Quality Index.
- The City's Stormwater Management Strategy aims to reduce sediment loading to the Bow River to or below the 2005 level by 2015. It strives to protect watershed health by developing sustainable stormwater management solutions. Some older areas of Calgary are being

retrofitted with stormwater retention facilities to help reduce total suspended solids from entering Calgary's rivers. New subdivision developments are required to include retention facilities that remove at least 85 per cent of total suspended solids.

- Treated wastewater in Calgary consistently complies with Alberta Environment regulations. The Pine Creek Wastewater Treatment Centre was completed in 2009 to meet the need for additional wastewater treatment capacity for Calgary and surrounding area. Pine Creek operations include primary treatment, biological nutrient removal, ultraviolet disinfection, effluent filtration, anaerobic sludge digestion, biogas management and odour control.

BACKGROUND

This is the fourth edition of The City of Calgary's State of Environment Report, which has been produced every four years since 1998. Tracking environmental indicators is an effective way for The City to assess progress towards our goal of protecting what's precious: land, air and water. Measurement and assessment play a critical role in collaboration with the community to improve Calgary's environmental conditions, and presenting the theme areas together in one report demonstrates how indicators are often interconnected.

The City of Calgary monitors a variety of environmental indicators to assess progress towards environmental goals. A number of community sustainability initiatives have taken shape in recent years that require measurement of progress towards long-term goals, including ecological footprint, imagineCALGARY, the Municipal Development Plan and the Calgary Transportation Plan. Monitoring and analysis are important to incorporate feedback on environmental trends into The City's policy, budget planning, actions and stakeholder dialogue

INDICATOR SELECTION CRITERIA

Indicator selection was aided by applying a consistent set of evaluation criteria using a systems framework. Potential indicators were evaluated in terms of scientific validity, issue and user relevance, data accuracy and availability, relationship to other indicators, measurability against targets and baselines, and cost effectiveness.

The indictors in the report reflect:

- The condition of Calgary's local environment.
- The impact of Calgarians' activities on the environment (human-environment interactions).
- Relation to environmental activities The City has influence over. This includes city-wide trends, but generally not internal environmental performance measures.

A chart comparing the imagineCALGARY environmental targets with the State of Environment Report targets is found in the Appendix.

LIST OF INDICATORS, FIGURES AND TABLES

Chapter 1. Land

INDICATOR THEMES

- Ecological footprint
- Built environment
- Natural environment
- Waste and waste diversion

ECOLOGICAL FOOTPRINT

Background

Ecological footprint is one measure of sustainability. It tells us about the effect of our activities on the environment by measuring the resources we consume and the waste we create and then comparing this to nature's ability to provide resources and absorb our waste. Ecological footprint accounting works much like financial budgeting: it allows us to see whether or not we are living within our means.

Key indicators

- Ecological footprints around the world
- Calgary's ecological footprint 2010
- Calgary's energy footprint
- Goods and services contribution to footprint
- Food contribution to footprint and number of community gardens
- Housing contribution to footprint
- Mobility contribution to footprint

Policy reference and target

Council Priorities 2009-2011 - Council Strategic Goal 2 includes reducing the impact of our activities on our ecological footprint.

Trends

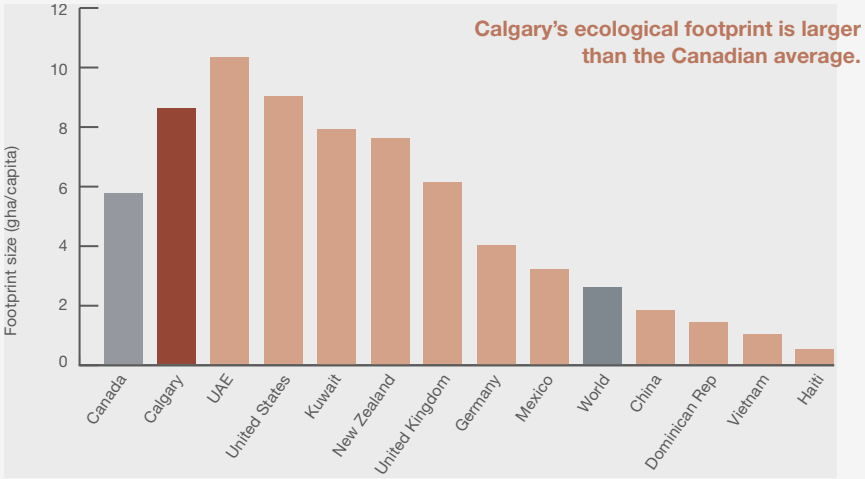
Figure 1.1 illustrates the ecological footprint of selected countries around the world as well as the world average. Worldwide, we are consuming more resources than we have, which is eroding our capital assets.

Ecological Footprint measurement

The 2010 ecological footprint calculations for Calgary and Canada have changed from the 2008 calculation. The change is

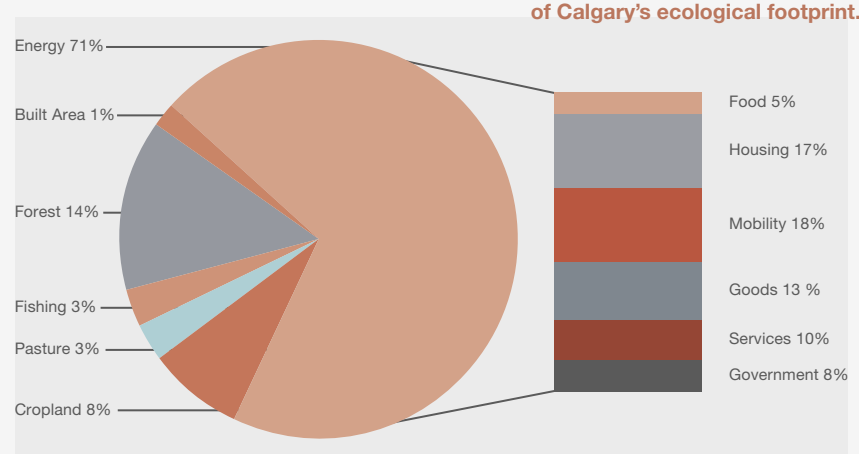
> The global effort for sustainability will be won, or lost, in the world's cities, where urban design may influence over 70 per cent of people's ecological footprint. High-footprint cities can reduce this demand on nature greatly with existing technology. Many of these savings also cut costs and make cities more liveable. Since urban infrastructure is long-lasting and influences resource needs for decades to come, infrastructure decisions make or break a city's future.
>
> *Mathis Wackernagel, President Global Footprint Network, 2010*

Figure 1.1 Ecological footprints around the world 2010



Source: All national data from Global Footprint Network, 2009. The Ecological Footprint Atlas 2009, www.Footprintnetwork.org/atlas. Calgary and Canada data from Calgary's Ecological Footprint, 2010.

Figure 1.2 Calgary's ecological footprint 2010



Note: The Government category addresses the contribution of federal, provincial, municipal and other government levels to our footprint through the provision of services that support the Calgary community.

due to methodological improvements and changes in economic activity, primarily in the cropland and grazing land resource areas from significantly higher yields.

- Calgary's ecological footprint reported for 2010 is 8.59 global hectares (gha) per capita, a decrease of 8.6 per cent from 2008.
- Canada's ecological footprint reported for 2010 is 5.76 gha per capita, a decrease of 19 per cent from 2008.

Figure 1.2 shows how consumption patterns relating to food, shelter, mobility, goods and services, and government influence Calgary's ecological footprint. The energy component has been expanded to illustrate the consumption areas within the largest sector of Calgary's footprint.

Calgary's energy footprint

Every aspect of the ecological footprint includes energy use. In fact, energy consumption represents the largest component of Calgary's ecological footprint, contributing to 71 per cent of Calgary's overall footprint. This is referred to as the carbon footprint. Although there has been a shift away from coal in electricity generation in favour of natural gas and renewables, Calgary's electricity demand continues to grow. Currently 49 per cent of electricity generation in Alberta is from coal. Between 2008 and 2010 the overall energy footprint grew by 15 per cent:

- food no change
- goods +4%
- mobility +8%
- services +3%
- housing +1%
- government -1%

Since Calgary's 2008 baseline footprint report, energy consumption related to mobility and goods and services has increased substantially. The number of vehicles on the road grew four per cent since 2008, and the amount of fuel consumed increased by 11 per cent. The increase in the consumption of goods and services is harder to pinpoint, but it reflects the purchase of items from cell phones and electronics, to services from banking and insurance to travel.

> Community gardens, personal gardens and even container gardens on building balconies all help reduce our ecological footprint. Eating more fruits and vegetables in a balanced diet of locally grown meats and dairy products help to support our local and regional economy and contributes to a healthy lifestyle.

Goods and services

Twenty three per cent of our energy footprint is attributed to the energy required to manufacture, transport and sell the goods and services we consume. Calgary's consumption of goods and services has increased by seven per cent in two years. A 2008 Statistics Canada report on spending patterns in Canada indicates that, among major cities, Calgary has one of the highest consumption standards. Based upon 16 household equipment items, Calgary led the country in all but five items.

The fewer disposable items we purchase, the longer the life we can get from non-disposable products. Recycling and reusing items results in fewer new resources and less energy used to manufacture, transport and sell the items. For example, aluminum can recycling saves 95 per cent of the energy needed to make aluminum from bauxite ore, and a can may be recycled indefinitely.

Food

The resources it takes to grow, harvest and transport food to markets accounts for five per cent of Calgary's energy footprint. Unlike other aspects of the Calgary's ecological footprint, food is land based, so the area required for growing crops and livestock is its true footprint. Currently food accounts for 16 per cent of Calgary's total footprint, 12 per cent less than in 2008. This reflects the overall reduction in footprint nationally, due to increased efficiencies in the agricultural system, such as higher yields over the past couple of years.

A good way to reduce our food footprint is to increase consumption of fresh, seasonal and local foods whenever possible. Even out of season, look for frozen and processed food that were produced locally.

The Community Garden Resource Network reports that in summer 2010, there were 32 public community gardens, an increase from 21 in 2009 and 15 in 2008. Forty-five private community gardens were identified, up from 25 last year. There are six ornamental community gardens, up from three last year (Calgary Horticultural Society, 2010). In 2009, City of Calgary Parks began planting fruit trees and shrubs at three community orchards. The sustainable food movement in Calgary is also growing, shown by the

rising profile of a number of local organizations dedicated to the promotion of sustainable local and regional food production, such as the Calgary Food Policy Council and Slow Food Calgary.

Housing

Housing makes up 17 per cent of Calgary's energy footprint with virtually no change since 2008. The choices we make about the size, type and location of our homes, the way we heat and cool our homes and how we construct, operate and maintain our homes have significant impacts on the size of our footprint. For example, new suburban housing creates a need to build and maintain infrastructure and services for communities at ever increasing distances from established areas.

Mobility

Transportation around the city accounts for 18 per cent of Calgary's energy footprint, an increase of 8 per cent since 2008. Calgarians own 22 per cent more vehicles than the national average of 597 per 1,000 population (World Bank, 2010). However, since 2007, the number people entering the downtown, the largest employment district in the city, has shifted from auto drivers to public transit (38 per cent versus 42 per cent) as the principal means to get to work. The method we choose and the distance we travel all determine how much energy we use, as well as how much air pollution and greenhouse gases are emitted.

The way we build our city has a strong influence on our mobility. A more compact form, an expanded, reliable transit system and access along with improvements that increase the convenience and safety of cycling and walking will all help reduce our ecological footprint. Further analysis is included in the Built Environment section.

A 2010 survey of Calgarians indicated that 33 per cent grow vegetables, 33 per cent grow herbs and 24 per cent grow fruit. Almost 80 per cent of Calgarians surveyed said it was important to purchase locally grown foods (HarGroup, 2010).

Reasons for not growing foods included:

- 50% no space
- 25% no time
- 13% not interested
- 7% did not know how
- 4% climate.

BUILT ENVIRONMENT

Background

The built environment, or built form, of a city includes the engineered surroundings that provide the setting for human activity and buildings, streets and infrastructure. Buildings emit 35 per cent of Canada's greenhouse gas emissions, use 33 per cent of Canada's total energy production, account for 12 per cent of non-industrial water consumption and produce 25 per cent of Canada's landfill materials (Canadian Urban Institute, 2005).

The need to shift away from unsustainable land use patterns, particularly low-density development, has emerged as a key environmental issue for Calgary. This means opportunities to build complete, people-centered communities that offer a mix of housing types, jobs, schools, amenities and recreation.

As Calgary's population is expected to more than double to 2.3 million people in the next 60 years, changes will need to be made to reduce the environmental impacts of living, working and playing in the city. The Municipal Development Plan and the Calgary Transportation Plan call for increased mixing of land uses, higher intensities of people living and working in Calgary, and more efficient and integrated transit, cyclist and pedestrian facilities.

Key indicators

- total housing growth 1995 to 2009
- types of housing starts in Calgary 2004 to 2009
- residential densities in established areas
- new suburban densities
- Calgary's spatial growth

Policy references

The 2009 Municipal Development Plan (MDP) will direct future growth of the city in a way that fosters a more compact and efficient use of land, creates complete communities, allows for greater mobility choices and enhances vitality and character in local neighbourhoods (2.2).

The 2009 Calgary Metropolitan Plan was developed by the Calgary Regional Partnership to bring regional municipalities together to help balance the need to protect the regional environment with the growth of our developed area and regional infrastructure and services.

Targets

The 2009 MDP specifies that new communities in future greenfield areas should achieve a minimum intensity threshold of 60 people and jobs per gross developable hectare and demonstrate how they will achieve 70 people and jobs per gross developable hectare over time (3.6.2).

Trends

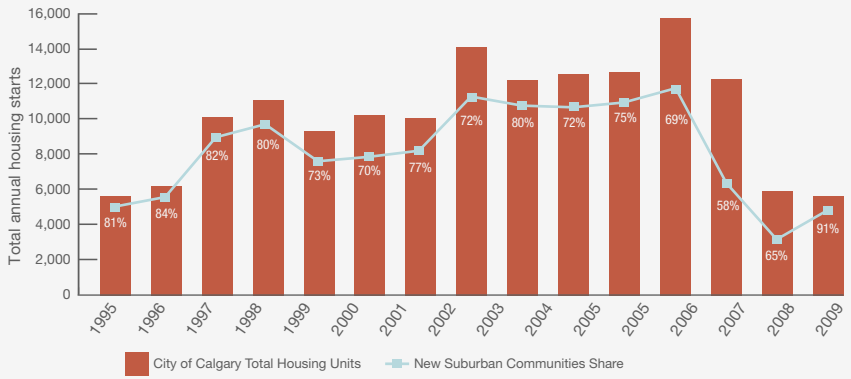
Housing unit growth

Between 2000 and 2009, approximately 82,440 net housing units were added to Calgary's new suburbs, while 31,770 were added to the city's established areas, meaning 73 per cent of new net units over this period were built in the new suburbs.

Since 2000, the new suburban share of total housing growth in Calgary has fluctuated between 58 and 91 per cent of growth.

Figure 1.3 Total housing growth (1995 to 2009)

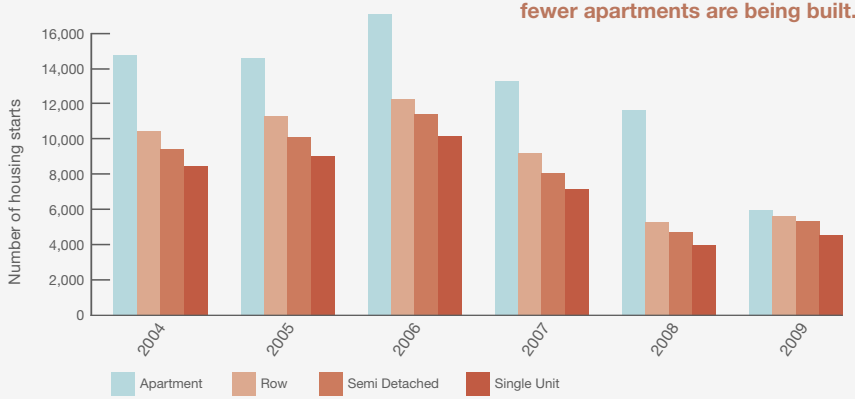
In 2009, 91 per cent of housing starts were in new suburban communities.



Source: Calgary Snapshots 2010. The City of Calgary, 2010a.

Figure 1.4 Types of housing starts in Calgary (2004 to 2009)

Housing starts have decreased over the last few years, and proportionately, fewer apartments are being built.



Source: Suburban Residential Growth 2010-2014 Monitoring Growth and Change Series. The City of Calgary, 2010b.

Housing type

Close to 60 per cent of Calgary's housing is made up of single-detached homes. The ecological footprint of these homes is generally larger than for smaller row and semi detached homes. Over the last five years, on average, multi-unit dwellings (apartments and row houses) represent 37 per cent of total housing starts in Calgary.

As Calgary's population continues to grow and becomes more diverse, ground oriented residential developments (i.e., row and semi-detached homes) may become more common in the future, as Calgarians seek more compact housing forms in established and new areas.

Residential density in established areas

Over the past five years, significant residential redevelopment has occurred in established communities, inner city communities and downtown. Older, single family homes are being replaced with a growing number of multi-family and infill developments in the inner city and downtown.

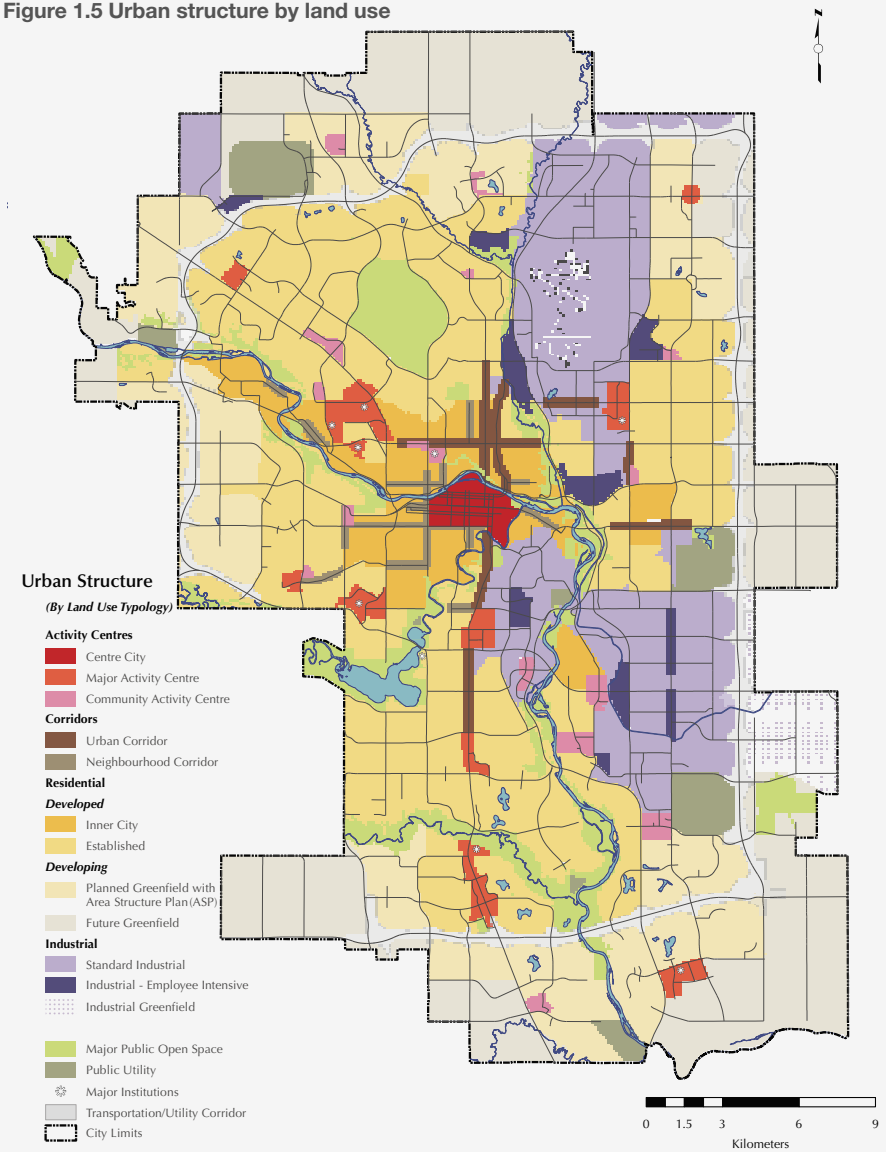
> Between 1990 and 2005, the num-ber of residential units increased in the downtown and the inner the city by 36 and 18 per cent respectively.

Increased density can be achieved through infill developments involving smaller land parcels, the repurposing of land for new large projects, and the redevelopment of lands around transit stations, for example.

Population density in established areas

While Calgary has experienced a notable increase in residential units in established communities in recent years, there has not been a proportionate increase in the population due to declining occupancy rates and community life-cycle factors.

Figure 1.5 Urban structure by land use



Source: City of Calgary, 2010c. Municipal Development Plan 2009.

Although some neighbourhoods are gaining a significant number of dwelling units through redevelopment, population density in some parts of developed areas is falling.

Residential density in new developing areas

Housing density in new communities influences how quickly the city expands on its edges. Communities built 30 years ago used more land than communities that are developing now for the same number of people.

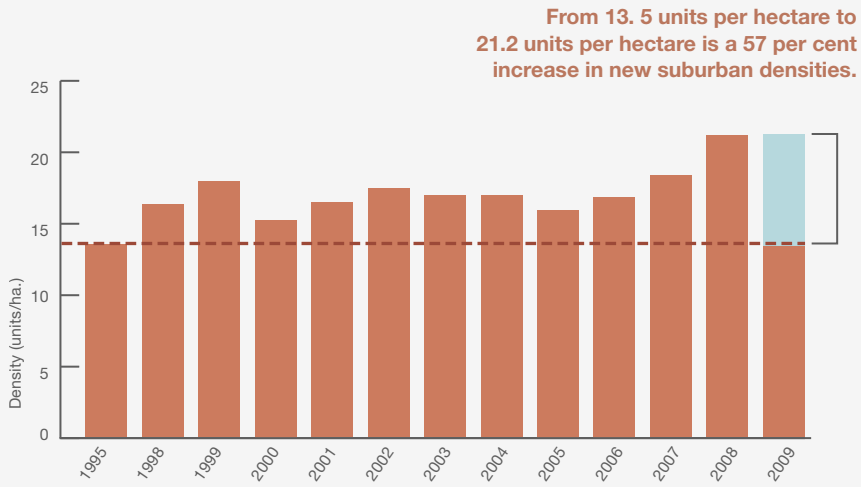
The MDP's minimum intensity target of 60 people and jobs per gross developable hectare is roughly equivalent to a residential density between 20 to 22 units per hectare (uph). This is an increase from the previous minimum density for new communities of 17 to 18 uph established in 2006.

The trend in housing density is moving upward. For many communities built from the 1970s to the early 1990s, suburban residential densities ranged from 11 to 15 units per hectare. Since the latter part of the '90s, policy plans have progressively required increased density. Since the 2000s, suburban densities were between 17 to 21 units per hectare (City of Calgary, 2010a). The dotted line in the graph showing the change in new suburban densities indicates that there has been a 57 per cent increase in suburban densities from 1995 to 2009.

New suburbs

Historically, Calgary's growth has been in the new suburbs as families with children have chosen these areas to establish roots. Over the last five years, the new suburbs have captured an average of 94 per cent of Calgary's population growth. There was a net migration of 15,236 people from established areas. This is in addition to over 200,000 new Calgarians (City of Calgary, 2010a). The gains in the outer, developing communities indicates the city is continuing to grow spatially.

Figure 1.6 New suburban densities (1995 to 2009)



Source: Calgary Snapshots 2010. The City of Calgary, 2010a.

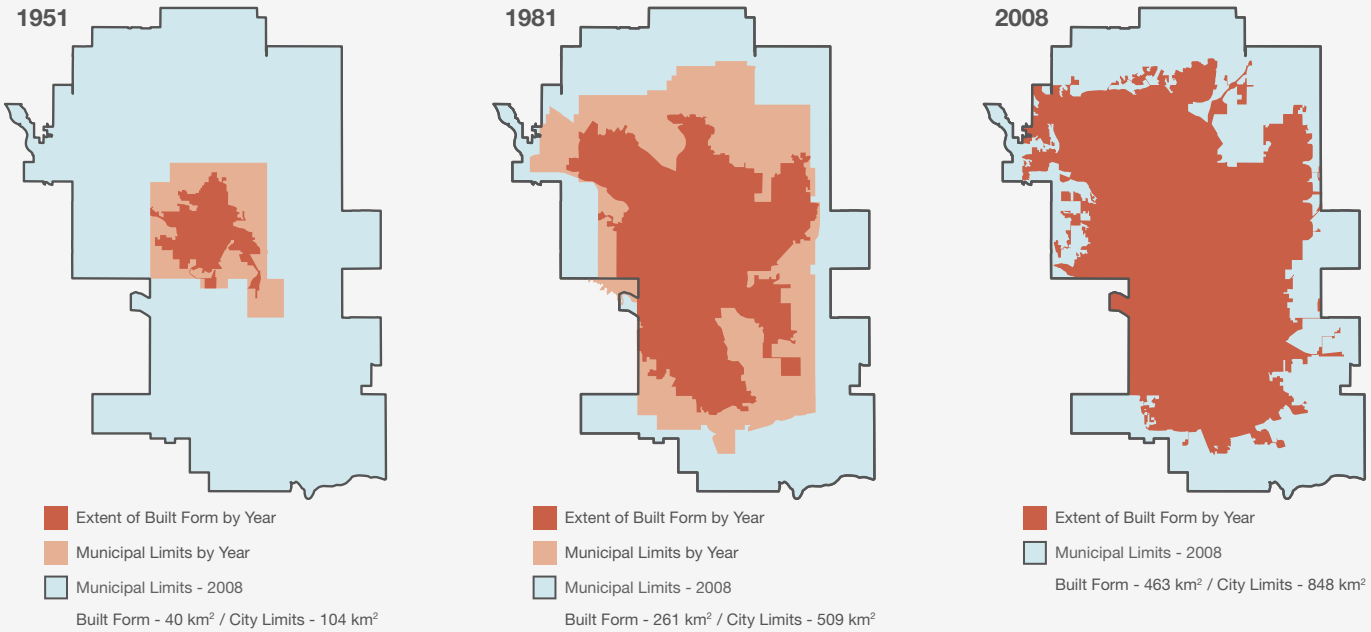
Calgary's spatial extent

As Calgary's population has grown, the area within its boundaries has also grown. Calgary has grown through several annexations over the past 50 years. While the annexation is intended to provide room for new Calgarians, Calgary's development pattern has also removed natural habitats, changed local hydrology and fragmented ecological networks. Striking a balance between accommodating growth and change and protecting regional natural resources remains a challenge.

To slow growth rates at the city's edge, the MDP has set a target for half of all new population growth over the next sixty years to happen in existing parts of the built city.

Figure 1.7 Calgary's spatial growth, built form and municipal limits, 1951-2008

Spatially, Calgary has grown from 509 km² in 1981 to 848 km² in 2008.



Source: Adapted from Calgary Snapshots 2010, The City of Calgary, 2010a.

SUSTAINABLE CONSTRUCTION

Background

Sustainable construction, or green building, is a growing movement to build and maintain homes and commercial buildings that reduce environmental impacts through site selection, energy efficiency, waste reduction, water conservation and the use of environmentally preferable building materials.

On average, Canadians spend over 90 per cent of their time inside buildings (CaGBC, 2005). Clearly, there is value in continually improving how we design, locate and construct our buildings to create a healthier, more comfortable and more sustainable built environment.

In 2009, The City developed a "Sustainable Design Declaration Form" to track and evaluate the adoption of sustainable technologies and design elements in new construction projects by developers throughout Calgary.

In Calgary, residential green building is being championed by Built Green Alberta. Likewise, two standards are used to benchmark the environmental performance of commercial buildings in Calgary: LEED (Leadership in Energy and Environmental Design) and BOMA (Building Owners and Managers Association) BESt (Building Environmental Standards). Tracking the number of Built Green, LEED, and BOMA BESt structures provides an indication of the extent to which sustainable building practices are being taken up in Calgary.

Key indicators

- Built Green certified homes in Calgary
- Registered LEED projects in Calgary

Policy references

The City of Calgary takes a leadership role in the community through its 2008 Sustainable Building Policy.

Targets

No specific community targets have been set for sustainable building construction.

Trends

Green buildings – residential

The industry-driven Alberta Built Green program was launched in 2003 to help enable the construction of resource-efficient homes. Built Green encourages homebuilders to use technologies, products and practices that reduce the ecological footprint of new homes.

Calgary's Built Green homes comprise roughly half of the over 5,500 Built Green homes constructed in Alberta as of 2009. Currently, Built Green offers certification for new single family homes and row homes. In 2008, the number of Built Green homes built in Calgary peaked before declining again in 2009. This trend echoes the dramatic decline in total housing starts in Calgary in 2009. In 2008, Built Green also introduced a Platinum level of certification and has since launched a pilot that includes multi-storey and residential towers.

Recognizing the role that green home construction could have in reducing Calgary's ecological footprint, The City began offering home building permit rebates in 2007 for homes built to Built Green standards.

Table 1.1 Built Green certified homes in Calgary

	2004	2005	2006	2007	2008	2009
Registered	24	71	9	3	10	5
Bronze	149	229	23	6	67	108
Sliver	65	121	49	17	166	252
Gold	32	209	341	458	1169	435
Platinum	0	0	0	0	3	23
Total	270	630	422	484	1415	823

Source: Built Green Canada. 2010.

Green buildings – commercial and institutional

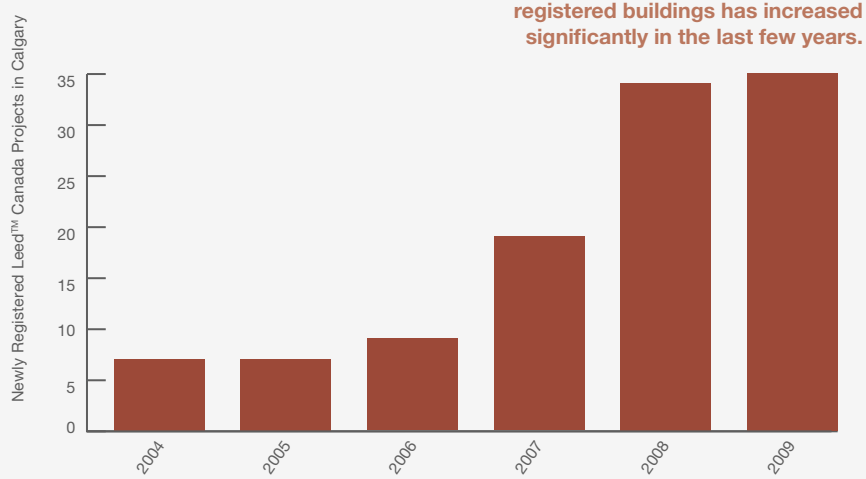
The LEED rating system is a standard for the development of high performance, sustainable buildings. For existing buildings, BOMA is tracking environmental performance using Building Environmental Standards (BESt) Plus certification and best practices.

By the end of 2009, there were a total of 111 registered LEED projects in Calgary, including local government, post secondary

Examples of LEED buildings in Calgary include the University of Calgary's Child Development Centre, The City's Water Centre, the Crowfoot Library and North Hill Home Depot.

Figure 1.8 Registered LEED projects in Calgary

The number of new LEED registered buildings has increased significantly in the last few years.



Source: Canada Green Building Council, 2009.

and commercial facilities. New projects registered each year jumped from seven in 2004 to 35 in 2009.

While LEED focuses on constructing sustainable new buildings, BOMA tracks the operational performance of existing buildings using BESt Plus criteria and certification. There are four levels of BOMA BESt certification that uphold increasingly green building standards. Through BOMA certification, building owners and operators are required to look at energy consumption, water use, recycling and waste disposal to help reduce the footprint of these buildings. As of 2010, there were 81 BOMA BESt certified commercial buildings in Calgary (BOMA BESt, 2010).

NATURAL ENVIRONMENT

OPEN SPACE AND BIODIVERSITY

Background

Calgary's natural spaces connect people to nature. Open spaces help protect landscape ecological integrity while providing important ecosystem services. Calgary's natural environment also provides citizens with a place for recreation.

Open space includes manicured areas like parks, pathways, roadway greens, golf courses, cemeteries and other types of open space. Natural Environment Parks, wetlands and river systems, environmentally significant areas, environmental reserve land and the urban forest are also examples of open space.

> Calgary's natural environment provides habitat for wildlife, supports regional biodiversity and brings balance into the urban ecosystem.

Parks classified as Natural Environment Parks are mainly comprised of animal and plant life. They are managed for both habitat protection and park user enjoyment. They are also important for the protection of Calgary's wildlife because they provide habitat for resident and migratory animals.

Key indicator

- Calgary's natural areas (hectares)

Policy references

The 2009 Municipal Development Plan established goals to conserve, protect and restore the natural environment (2.6), connect green infrastructure throughout the urban fabric (2.6.1) and maintain biodiversity and landscape diversity, integrating and connecting ecological networks throughout the city (2.6.4).

The City's Open Space Plan 2002 aspires to preserve significant, representative and high-quality natural areas; consider long-term sustainability in open space management; create an integrated open space system and minimize the impact of urban development on parks and natural ecosystems.

Targets

No specific targets set.

Trends

Calgary's natural areas

With local biodiversity indicators currently under development, looking at Calgary's natural areas can provide some insights into trends in the natural environment. Although the amount of natural areas in Calgary has increased three per cent between 2005 and 2007, with Calgary's population increasing at the same time, the amount of natural area per person has actually declined by three per cent (City of Calgary, 2009a). Calgary's habitat supply is decreasing for many species, but increasing for others.

In 2007, Calgary annexed 103 km^2 of land, including 56 km^2 in the east, 37 km^2 in the north and 9 km^2 in the west. The annexed

> Biodiversity is the measure of the wealth of species and ecosystems in a given place or habitat. It is an important indicator of ecosystem health, both regionally and globally. In general, it can be said that ecosystems with a diverse, rich assemblage of species are healthier and more resilient. Globally, the two most significant threats to biodiversity are invasive species and urban expansion.

lands are predominantly a mix of cropland and rangeland, including some of Alberta's most productive agricultural soils. Wetlands cover almost 10 per cent of the annexed area which also includes rare native prairie habitat. Dominant landscape features include the Bow Valley landform and Bow River, the Symons Valley and Nose Creek Valley systems, riparian areas, native grasslands and forest patches, all of which are important in providing ecosystem services, such as biodiversity, habitat connectivity and water regulation (O2 Planning + Design Inc, 2010).

Natural Environment Parks

The role of Natural Environment Parks within the city is to:

- Conserve areas of environmental significance and biodiversity.
- Provide opportunities for environmental education, interpretation and nature-related recreation.
- Provide opportunities for recreation.
- Provide relief from our built environment.

There are more than 693 natural areas that make up over 50 per cent of the park space in Calgary (City of Calgary, 2009a). Some of these areas are a result of a requirement to retain municipal reserve land and protect a portion of land as environmental reserve when new development occurs.

- Conserve dominant natural elements that enhance the character, appearance and health of the city (e.g., escarpments, creeks and river valleys, wetland complexes).
- Contribute to clean air and water.

As Calgary grows, identifying and protecting significant habitat and landscape features is an important element of conservation planning and provides a framework for future natural environment parks in new communities.

Techniques for habitat restoration in Natural Environment Parks include erosion control, weed control and replanting native vegetation.

Calgary's lands designated as natural areas currently include those that contain native species, such as Nose Hill Park. These areas have shown a general steady increase from 1997 to 2008. There was a slight drop in natural area per capita from 2007 to 2008.

The City is changing the way natural areas and Calgary's Natural Environment Park inventories are reported in the future. This will improve the methods of accounting for core natural area assets. Changes to the current reporting structure for Calgary's natural areas will improve our understanding of these vital areas, as there are many natural areas that are not currently in the inventory.

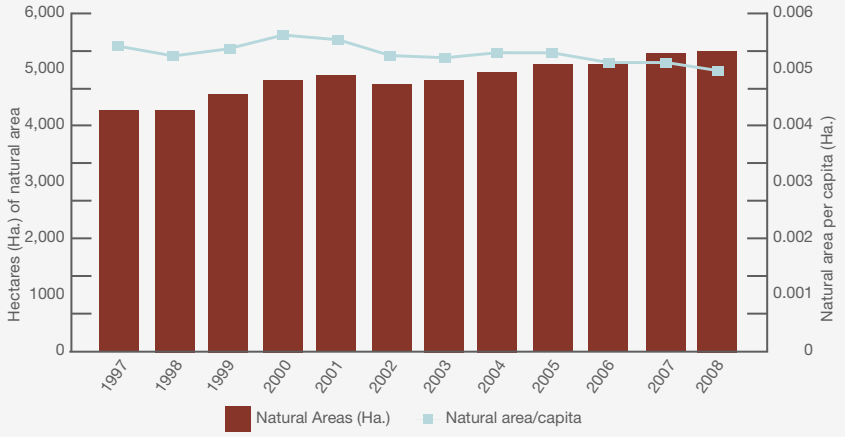
URBAN FOREST

Background

Trees help purify the air, reduce storm water runoff and erosion, create wildlife habitat,

Figure 1.9 Calgary natural areas (includes Fish Creek Provincial Park)

The overall amount of natural areas in Calgary increased between 1997 and 2008.



Source: City of Calgary Parks, 2009. Note: No data was available for Natural Areas for 2006, therefore data from 2005 was applied to 2006 against 2006 population data. (City of Calgary, Parks and ESM, 2009). Note: Fish Creek Park was 1,140 ha in 1990; 1,348 ha in 2005; and 1,400 ha in 2009 (Source: Alberta Government).

At the end of 2009, The City managed 7,742 hectares of parkland spread over 5,345 individual parcels across Calgary. This includes 1,163 hectares of mowed grass.

store carbon dioxide, produce oxygen, and save energy through shading and wind reduction.

The urban forest includes trees, shrubs and understory in parks, river valleys, streets and private land. Historic photographs of Calgary show a landscape largely devoid of trees, as it is located in the grasslands of Alberta. The current urban forest is the result of the commitment of generations of Calgarians to planning, nurturing and protecting the forest.

Pressures on the urban forest include invasive species, pests, diseases, drought, Calgary's arid climate, an aging tree population and urban development. Preserving the urban forest is aided by the maintenance of tree health, tree preservation during development, proper species and site selection, and a diversity of tree species.

Key indicators

- Calgary tree canopy change
- trees on City-owned land

Policy references

Parks Urban Forest Strategic Plan 2007 aims to achieve a sustainable urban forest through the growth, preservation and enhancement of the urban forest on land owned or controlled by The City.

Calgary Open Space Plan 2002 states that The City should promote the provision and maintenance of a healthy, viable urban forest by protecting the existing urban forest and facilitating additional planning to keep up with the growth of the city.

Tree Protection Bylaw 23M2002 protects public trees from unauthorized removal, cutting or pruning, as well as from damage caused by construction activities.

Targets

The 2009 Municipal Development Plan includes a tree canopy cover target of 14 to 20 per cent over the next 60 years. (5.3).

The Parks Urban Forest Strategic Plan 2007 established the following targets:

- The per capita tree supply standard is one tree either along a roadway or in a groomed park for every two Calgarians.
- The urban forest on public and private lands should increase by one per cent per decade with an ultimate canopy cover target of 20 per cent.
- The total vegetation biomass should be sufficient to offset 0.5 per cent of the city's carbon emissions.

Trends

Calgary's tree canopy cover was approximately seven per cent in 2007. In 2009, Calgary had approximately 272,000 street trees. However, Calgary is falling behind the target to have one street or park tree for every two Calgarians. Based on a count of individual trees in groomed parks and along roadways in 2007, there was a tree deficit of 120,000. Calgary's tree population at that time included: 170,000 roadway trees, 190,000 park trees, 1,000,000 residential trees and over 7,000,000 native trees. Despite the deficit, the sustainability of Calgary's forest depends on more than just the number of trees. Factors such as tree health, tree biomass and canopy must be considered. The City's Parks department works to ensure overall urban forest sustainability.

Organic orchard pilot

2009 marked the first year of a five-year pilot project to grow public fruit orchards. The City's community orchard pilot project will determine if public and community-run orchards can grow, thrive and produce in Calgary. The project will demonstrate and test a range of fruit trees and shrubs, encourage local food production and foster community involvement.

As of 2009, three orchards have been planted – two in Hillhurst-Sunnyside and one in Bowness Park.

Significant work has been undertaken in response to pressures on the urban forest, including the approval of new residential street tree standards, the tree protection bylaw, the introduction of injection and barrier traps to manage pests, watering bags and drip irrigation to water trees, and the poplar life-cycle program.

Keeping our urban forest healthy and safe in 2009, The City:

- Pruned 16,700 trees.
- Planted 4,450 trees.
- Removed 1,600 trees.
- Planted 5,500 trees in the BP BirthPlace Forest program.
- Planted 629 additional trees in 13 communities through the NeighbourWoods program.

While planting trees and preserving a healthy forest has many ecological advantages, Calgary's total vegetation biomass is only able to offset less than one per cent of city-wide greenhouse gas emissions.

Community involvement is a large part of growing the urban forest. Successful programs within The City include Arbour Day, the Community Model Forest, NeighbourWoods, the BP Birthplace Forest and Forever Green.

PEST MANAGEMENT

Background

Infestations of insects or weeds can be harmful to public health, the environment and public infrastructure. In these cases, pesticide use can be essential. However, chemically-based pesticides can pose a risk to human and environmental health if mishandled or misused. While Calgary does not have a bylaw related to pesticides, they are regulated by the provincial and federal government. In Calgary, pesticides are mainly used to manage weeds, insects, rodents and fungus.

The City of Calgary manages pests that affect City property. The City's integrated pest management (IPM) plan is a science-based approach that identifies, monitors and suppresses pests using economically and environmentally sound practices. The IPM program evaluates new alternatives to traditional pest control. Homeowners are encouraged to follow The City's example through the Healthy Yards program and other initiatives.

Invasive plant species are an emerging risk to Calgary's biodiversity. The City's Invasive Plant Strategic Management Plan was approved in 2008 to protect biodiversity. In 2010, the revised Alberta Weed Control Act increased the number of highly invasive weeds (termed Prohibited Noxious) that require eradication from seven to 46 species. These species are highly aggressive and require control measures.

Key indicators

- pesticide sales in Calgary
- pesticide use by The City of Calgary

Policy references

The City's Integrated Pest Management (IPM) Plan 1998 focuses on a science-based approach to control pests using environmentally responsible practices.

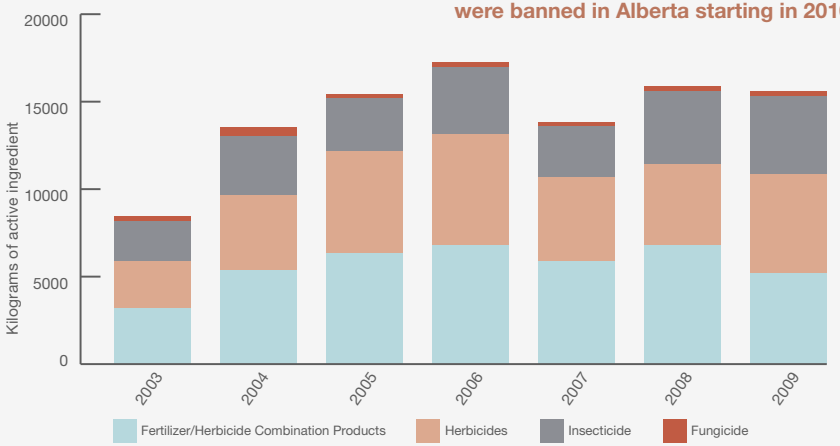
Open Space Plan 2002 indicates public golf courses should demonstrate excellence in integrated pest management.

Target

No specific community targets are set. The City of Calgary establishes performance measures for all of its IPM projects and programs. Due to the diversity of the landscape and variety of pest types managed, numerical program targets are not appropriate.

Figure 1.10 Pesticide sales in Calgary

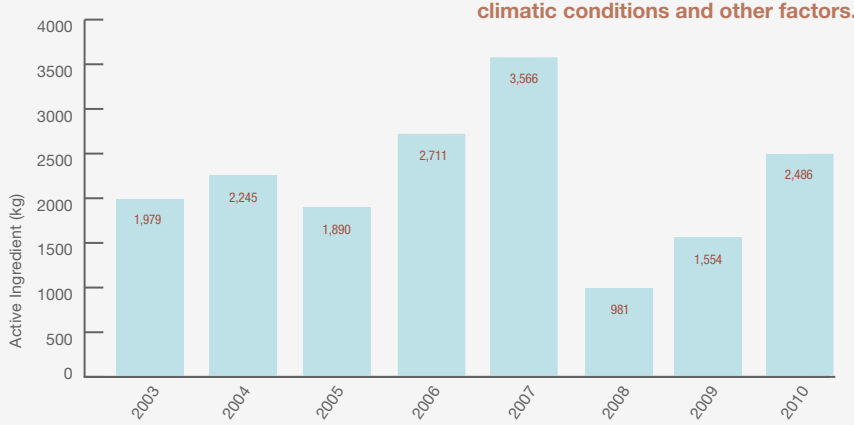
Pesticide sales have decreased since 2006. Herbicide-fertilizer combination products were banned in Alberta starting in 2010.



Source: Alberta Environment, 2010.

Figure 1.11 Herbicide use by The City of Calgary

Herbicide use on City of Calgary land fluctuates annually, depending on climatic conditions and other factors.



Source: City of Calgary, Parks 2010.

Trends

Community wide use of pesticides

Some homeowners use pesticides and other lawn care products to maintain their landscape. However, pesticide use across Canada is coming under more scrutiny due to potential health concerns and impacts on our environment.

In 2009, almost 70 per cent of total pesticide sales in Calgary were herbicides. Close to 48 per cent of herbicide sales were herbicide-fertilizer (weed-and-feed) products. As of Jan. 1, 2010, these products were banned from sale in Alberta. The City led the process to pass a resolution at the Alberta Urban Municipalities conference to support this action.

Since weed and feed is applied to an entire lawn, it results in an over-application of herbicide. It is expected that the banning of weed-and-feed products will result in less chemical migration from lawns and gardens into waterways. Ongoing monitoring will determine levels of chemicals entering waterways.

Naturalized areas as part of Integrated Pest Management

Restoring manicured landscapes to a more natural state accomplishes several goals, including increased biodiversity, reduction of water use, lower maintenance cost and reduced pest populations. Native plant materials that are adapted to Calgary's environment require fewer inputs to sustain. The City of Calgary is identifying sites and developing plans to incorporate naturalization.

City of Calgary corporate use of pesticides

The City considers health and safety, environmental sustainability, risk management, and asset protection as key factors when designing pest management strategies. Herbicides accounted for 83 per cent of The City's pesticide use in 2010, followed by fungicides (9 per cent), rodenticides (8 per cent) and insecticides (0.1 per cent).

Herbicide use on City of Calgary land fluctuates annually depending on climactic conditions and other factors.

The increase in herbicide use in 2006 and 2007 were the result of flood conditions across Calgary in 2005, which created many landscape disturbances that temporarily required intensive weed control.

Pesticide use by The City decreased significantly in 2008 as a result of the moratorium on spraying herbicides that year.

Pest control operations are conducted on a site by site basis. Each site is surveyed, and if the infestation exceeds the acceptable threshold, control measures are applied based on site criteria. The City is planning to update its herbicide use reporting method. This will improve the understanding of the herbicide use. Changes to the reporting structure for the IPM staff in Parks has improved The City's ability to standardize operations, improve communication and ensure all federal and provincial regulations are met.

WASTE AND WASTE DIVERSION

Background

Canada's cities generated 791 kg per capita of municipal waste in 2005, above the 17-country average of 610 kg per capita (Conference Board of Canada, 2009). There is an increasing trend in major Canadian municipalities to treat municipal solid waste as a resource to be recycled rather than disposed of in landfills. Reducing, reusing, recycling and residual management is The City of Calgary's approach to waste management.

The year 2009 was a landmark in Calgary for Waste & Recycling Services, as The City's Blue Cart recycling program was launched to approximately 300,000 single family residential homes. As well, the network of 52 Community Recycling Depots was changed to co-mingled recycling, which requires no sorting of materials. All recyclables from blue carts and the Community Recycling Depots are processed at the Materials Recycling Facility (MRF), which is owned by Cascades Recovery Inc. and serves both residential and commercial clients.

The City's target to divert 80 per cent of waste from landfills by the year 2020 signals a commitment to sustainability. Diverting waste away from landfills limits the need for landfill expansion, reduces methane gas production from decomposing organic waste and allows for the highest end use of many materials.

Waste in Calgary comes from four sectors representing groups that have similar needs, materials to be handled, collection methods and diversion challenges.

- residential
- multi-family
- industrial, commercial and institutional (ICI)
- construction and demolition (C&D) waste

The City's waste diversion target covers all four sectors.

Key indicators

- total waste landfilled
- waste material composition
- residential household output: landfilled waste and diverted materials

Policy references

2009-2011 Council Priority 2.1: Meet our legislative and environmental requirements

for landfills and pursue waste diversion activities outlined in the 80/20 by 2020 Strategy.

Waste and Recycling Services' 2009-2011 Strategies and Actions include a number of waste-diverting actions: maintaining waste diversion programs and expanding them to service growth (3.1.6); deliver on the targets and actions embedded in the 80/20 by 2020 diversion strategy (3.3.5); planning for the management of organic materials, including assessing the feasibility of waste-to-energy recovery (3.3.6).

In 2007, Council approved the Construction and Demolition Waste Strategy and Action Plan, which includes research projects, processes and pilot projects.

Target

80/20 by 2020 – The City set a target in 2004 to divert 80 per cent of waste from landfills, with just 20 per cent of waste going to landfills, by the year 2020.

Trends

Total waste landfilled

In 2009, 680,000 tonnes of waste was disposed of in City landfills, which is approximately 638 kilograms of waste per capita. Total landfilled waste has been in decline since peaking in 2007, and 2009 marked the lowest volume of landfilled waste since 2002. The decrease is in spite of a growing population.

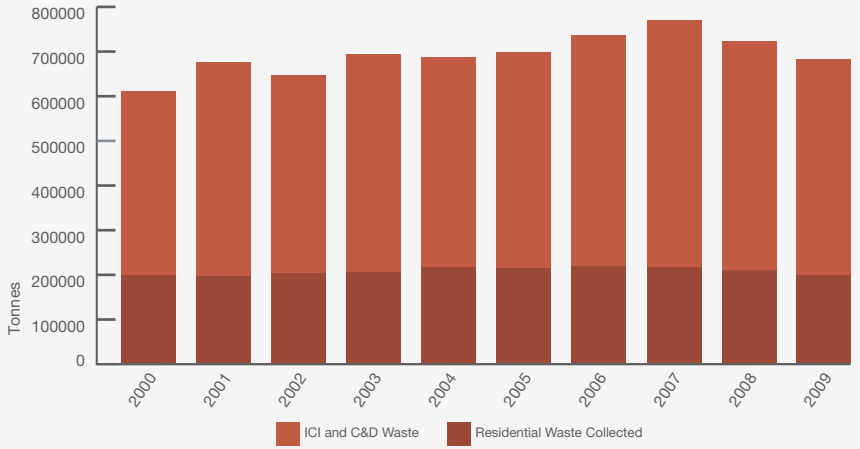
Single-family residential waste typically accounts for 30 per cent of waste in city landfills. Multi-residential, industrial, commercial and institutional waste make up the other 70 per cent.

Waste material composition

To achieve 80 per cent diversion by 2020, it is fundamental to have a clear understanding of what is in the waste stream received by City of Calgary landfills. Waste & Recycling Services is undertaking a significant

Figure 1.12 Total waste disposed of in City-owned landfills

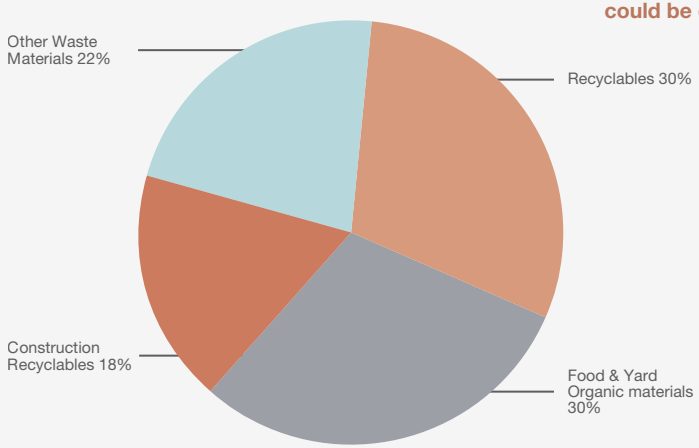
The total waste going to city landfills has declined since peaking in 2007.



Source: City of Calgary Waste & Recycling Services, 2010.

Figure 1.13 Total waste material composition

The majority of materials entering Calgary's landfills could be diverted.



Source: City of Calgary Waste & Recycling Services, 2010.

project to update this information and the understanding of waste composition reaching City landfills. Figure 1.13 illustrates the types of materials entering City landfills.

New provincial construction and demolition waste legislation is under development. The City of Calgary initiated a pilot in November 2009 to divert waste materials from construction, demolition and renovation activities. The pilot focused on four main materials: cardboard, asphalt shingles, drywall and wood. Between November 2009 and September 2010, the pilot had collected 2,271 tonnes of recyclable material.

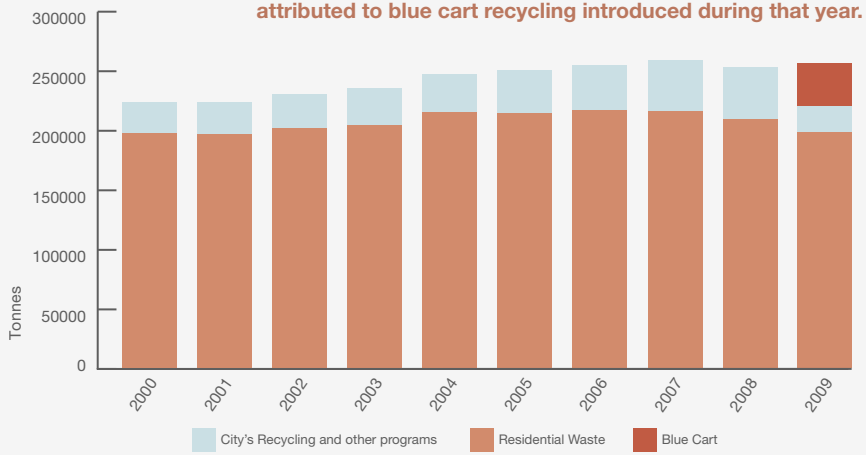
Residential household output

Total household output is the total amount of materials disposed of from Calgary households that is sent to landfill and to diversion programs. It gives an indication of how Calgarians are reducing waste and using diversion programs.

In 2009, Calgarians recycled more than ever, with 23 per cent of residential household output reaching City diversion programs. This success is mostly due to the introduction of the Blue Cart recycling program in the spring of 2009.

Figure 1.14 Residential household output: land-filled waste and diverted materials

In 2009, Calgaryians recycled 23 per cent of their household output. This is the highest diversion rate ever, and is mostly attributed to blue cart recycling introduced during that year.



Source: City of Calgary Waste & Recycling Services Annual Reports 2000-2009.

In 2009, over 56,000 tonnes of recycling were collected from Blue Cart customers and Community Recycling Depots. Other important recycling programs include leaf and pumpkin composting, Christmas tree recycling, backyard composting, household chemical drop-off depots and electronics recycling.

Starting in 2009, Calgary's recycling programs starting accepting: cardboard, plastics 1-7, newspaper, paper, food cans and glass food containers all in one cart – no sorting. The Blue Cart recycling program and Community Recycling depots are expected to double the amount of material that Calgarians recycle. Active participation in these programs is the key to achieving the 80/20 by 2020 target.

For Calgary to reach the 80/20 goal, policies and programs will need to be developed for:

- Recycling for business, multi-family homes, and construction and demolition businesses.
- Food and yard waste processing for all residences and businesses.
- Continuing to work with other levels of government on waste reduction strategies across all sectors.

Program	Total 2009 diversion
Leaf and pumpkin program	2,169 tonnes
Christmas tree program	313 tonnes
Electronic waste	2,413 tonnes

Source: City of Calgary, Waste & Recycling Services 2009 Annual Report

Chapter 2. Air

INDICATOR THEMES

- Air quality
- Climate change
- Energy consumption
- Transportation

AIR QUALITY

Background

Air quality is linked to our quality of life. Elevated levels of pollutants in the atmosphere can cause smog, reduced visibility, health issues, damage to vegetation and can impact our ability to enjoy the outdoors. Rising temperatures can worsen air quality.

Calgarians are fortunate because our air quality can usually be described as good. Strong winds from the west help discourage the formation of low-level smog above the city. However, Calgary's growing population and air emissions from vehicle travel, road dust or regional forest fires can cause air quality to deteriorate. Calgary's cold, dry climate can cause an inversion, which also traps pollutant emissions near to the ground (CRAZ, 2009).

Calgary's air quality is affected by both climactic conditions and by air pollutants that are generated locally, regionally, nationally and internationally. Transportation emissions are the largest contributor to air quality impacts in the Calgary area (CRAZ, 2009).

Air quality and climate change are inextricably linked. Emissions from the use of fossil fuels are a source of air pollution and greenhouse gases. The same emission sources that contribute to the key ingredients of smog also release greenhouse gases. Fortunately, the actions that we take to reduce greenhouse gas emissions can also help to improve air quality.

The Calgary Region Airshed Zone (CRAZ) Society is a non-profit association with members from government agencies (federal, provincial and municipal), non-government organizations and the public. The City of Calgary is one of the founding members. The society's vision is to have air quality that is not harmful to human health and the environment. Its mission is to monitor, analyse and provide information on air quality and develop strategies to manage air quality issues within the airshed.

Five key air pollutants of concern in Calgary include nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), particulate matter ($PM_{2.5}$) and ozone (O_3). All are precursors to smog formation and pose health risks during periods of elevated atmospheric concentration.

Key indicators

- annual average concentration - particulate matter 2.5 ($PM_{2.5}$)
- annual average concentration - ozone (O_3)
- annual average concentration - nitrogen dioxide (NO_2)
- annual average concentration - sulphur dioxide (SO_2)
- annual average concentration - carbon monoxide (CO)

Policy references

The 2008 Calgary Region Airshed Zone (CRAZ) Particulate Matter and Ozone Management Plan outlines the future management of particulate matter (PM) and ground level ozone (O_3) in accordance with provincial policy.

The 2008 CRAZ Strategic Plan consists of a series of strategic objectives, goals and tactics relating to air quality in the Calgary Region Airshed. Tactics include the operation of a comprehensive air quality monitoring network that monitors and records on the five key indicators and related weather conditions.

Targets

Provincially, Alberta has several ambient air quality objectives that set thresholds for ambient concentrations of air contaminants. Alberta aligns with the Canada Wide Standards (CWS) for two key air pollutants: fine particulate matter ($PM_{2.5}$) and ozone (O_3); these standards set upper limits for ambient concentration of these pollutants.

Table 2.1 Criteria air contaminant limits

Contaminant	annual AAAQO (†µg/m³)	annual NAAQO (ppb)
NO_2	60	32
SO_2	30	23
CO	n/a	n/a
$PM_{2.5}$	n/a	n/a
Ozone	n/a	15

Source: Built Green Canada. 2010.
† µg/m³ is the weight, in micrograms, of the substance in one cubic metre of air.
(Annual limits) Based on 24-hour averaging time by year 2010. Achievement to be based on the 98th percentile annual ambient measurement averaged over three consecutive years.
- AAAQO: Alberta Ambient Air Quality Objective
- NAAQO: National Ambient Air Quality Objectives – Acceptable Levels
- ppb: parts per billion
- µg/m3: micrograms per cubic meter

Federally, under the Canadian Environmental Protection Act (CEPA) air pollution emissions by industrial sources at certain thresholds must be reported to the National Pollutant Release Inventory (NPRI). A Comprehensive Air Management System (CAMS) is currently under development.

Further, Alberta has a Particulate Matter and Ozone Management Framework, in place since 2003, that contains more stringent thresholds and triggers for action before levels reach the CWS.

Trends

Three air monitoring stations in Calgary gather continuous air quality data. In 2008, CRAZ took over the operation of these stations from Alberta Environment. All data is administered through Alberta's Clean Air Strategic Alliance (CASA). There is one station located in central Calgary (downtown), one in northwest Calgary (residential) and the third is located in east Calgary (industrial). The central Calgary station moved to another downtown location in 2008 and is referred to as Calgary Central 2. This location is currently under review and, a new station is planned to be operational by the end of 2011 as part of an expanded network for the airshed.

Particulate matter 2.5 ($PM_{2.5}$)

Respirable particulate matter at the size of 2.5 µm, or $PM_{2.5}$, in the atmosphere poses a risk because these small particles can penetrate deeply into an individual's lungs. $PM_{2.5}$ exposure can aggravate cardio-respiratory diseases and has been linked to increased mortality rates (Alberta Government, 2010). In Alberta, sources of particulates include vehicle emissions, soil and road dust, forest fires and industrial emissions sources. Elevated levels of particulate matter are detected in wintertime smog as well.

In Calgary, 94 per cent of $PM_{2.5}$ emissions are from vehicular transportation (CRAZ 2008).

At the Calgary Central Monitoring Station, average $PM_{2.5}$ concentrations have been in decline since 1998. Data was not collected at Calgary East and Calgary Northwest Monitoring Stations until 2003. Between 2005 and 2006, $PM_{2.5}$ averages at these stations increased somewhat before decreasing again in 2007.

In 2008, the Calgary Central 2 station recorded an average $PM_{2.5}$ concentration nearly triple that of the other two monitoring stations. The increase is likely due to an improvement in measurement technology between the Calgary Central and Calgary Central 2 stations (Alberta Environment, 2009).

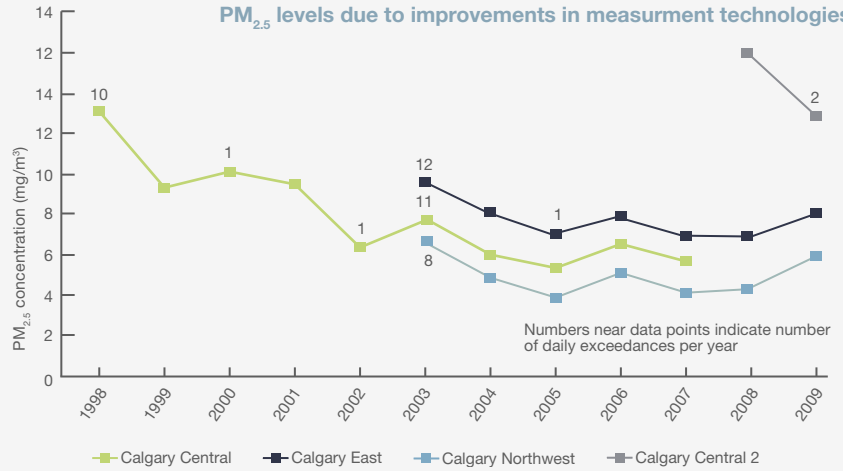
Ozone (O_3)

Ground-level ozone is an environmental and health concern. It is different from stratospheric ozone, which helps protect the earth from harmful ultraviolet radiation from the sun. Ground-level ozone is not emitted directly by human activities, but is produced by chemical reactions involving oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight.

Ozone exposure can irritate the respiratory tract, and higher exposures are linked to hospital admissions and premature deaths (Ontario Ministry of Environment, 2009). In Calgary, the main sectors contributing to peak ozone concentrations are upstream oil and gas, on-road transportation and various transboundary sources (CRAZ, 2008).

Figure 2.1 Annual average concentration – particulate matter ($PM_{2.5}$)

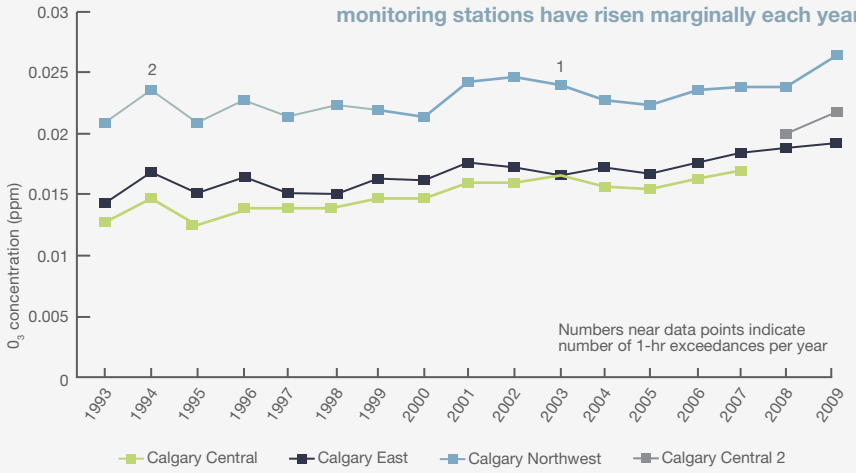
The new monitoring station, Central 2, is recording higher $PM_{2.5}$ levels due to improvements in measurment technologies.



Source: CASA Data Reports – available at casadata.org.

Figure 2.2 Annual average concentration – ozone (O_3)

Since 2005, ozone levels reported at Calgary's three air monitoring stations have risen marginally each year.



Source: CASA Data Reports – available at casadata.org.

Alberta Environment required the Calgary Region Airshed Zone to develop a plan to address ozone and particulate matter (PM) levels in the airshed when ambient ozone measurements exceeded the 8-hour Canada-wide standard on two days in 2003.

In 2008, the Calgary Regional Airshed Zone completed a PM/O_3 management plan and implementation is now underway through CRAZ programs supported by all members, including The City. A PM/O3 Audit Committee is responsible for monitoring implementation and reporting back to Alberta Environment.

Annual average ozone concentrations in Calgary have increased each year since 2005, though generally, average ozone levels have been well below the one hour and eight hour limits.

Nitrogen dioxide (NO_2)

Nitrogen dioxide (NO_2) in the atmosphere is partially responsible for the brown haze and smog sometimes observed over Calgary (CRAZ, 2008). NO_2 also contributes to the formation of ground-level ozone, a major component of smog.

NO_2 is part of a family of gases known as oxides of nitrogen (NO_x). Most NO_x emissions are converted to NO_2 in the atmosphere, which is why monitoring stations in Calgary track NO_2. Annual average levels of NO_2 have decreased or have remained relatively stable at Calgary's three air monitoring stations from 1993 to 2007. A spike (exceedance) of the one-hour limit for NO_2 has not occurred since 1991.

Vehicular traffic is the major contributor to NO_2 levels in Calgary, which can rise rapidly when traffic density is high (RWDI, 2006). Advances in automobile emission technologies, such as improvements in fuel injection and combustion efficiency from catalytic converters, are generally credited with decreases in NO_2 levels, even though the volume of cars on Calgary's roads has increased (CRAZ, 2008). However, at Calgary Central, NO_2 levels have been increasing since 2005.

Sulphur dioxide (SO_2)

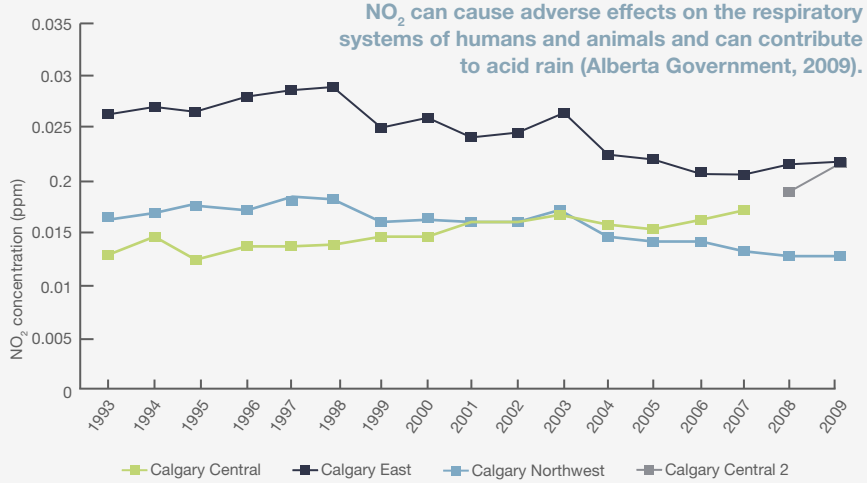
SO_2 is formed when fossil fuels are combusted to power vehicles, heat buildings and generate electricity. Although SO_2 can come from vehicle emissions, most SO_2 in Alberta is produced regionally by natural gas processing plants, power plants and oil sands activities.

Once released to the atmosphere, SO_2 can act as a precursor to acid rain. Human exposure to high levels of SO_2 is also linked to respiratory illness and cardiovascular disease (Ontario Ministry of Environment, 2009).

SO_2 is only monitored locally at the Calgary East station. In 2007, SO_2 levels in Calgary were 43 per cent lower than they were in 1993. Average SO_2 concentrations are well below the provincial and national standard criteria, with no spikes between 1993 and 2008. A number of regulations and initiatives have allowed for large reductions in emissions of SO_2 nationally. For example,

Figure 2.3 Annual average concentration - nitrogen dioxide (NO_2)

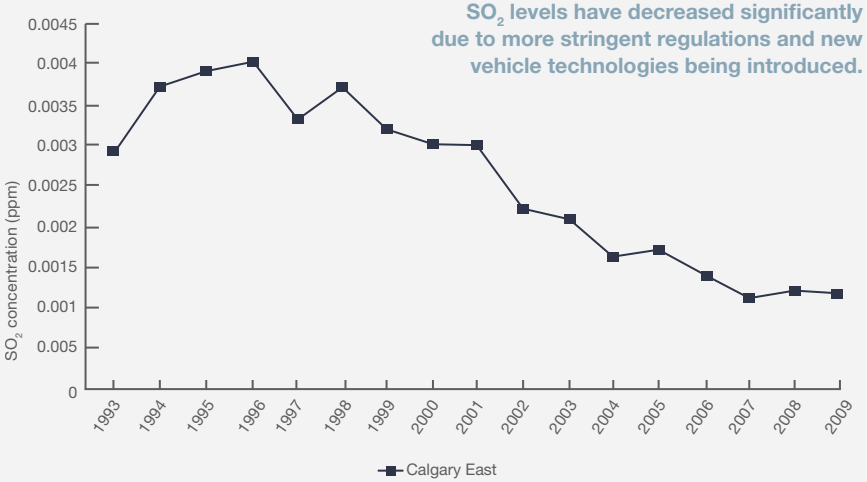
NO_2 can cause adverse effects on the respiratory systems of humans and animals and can contribute to acid rain (Alberta Government, 2009).



Source: Clean Air Strategic Alliance (CASA) Data Reports – available at casadata.org.

Figure 2.4 Annual average concentration - sulphur dioxide (SO_2)

SO_2 levels have decreased significantly due to more stringent regulations and new vehicle technologies being introduced.



Source: CASA Data Reports – available at casadata.org.

in 2006, Environment Canada introduced strict regulations to lower the maximum allowable amount of sulphur in on-road diesel vehicle fuel from 500 ppm to 15 ppm.

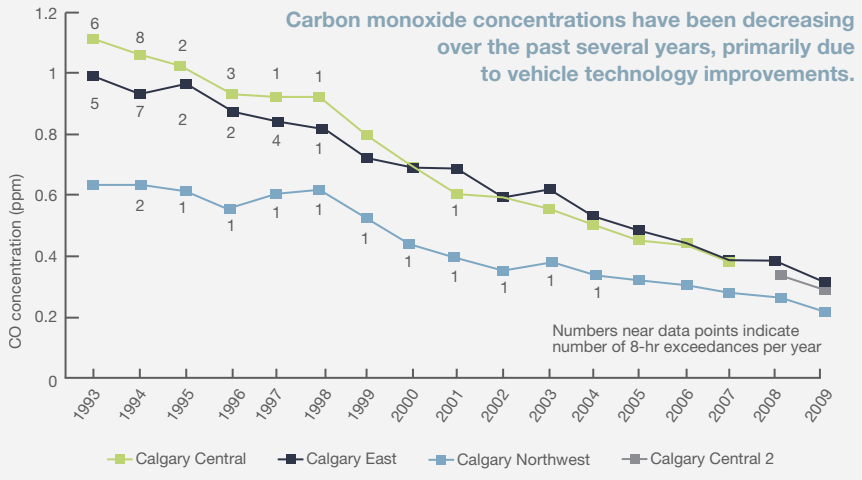
Carbon monoxide (CO)

Carbon monoxide (CO) is a colourless, odourless gas that reduces the capacity of blood to absorb and carry oxygen to organs and tissues in the body. Exposure to high concentrations of carbon monoxide can cause dizziness, headaches, mental and physical fatigue, and even death (Alberta Government, 2009).

The major source of CO in urban areas is motor vehicle exhaust. CO levels in urban areas follow a daily pattern that correlates with peak traffic. Other CO sources include fireplaces, industry, natural gas combustion and air traffic. Forest fires are also a significant natural source of CO.

CO emissions are closely tied to the efficiency of vehicle fuel combustion. The decline in average CO concentrations, reaching a minimum in 2007, can be partially credited to improvements in vehicle emissions technologies that achieve more complete fuel combustion.

Figure 2.5 Annual average concentration – carbon monoxide (CO)



Source: CASA Data Reports – available at www.casadata.org.

CLIMATE CHANGE

Background

In Calgary, the consumption of energy from fossil fuels is the dominant source of greenhouse gas emissions that contribute to climate change. Changes in the global climate system can adversely impact our natural environment, air, water and health. A changing climate requires adaption and mitigation action.

> Urban expansion, energy inefficiency and consumption habits are some of the pressures driving greenhouse gas emissions upward in Calgary.

A 2010 United Nations report found that Calgary has one of the largest carbon footprints among cities in the world – with Calgarians producing 17.7 tonnes of greenhouse gas emissions per capita each year. Calgary placed fifth highest out of 50 major cities, with more emissions per capita than people in New York, Mexico City, Vancouver and Toronto.

Key indicators

- Calgary's greenhouse gas (GHG) emissions
- Calgary's GHG emissions by source
- City of Calgary corporate GHG emissions

Policy references

Council Priorities 2009-2011 includes priorities to reduce community GHG emissions, purchase green electricity, pursue green fleet initiatives and encourage sustainable urban design, and incorporate sustainable building strategies into City projects.

The Calgary Climate Change Action Plan Target Minus 50 (2006) identifies strategies to reduce The City of Calgary's corporate GHG emissions and proposes community emissions action areas. The plan will be updated and a community GHG reduction plan is under development for completion in fall 2011.

Targets

World Energy Cities Partnership – The Calgary Climate Change Accord

The World Energy Cities Partnership (WECP) is a forum for international energy cities to share knowledge about energy issues. In October 2009, several WECP member cities signed the Calgary Climate Change Accord in Calgary. The accord outlines signatories' commitment to reducing municipal GHG emissions by a minimum of 20 per cent by 2020, with a further reduction of 80 per cent by 2050 compared to 2005 levels. Community GHG targets will be included in the community plan.

Trends

Community greenhouse gas emissions

Community greenhouse gas emissions have increased by almost five per cent since 2005, the Calgary Accord baseline year. Per capita GHG emissions have remained between approximately 16 and 18

tonnes per person over the last five years. Over the last two decades, community GHG emissions increased by almost 40 per cent, driven by population growth and corresponding increase in electricity, natural gas and motor fuel consumption. Community emissions include The City of Calgary's operational emissions, which account for approximately two per cent of the community's overall emissions.

Electricity use is the largest source of GHG emission in Calgary, making up 43.7 per cent of emissions in 2009. Electricity generation in Alberta is dominated by the use of coal, a GHG-intensive fuel. Vehicular fuel and natural gas use are the second and third largest local GHG sources, contributing 29.6 per cent and 25.6 per cent of total emissions in 2009, respectively. Less than three per cent of motor fuel emissions are attributed to public transportation (City of Calgary, 2009d). Methane emissions from municipal waste in Calgary's landfills accounted for just over one per cent of community GHG emissions in 2009.

Community emissions are influenced by GHG sources and sinks. Sinks, such as green spaces and the urban forest, which capture and use carbon dioxide, are not accounted for in these estimates. The urban forest has been estimated to provide approximately 16,000 tonnes of carbon storage (USFS, 1998). The City's 2007 Urban Forest Strategic Plan has a goal to offset 0.5 per cent of the city's carbon emissions

Table 2.2 Calgary's GHG emissions by source (tonnes CO_2 equivalents (CO_2e)

Source	1990	1997	2000	2003	2004	2005	2006	2007	2008	2009
Electricity	5,435,000	5,963,000	6,479,000	7,120,000	6,926,000	7,361,000	7,676,000	7,097,000	7,250,000	7,231,000
Natural gas	2,884,000	3,093,000	3,596,000	3,833,000	3,708,000	3,797,000	3,722,000	3,878,000	4,070,000	4,240,740
Motor fuel*	3,464,000	3,716,000	3,802,000	4,548,000	4,582,000	4,507,000	4,950,000	5,030,000	4,615,000	4,897,000
Landfill gas emissions from municipal waste	88,000	103,000	111,000	121,000	125,000	128,000	118,000	122,000	125,000	192,220**
Total community emissions (tonnes CO_2e)	11,871,000	12,875,000	13,989,000	15,622,000	15,341,000	15,793,000	16,466,000	16,127,000	16,060,000	16,560,960

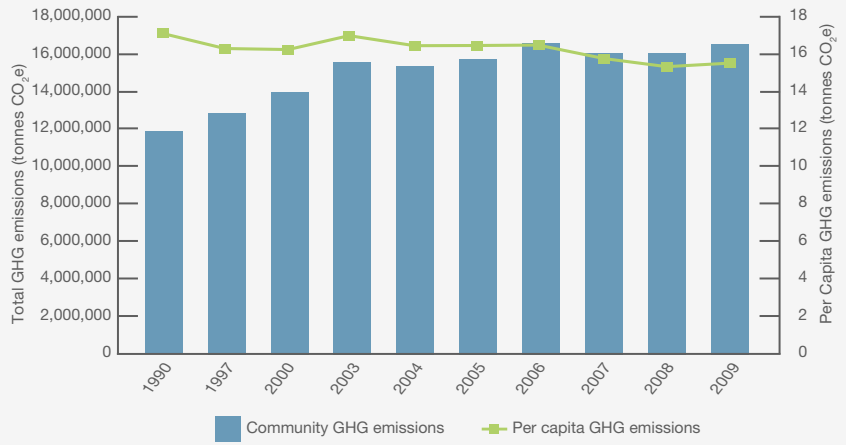
*Motor Fuel is based on total fuel consumed and reported for provincial tax rebate purposes. There is no current means to distinguish between private motor vehicle consumption and commercial fuel use. Motor fuel includes diesel and gasoline fuel only and includes emissions from Calgary Transit. Note that fuel for air travel is not included in the above data, and it is a large source of GHG emissions in Calgary.

**In 2009, Alberta Environment revised the Landfill Gas Quantification Guidelines. The increase in fugitive landfill gas emissions from municipal waste is a result of amendments made to the calculation for estimating the amount of methane that can be potentially produced per tonne of landfill waste.

Sources: As in Figure 2.6.

Figure 2.6 Community greenhouse gas emissions

Community greenhouse gas emissions have increased by five per cent since 2005, with Calgary's growing population.



Note: GHG emissions are in calculated in tonnes of CO2 equivalents

Sources: Electricity – Alberta Energy Utilities Board, ENMAX Energy Corporation; Natural Gas – ATCO Gas; Motor Fuel – City of Calgary Finance & Supply; Waste – City of Calgary Waste & Recycling Services; Population of Calgary – City of Calgary 2009b.

Landfill gas used for energy

When disposed of in landfill, organic waste (food and yard waste) decomposes anaerobically (without oxygen). This releases landfill gas (LFG) into the atmosphere. LFG is a mixture of carbon dioxide (CO_2) and methane – a greenhouse gas 21 times more potent than CO_2. The City is recovering landfill gas and using it as fuel to generate electricity at the East Calgary and Shepard landfill facilities. The electricity produced by the LFG is then used onsite at the landfills. In 2009, about 750,000 kWh of power was generated. This is more than two and a half times the 285,279 kWh generated from landfill gas captured in 2007. Planning is underway to expand LFG capture and treatment at all three landfills.

through total vegetation biomass from Calgary's urban forest.

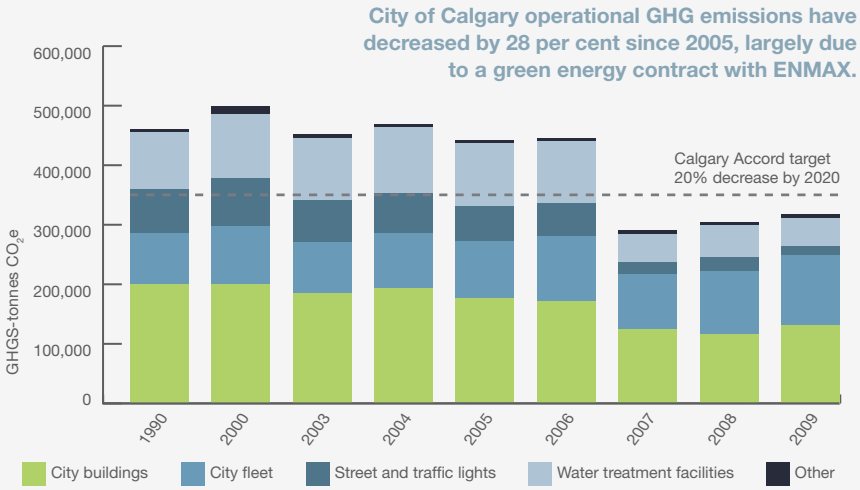
City of Calgary corporate greenhouse gas emissions

In 2009, City of Calgary operations accounted for just under two per cent of Calgary's overall GHG emissions. The City started taking action to reduce its own GHG emissions in 1999, and emissions have decreased by over 28 per cent between the 2005 Calgary Accord baseline year and 2009.

This decrease is largely due to a green electricity agreement with ENMAX, which started with 75 per cent green electricity for corporate operations in 2007. The agreement will target 100 per cent green electricity use by The City by 2012. As Calgary grows, demand for municipal services grows, resulting in an increased corporate demand for energy. Between 2008 and 2009, emissions increased by about four per cent. For more information, consult The City's annual Corporate Environment, Health & Safety report.

ENMAX District Energy Centre

Figure 2.7 City of Calgary corporate GHG emissions



Source: City of Calgary, 2009d.

ENERGY CONSUMPTION

Energy is a central part of our daily lives as Calgarians. Energy is used for heating, electricity and fuelling vehicles. Indirect energy includes the energy it takes to grow, manufacture, transport and sell the goods we purchase and the food we eat.

Indicators

- total and per capita electricity use
- total and per capita natural gas use in Calgary
- total and per capita motor fuel use in Calgary

Trends

Total and per capita electricity use

In Alberta, the majority of electricity is produced from burning fossil fuels, particularly coal and natural gas. Electricity use in Calgary has grown steadily since 1990 and is tied to Calgary's population growth and increasing demands for lighting, household appliances, machinery and tools. Electricity for commercial purposes accounts for about 70 per cent of Calgary's electricity use, while residential use accounts for 30 per cent of the total.

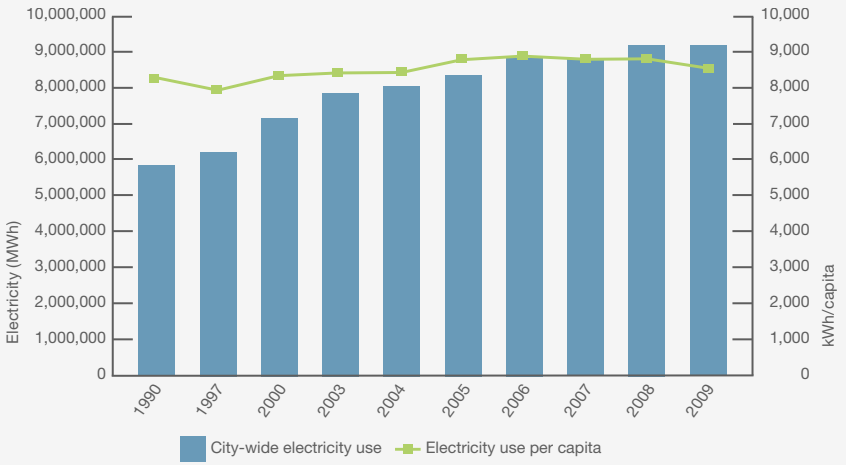
Total and per capita natural gas use in Calgary

Natural gas is used to heat and cool indoor spaces in Calgary buildings, to heat water

Energy consumption makes up 71 per cent of Calgary's total ecological footprint. Calgary's fossil fuel use is the most significant contributor to emissions of both greenhouse gas and criteria air contaminants. Environmental improvements are achievable when we focus on energy efficiency, conservation and the use of low carbon energy sources, such as wind and solar power. Recognizing the link between energy use, climate change and air quality, along with increased awareness and innovation, will be vital to reduce energy use and increase efficiencies.

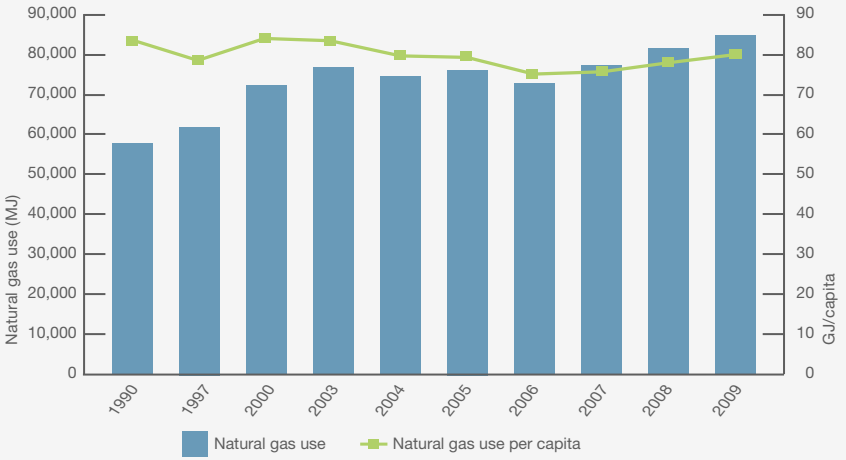
Figure 2.8 Total and per capita electricity use

Total natural gas and electricity consumption has increased with Calgary's growing population. This has resulted in increasing GHG emissions.



Source: ENMAX Energy Corporation, City of Calgary Civic Census 2009b.

Figure 2.9 Total and per capita natural gas use in Calgary



Sources: ATCO Gas, City of Calgary Civic Census 2009b.

and to power some household appliances, gas fired electricity plants and industrial processes and equipment. In the winter months, natural gas use increases significantly as buildings are heated in the cold weather.

Natural gas use per capita has decreased somewhat since 1990, although overall use has increased alongside population growth. Commercial and industrial natural gas use accounts for about 51 per cent of Calgary's total, while residential natural gas use accounts for the remaining 49 per cent.

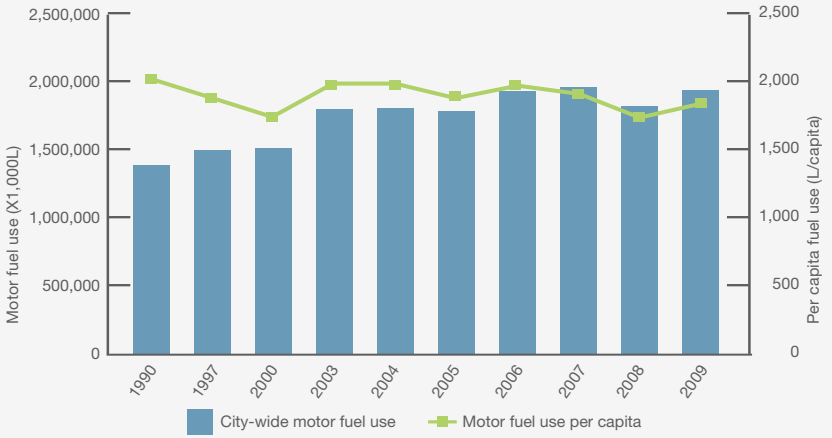
Total and per capita vehicle fuel use

City-wide consumption of gasoline and diesel has increased since 1990 and tends to fluctuate year to year, with high fuel prices and increased number of kilometres travelled being factors affecting consumption. Per capita fuel use has declined, reaching a minimum in 2008. This can be largely attributed to improvements in vehicle engine technology in the last 15 years. Additionally, fluctuating gas prices have influenced the amount of motor fuel used by Calgarians, with particularly high prices seen in 2008.

Natural gas used for space and water heating represent the largest areas of growth in energy use, so is therefore one of the best opportunities for energy reduction.

Figure 2.10 Total and per capita motor fuel use in Calgary

Gasoline and diesel consumption has increased overall, but fluctuates yearly.



Source: The City of Calgary Finance Department. Data reflects all gasoline and diesel sold in Calgary. There is no current means to distinguish between private motor vehicle consumption and commercial fuel use.

TRANSPORTATION

Background

While personal vehicles are the most common travel mode in Calgary, Calgarians are increasingly choosing public transit, walking and cycling as mobility options. How we build our city influences the way we travel. Land uses (home, job, school, day care, retail, etc.) that are further away from each other result in lengthier trips and more traffic. Calgary's northern climate is another factor influencing travel choices.

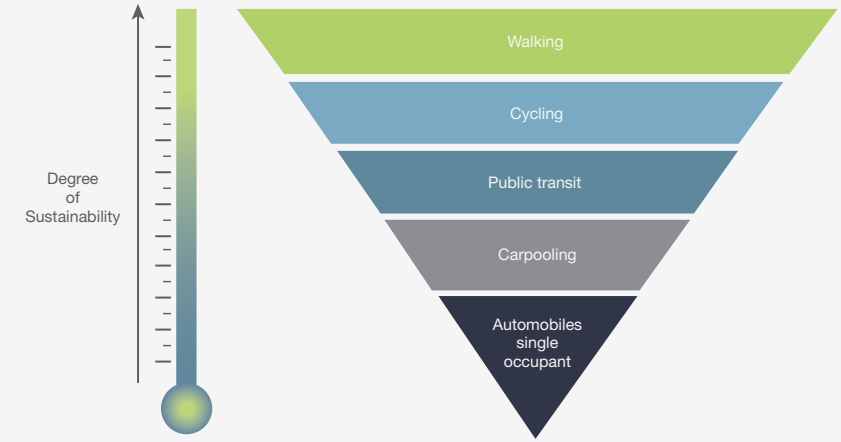
One of the goals of the Municipal Development Plan and Calgary Transportation Plan is to make all types of transportation more convenient. Walking, cycling and transit are at the top of The City's transportation hierarchy because they are the most sustainable modes of transportation.

Transportation indicators help to track progress in developing and using a sustainable transportation system. Increasing the use of public transit, walking, cycling and reducing reliance on the personal automobile can help Calgary move up the transportation sustainability hierarchy.

Greenhouse gases and air pollutants emitted by burning fossil fuels, as well as the design of Calgary's transportation infrastructure network, are the major environmental pressures posed by transportation in our city.

Ensuring that transit is fast, frequent and reliable, and building better facilities and infrastructure for pedestrians and cyclists are key strategies to reduce Calgary's ecological footprint.

Transportation Sustainability Triangle



Source: Calgary Transportation Plan, 2009.

Key indicators

- transit ridership and service hours
- journey to work by mode
- number of privately owned vehicles per capita registered in Calgary
- annual vehicle kilometres travelled
- pathway and bikeway network

Policy references

The 2009 Calgary Transportation Plan (CTP), in alignment with the Municipal Development Plan, places increased emphasis on sustainable modes of transportation

Plan It Calgary and transportation

Transportation and land use are interconnected and have a significant impact on each other and on the environment. Where homes, jobs, services and amenities are located impacts how people travel. Recognizing this, The City developed an integrated Calgary Transportation Plan and Municipal Development Plan through the Plan It Calgary process.

(walking, cycling and transit) (3.1). The plans support the introduction of new cycling facilities, improved design of new and redeveloped streets, and the creation of better connections in new communities and activity centres. A primary cycling network has also been designated to connect major destinations and institutions.

Council Priorities 2009-2011: Increase facilities for pedestrians and bicycles. Design and construct key pedestrian, cycle and roadway projects to maximize mobility.

The City's 2008 Pedestrian and Bicycle Policies and Design reports provide guidance on how to plan, design, build, operate and maintain walking and cycling as accessible forms of transportation.

Target

The Calgary Transportation Plan, 2009, established a 60-year target of 3.7 transit service hours per capita annually.

The 60-year target for the transportation mode split was established in the Calgary Transportation Plan 2009.

- Walking and cycling mode split 20 – 25 per cent
- Transit mode split 15 – 20 per cent
- Auto mode split 65 – 55 per cent

The target of a 60 per cent transit mode split to downtown was introduced in the Centre City Plan.

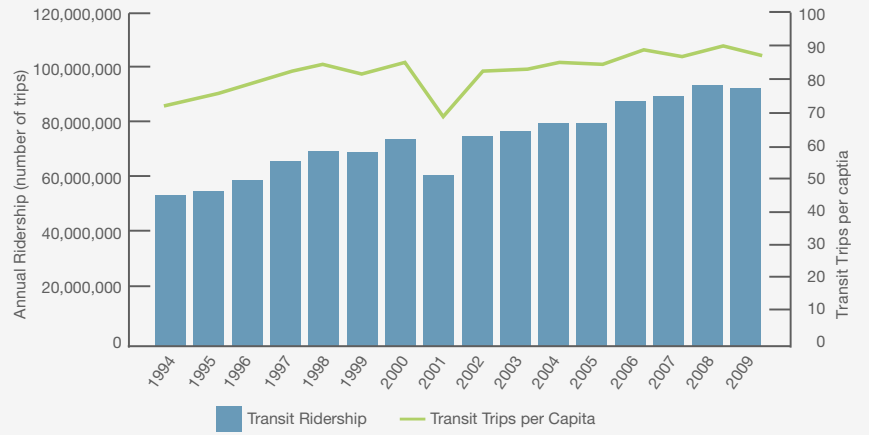
Trends

Transit ridership and service hours

The City operates a transit system that includes light rail trains, buses and community shuttles. Transit services help reduce air pollutants and greenhouse gas emissions while helping to alleviate traffic congestion. Keeping track of transit ridership and service hours can help to gauge changes in local emissions associated with transportation. The level of transit use is one indicator of the readiness of citizens to use their vehicles less often.

Figure 2.11 Transit ridership and trips per capita

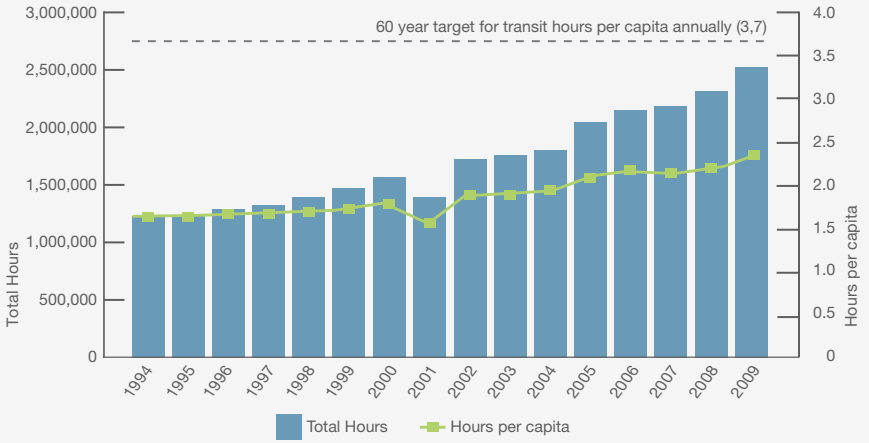
Since 1995, transit ridership has increased 67 per cent, averaging an annual growth of four per cent.



Source: Calgary Transit, 2010. Note: Transit strike occurred in 2001.

Figure 2.12 Transit service hours

Transit service hours have almost doubled since 1994, and per capita hours have also increased.



Source: Calgary Transit 2010. Note: Transit strike occurred in 2001.

The increase in transit ridership over the last 15 years is significant given the rapid population growth during this time. Transit trips per capita have also grown by almost 18 per cent between 1995 and 2009.

The increase in transit ridership and trips per capita can be partially attributed to the increase in service levels over the same period. Some other factors influencing transit ridership are:

Density – The intensity of people living or working in the area.

Diversity – Mix of land uses in the area.

Design – Creating a quality of pedestrian environment through urban design elements.

Distance – Locating the right land uses close to transit.

The integration of increased transit service levels, service reliability and the four elements above will determine the ultimate success of increasing transit ridership and, therefore, transit trips per capita.

Annual transit service hours almost doubled between 1995 and 2009. Service hours per capita have also been increasing. To meet the Calgary Transportation Plan's 60-year target of 3.7 service hours per capita, service hours will have to increase three and a half times over the long term.

Primary transit network

The 2009 Calgary Transportation Plan enables the development of a primary transit network consisting of high-frequency transit services operating every 10 minutes or better, 15 hours a day, seven days a week. The primary transit services will connect major destinations, activity nodes and the downtown core.

Mode split

The ways in which we travel, such as walking, cycling, taking transit and driving, are known as modes. The mode split is the proportion of each mode that is used, and these vary depending on factors such as the location of land uses, the length and type of trip and the weather.

The overall mode split is a measure of how many trips Calgarians make by walking, cycling, transit and car. In 2005, within a 24-hour time period, walk and bike trips contributed to 14 per cent of all trips made. Transit trips represented nine per cent of all trips and the remaining 77 per cent of all trips were made by car (CTP, 2009). A 60-year target was set to reduce the percentage of trips made by car to between 65 and 55 per cent while increasing the use of other modes.

Between 1996 and 2006, Calgarians also began to reduce their reliance on the car for the commute to work. In 2006, 23.8 per cent of Calgary commuters used sustainable transportation (walking, cycling or public transit) to commute to work. However, close to 70 per cent of Calgary commuters still rely on their vehicles.

The median commuting distance in the Calgary metropolitan area increased from 7.7km in 2001 to 8.2km in 2006.

Table 2.3 Journey to work for Calgarians

		1996	2006
	Population	767,059	991,759
	Car As driver	71.9%	67.6%
	Car As passenger	7.2%	7.6%
	Public Transit	13.3%	16.8%
	Walking	5.5%	5.6%
	Cycling	1.1%	1.4%
	Other modes (Motorcycle, taxi, etc)	0.9%	1.0%

Source: Customized from Statistics Canada, Federal Census, 2008.

Commuting to downtown

From 1996 to 2006, sustainable modes of commuting to downtown during the work week (walking, cycling and transit) rose by 16.1 per cent. Transit was the most used commuting method to downtown (with an increase of 12.7 per cent), while the number of people driving alone decreased from 49.5 per cent to 37 per cent. Downtown Calgary has all the attributes of a successful transit system: service hours and density, diversity, design and distance. In 2006, 45.1 per cent of all commuting trips to downtown were done by transit, while only 16.8 per cent of commuters travelling to other parts of Calgary used transit.

Between 1996 and 2006, Calgarians reduced vehicle usage for trips to work by car by almost 4.5 per cent, and public transit use is up by 3.5 per cent. The number of people cycling to work increased just 0.3 per cent and walking trends show an increase of 0.1 per cent throughout this period.

Number of privately owned vehicles per capita registered in Calgary

Knowing the number of registered vehicles helps to understand consumption habits impacting the ecological footprint, as well as the reliance Calgarians have on the personal automobile. Measuring this trend helps us learn how to address challenges in encouraging travel alternatives, such as walking, cycling or transit. In 2006, there were 743,767 registered vehicles in Calgary. By 2010, this number grew to 852,930 (Alberta Transportation 2010).

The number of registered vehicles increased by 14.7 per cent from 2006 to 2010.

2006 marked the first year where there were more registered vehicles in Calgary than licensed drivers (City of Calgary, 2008a). The private vehicle can consume almost four times the energy per passenger per kilometre compared with a bus (Steemers, 2003).

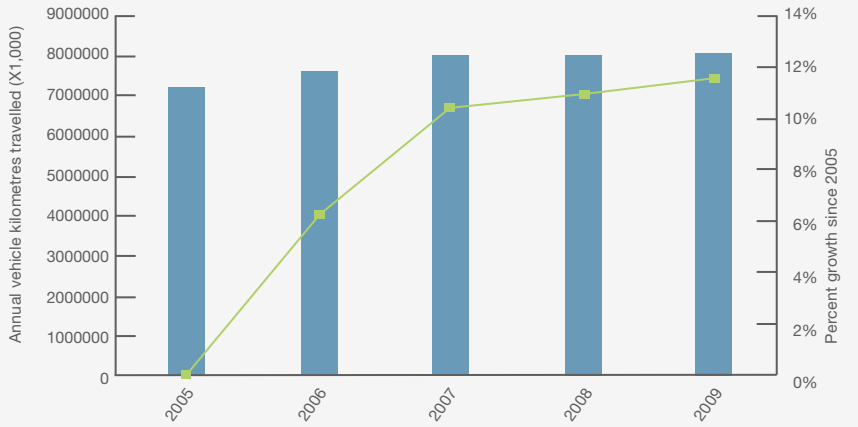
Annual vehicle kilometres travelled (VKT)

The annual vehicle kilometres travelled (VKT) is correlated with greenhouse gas emissions and air pollutants. Variables that can contribute to vehicle kilometres travelled include the economic situation, distances between home, job, schools, etc., the availability of other transportation options and fuel prices, among others.

Calgary's annual VKT has increased by 12 per cent from 2005 to 2009 in parallel with the growing population. However, from 2007 to 2009, the VKT increased by only one per cent, which may have been in response to rising fuel prices in Calgary. Annual VKT calculations are based on estimates of weekday vehicle kilometres travelled on primary roadways and include commercial travel.

Figure 2.13 Annual vehicle kilometres travelled

Annual vehicle kilometres travelled have increased 12 per cent since the 2005 baseline.



Source: 2010 Vehicle Kilometres Travelled in Calgary: Proposed methodology. City of Calgary. Transportation Planning.

Pathway and bikeway network

Calgary has one of the most extensive off-road pathway and bikeway networks in North America. The network is used for both recreation and commuting.

By encouraging the choice to walk or cycle, Calgary's pathways and bikeways can help to reduce GHG emissions, alleviate traffic congestion and improve health through physical activity.

Cyclists, pedestrians, in-line skaters, wheelchair users and other non-motorized modes of transportation are allowed on pathways. Bikeways are incorporated into roads, and are equipped with elements such as signage, wider curb lanes and bicycle stencils on the pavement. In 2009, The City focused on improving the quality of existing bikeways rather than adding more kilometres.

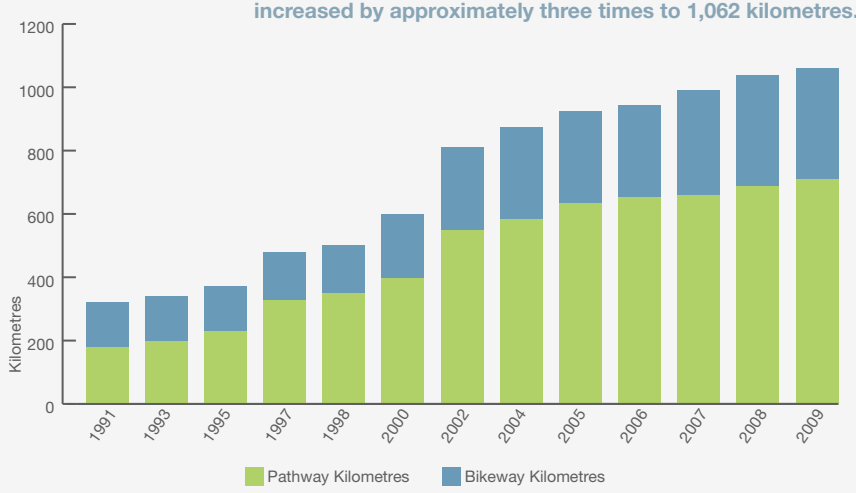
The number of pedestrians entering the downtown in the morning peak hours more than doubled between 1991 and 2006 (City of Calgary, 2008c). Every weekday an estimated 7,000 pedestrians enter the downtown between 7 and 9 a.m.

There has also been a steady increase in the number of cyclists travelling to downtown. Since 1991, the number of commuting cyclists has quadrupled to 9,500 in 2008 (CTP, 2009). The number of cyclists entering the downtown is counted most years on one day during the spring. Over the last few years, a cycling culture resurgence has hit Calgary, encouraged by local groups across the city, which may account for some of the increase in number of cyclists.

Factors that influence a person's choice to cycle include weather, availability of bicycle lanes or pathways, bicycle parking and other supporting facilities (e.g., showers) at the cyclist's destination, fitness levels, safety and comfort.

Figure 2.14 Kilometres of pathways and bikeways in Calgary

Between 1991 and 2009, the length of pathways and bikeways increased by approximately three times to 1,062 kilometres.



Source: City of Calgary, Transportation Planning and Parks, 2010.

Chapter 3. Water

INDICATOR THEMES

- Water quantity.
- Water quality in Calgary's rivers.
- Wetlands and riparian areas.
- Treated wastewater quality.

WATERSHED HEALTH

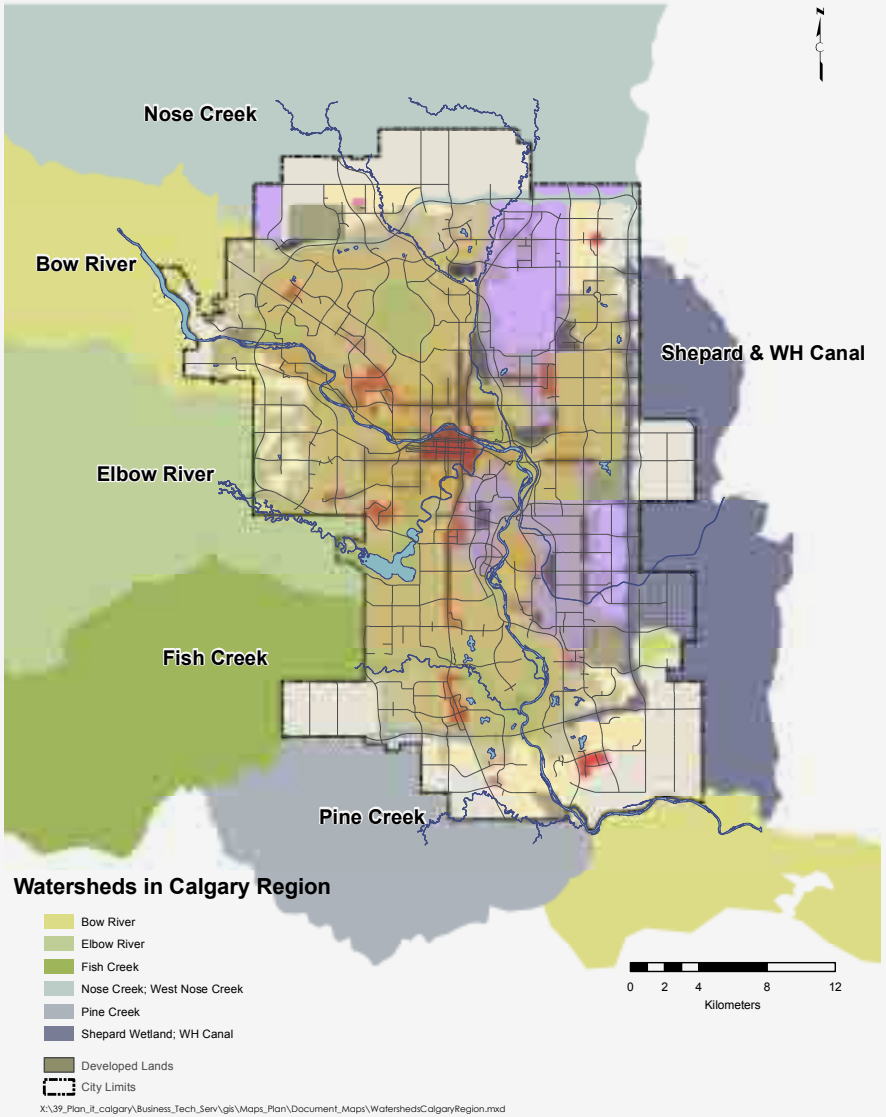
As the Elbow and Bow rivers flow from their headwaters through Calgary, they supply our drinking water, provide recreation opportunities, support aquatic and terrestrial ecosystems and enrich Calgary's scenery. However, a finite supply of fresh water, sediment and pollution loads, the effects of climate change and rapid urban growth have made water management one of Calgary's most significant environmental issues. To deal with these complex issues, water management is increasingly focused at the watershed scale.

Calgary is situated within six watersheds. Understanding the state of each watershed involves looking at water quantity, quality, aquatic ecosystems and riparian areas, as well as the variety of land use issues that impact water. The goal is to conserve and protect source waters, limit pollution and ensure the overall health of our regional watersheds.

The City is a member of the Bow River Basin Council, the Elbow River Watershed Partnership, Ghost Stewardship Monitoring Group and the Nose Creek Watershed Partnership. Together these groups work to preserve and enhance river water quality and the overall health of our watersheds.

The last few years have seen the development of watershed management plans for the Bow Basin , the Elbow River Basin, and Nose Creek. Developed under the Government of Alberta's Water for Life strategy, these plans have helped define guidelines, targets and recommendations to protect our watersheds.

Figure 3.1 Watersheds in the Calgary area



Source: Municipal Development Plan, 2009.

DRINKING WATER DEMAND

Background

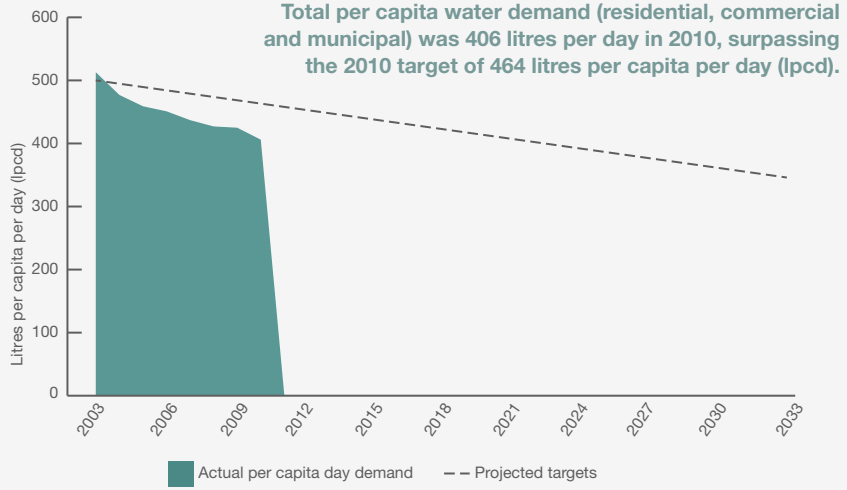
Calgary's demand for clean, fresh water places a demand on our surrounding environment and requires a large enabling infrastructure. Within Calgary, the Bow and Elbow rivers supply us with quality source water that is treated prior to use.

Along with the challenges posed by urban growth, water quantity is also influenced by upstream development and the need to share our rivers with downstream users, including communities, farmers, ranchers and industry.

In 2006, the Government of Alberta announced that new water licences would no longer be granted in the Bow River Basin.

Factors affecting Calgary's climate are complex. Recent trends and predictions include lower summer stream flows, changes of precipitation in the winter, warming temperatures and increased extreme weather. Climate change is expected to negatively affect both the supply and quality of water placing increase pressures on water infrastructure.

Figure 3.2 Calgary's per capita water demand



Source: 2010 Year end Water Efficiency Report, The City of Calgary, 2011.

This means that Calgary must make use of our existing water licences in the context of an increasingly competitive demand for water in southern Alberta. Responsible management hinges on improving water efficiencies and conservation in the way water is used and valued.

Key indicators

- Calgary's per capita water demand.
- Universal water metering
- Calgary's peak day water demand.
- Non-revenue water – Infrastructure Leakage Index.

Policy references

Council Priorities 2009–2011: Invest in initiatives that will help conserve our long-term water supply.

Water Efficiency Plan 2005: The City is committed to reducing per capita water use and ensuring sustainable planning and management of Calgary's water resources for future generations.

Targets

Calgary City Council adopted a goal of accommodating Calgary's future population growth with the same amount of water removed from the river in 2003. To do this, Calgary needs to reduce per capita water use by 30 per cent in 30 years (30-in-30). The targets of this plan include:

- Reduce total (residential, business and municipal) per capita demand to 350 litres per day by the year 2033.
- Achieve 100 per cent metering of all residential customers by Dec. 31, 2014.
- Keep peak demand below 950 megalitres through to 2032.
- Achieve an Infrastructure Leakage Index (ILI) below three by following best management practices and through proactive leak monitoring.

Trends

Per capita water demand

Per capita water demand is the average volume of water used per person per day (lpcd). It is calculated by dividing the annual demand by the city population and number of days in a year. In can be expressed in two ways:

- Total per capita demand is the measure of all water used city wide (municipal, commercial and residential) for the total population. It represents the amount of water required to support all business, government services and residential needs.
- Single-family residential per capita demand is the measure of all the water used by single-family residences (detached homes, duplexes) and does not include consumption by multi-family buildings. Single family per capita day demand provides the best estimate of residential consumption patterns.

The 2010 single-family residential per capita day demand is estimated at 257 lpcd. A comparison of residential per capita demand from 2004 indicates that while

Calgary's residential demand is less than the Canadian average, it still exceeds that of some large cities in the prairie-provinces.

Universal water metering

Universal water metering helps customers reduce water consumption by tracking monthly water use. Customers on a water meter can use up to 60 per cent less water than customers on a flat-rate account (City of Calgary Water Efficiency Report, 2010). Significant progress has been made since the mid-1980s, when only about 20 per cent of residential accounts in Calgary were metered. To achieve universal metering by the end of 2014, Council approved changes to the Water Utility Bylaw in November

2009 to require mandatory installation of water meters beginning Jan. 1, 2010. The start date was moved forward two years to allow for Calgary's remaining flat water accounts to be converted at a pace of about 10,000 meters per year. In 2010, 9,700 residences had a water meter installed and were converted from flat-rate to metered billing accounts. There were 41,800 flat-rate accounts remaining at the year-end 2010. The City is on track to meet the universal water metering target. All industrial, commercial and institutional customers are already metered.

Peak day demand

The one day per year that Calgary requires the most water is referred to as the peak day demand. In the spring and summer months, water demand can spike due to outdoor watering activities. Peak day demand helps indicate how wisely we are using water outdoors. It is important because water demand can double during the outdoor watering season. In total, outside water use can make up over 12 per cent of our total water use.

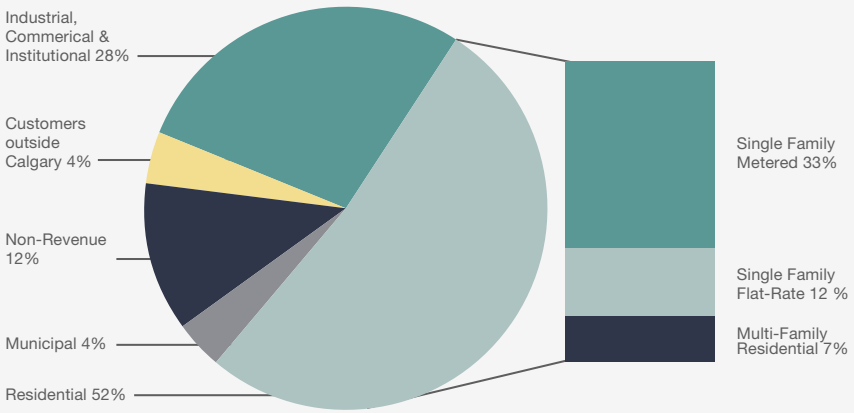
The target for peak day demand is to keep it below 950 megalitres (one megalitre, ML, is equal to one million litres of water). Calgary's peak day demand was 648 ML on July 9, 2010. Despite the city's growth, peak day demand has remained relatively stable.

Non-revenue water

Fixing leaks in the water distribution system is a key strategy to reduce water consumption. Significant water losses can occur from leaks in the water distribution system. The City tracks where water flows in its system to try and minimize these losses. The Infrastructure Leakage Index (ILI) is used to benchmark Calgary's performance in comparison to other utilities.

Figure 3.3 Water demand by sector

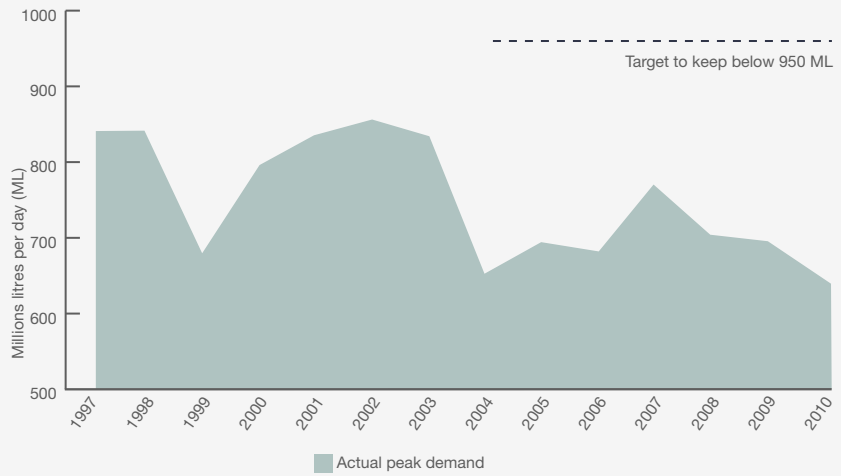
Residential use accounts for over half of Calgary's water demand. About 10,000 residential meters need to be installed each year until 2014 to achieve universal metering.



Source: 2010 Year end Water Efficiency Report, The City of Calgary, 2011.

Figure 3.4 Calgary's peak day water demand

Calgary's maximum day water demand is well below the 950 megalitre target.



Source: 2010 Year end Water Efficiency Report, The City of Calgary, 2011.

While ILIs can range from one to 12, the ILI for top performers is between one and three. The City aims for an ILI below three. In 2009, Calgary's estimated ILI was between 3.1 and 3.9. Monitoring for leaks, upgrading treatment plants and replacing water mains can help us reduce our ILI and save significant volumes of water. In 2010, six kilometres of older water mains were replaced. In the 1980s there were approximately 1,800 water main breaks a year in Calgary, but through aggressive prevention measures, we now average between 300 and 400 main breaks a year – one of the lowest rates in North America.

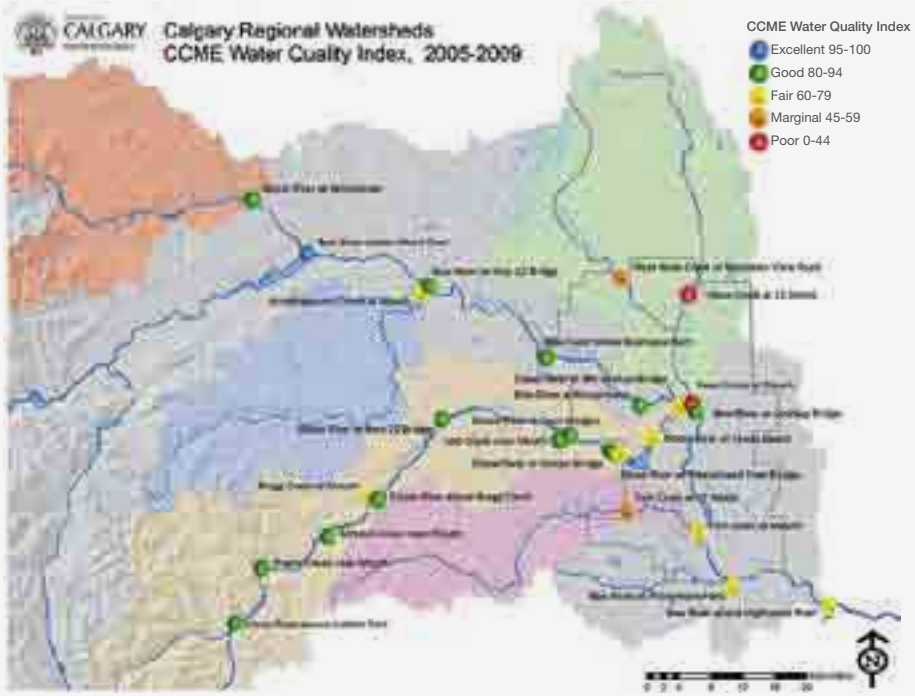
WATER QUALITY OF CALGARY'S RIVERS

Background

Calgary's urban growth has had a significant impact on the natural hydrological cycle and water quality within our local watersheds. Excess nutrients, sediment, bacteria, chemicals and metals enter our rivers from various sources, contributing total loadings to our waterways.

The City has adopted an integrative strategy to protect local surface waters from key pollutants. Total loading management considers loadings from stormwater releases from city outfalls (non-point sources) and from Calgary's wastewater treatment plants (point sources). The intent is that Calgary's total loadings will not cause significant adverse effects on the aquatic ecosystems of the watersheds.

Figure 3.5. Canadian Council of Ministers for the Environment Water Quality Index Ratings 2005-2009



Source: City of Calgary, Water Resources, 2010.

Key indicators

- Water Quality Index Ratings 2005-2009
- E.coli bacteria in the Bow and Elbow rivers
- dissolved oxygen in the Bow and Elbow rivers
- total phosphorus in the Bow and Elbow rivers
- nitrogen in the Bow and Elbow rivers
- total suspended solids in the Bow and Elbow rivers

Policy references

Council Priorities 2009-2011: Protect the quality of water in our rivers and streams.

- Conduct ongoing water quality testing.
- Reduce the amount of runoff and sediment that enters our rivers and streams.

The City's Total Loading Management Plan 2008 recommends general principles for managing total loadings of pollutant releases from Calgary to the Bow River.

In 2007, Calgary City Council approved the Nose Creek Watershed Water Management Plan to achieve specific water quality objectives. The Bow Basin Watershed Management Plan and the Elbow River Watershed Management Plan were approved in 2008.

The Environmental Reserve Setback Guidelines 2007 require a minimum setback for development of 50 metres from Nose Creek, the Elbow River and the Bow River. Setbacks for new developments adjacent to wetlands have been raised from six metres to 30 metres, allowing for better protection of these waterbodies.

The City's 2005 Stormwater Management Strategy seeks to develop sustainable stormwater management practices.

Trends

Water Quality Index in our rivers

The Canadian Council of Ministers for the Environment (CCME) Water Quality Index provides a snapshot of surface water quality conditions. The map shows the CCME Water Quality Index ratings for the regional watershed sampling stations between 2005 and 2009 (except for the Elbow River at Sarcee Bridge which is 2006 – 2009 and Ghost River at Benchlands and Bow River below Ghost Dam stations, both 2008 and 2009 only). The water quality index is a composite statistic evaluating ambient nutrient, metals and bacterial water quality (CCME, 2003). Surface water quality sampling is conducted at these sites by The City of Calgary Water Resources.

During this period, water quality was rated as fair at the mouth of Fish Creek. Water quality at Nose Creek sites was marginal to poor between 2005 and 2009. The Nose Creek Watershed Water Management Plan will function to improve this rating as conditions change in the future. Water quality upstream and downstream of Calgary was generally fair to good.

Water quality along the Bow River and Elbow River within Calgary can generally be described as fair to good.

Figure 3.6A E.coli in the Bow River

E.coli levels downstream in the Bow and Elbow rivers are higher than upstream, but most sites have been well below water quality guidelines since 1995.

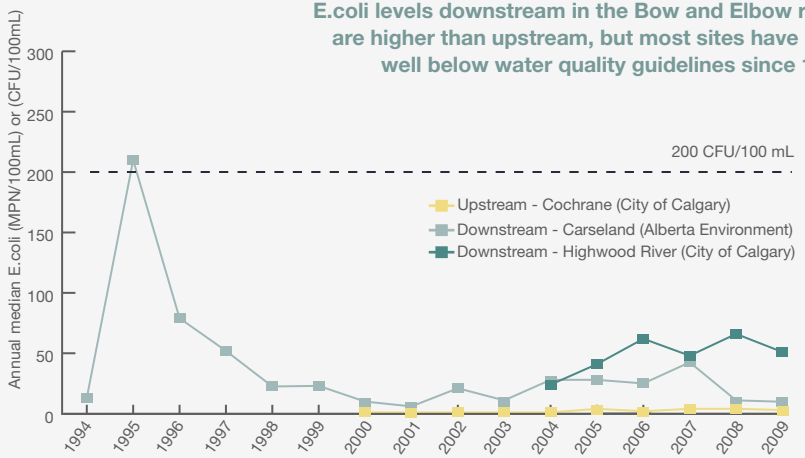
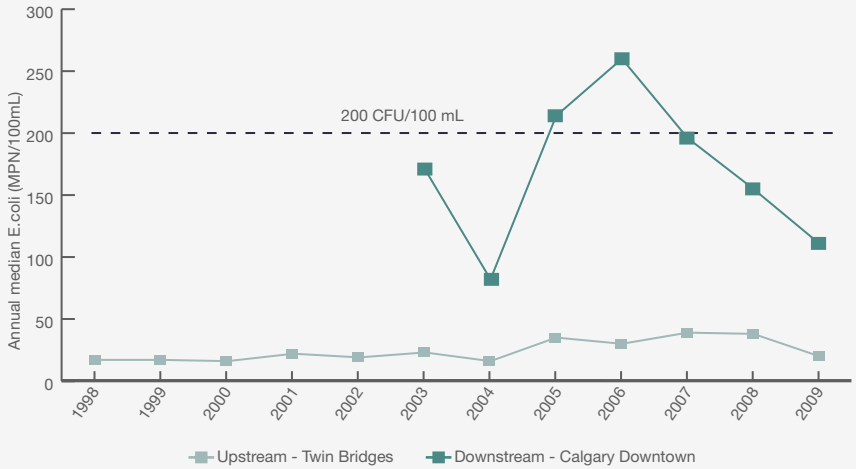


Figure 3.6B E.coli in the Elbow River



Sources: Alberta Environment and City of Calgary Water Resources, 2009.
Note: City of Calgary reports E.coli using MPN/100 mL where MPN stands for Most Probable Number. Alberta Environment uses CFU/100mL where CFU stands for Colony Forming Units. While analytical procedures are different, the two units are comparable.
Objectives: Alberta Surface Water Quality Guidelines for Recreation and Aesthetics: Escherichia coli: <200 E.coli per 100 mL (geometric mean 5 samples/ 30 d). The Bow Basin Watershed Management Plan, Phase 1, set a water quality objective for E.coli of <400 E.coli per 100 mL for the Bow River below Banff Park boundary and the Elbow River Central reaches.

E.coli bacteria in our rivers

There are several different strains of E.coli bacteria, many of which are harmless and live in the intestines of healthy humans and animals, but certain strains can cause severe illness.

Since monitoring began downstream of Calgary at the Highwood site on the Bow River in 2004, E.coli levels have shown an increasing trend, likely due to non-point sources of contamination. These include urban runoff and untreated stormwater entering the Bow from various points along its length. Similarly, E.coli levels are higher at both downstream sites than at the upstream site. Since peaking in 1995, E.coli levels have decreased substantially downstream, but have increased somewhat in recent years.

Dissolved oxygen in our rivers

Dissolved oxygen (DO) is one of the most important constituents of watercourses. Depletion of DO in surface waters occurs due to natural effects, water temperature, pollution and eutrophication (excessive nutrients). Dissolved oxygen levels are monitored to track the effects of phosphorus releases to the Bow River.

The City's Total Loading Management Plan aims to ensure dissolved oxygen levels in the Bow River downstream of Calgary do not drop below Alberta's acute guideline. Median DO levels in the Bow are generally above the guidelines, but seasonal fluctuations can result in minimum DO levels below the guidelines (Figure 3.7A). The Elbow River does not face the same stressors on DO as the Bow because there are not wastewater treatment plants discharging to it. However, annual median DO levels downstream along the Elbow River have generally been slightly lower than upstream.

Fish and other aquatic animals require dissolved oxygen to breathe. Dissolved oxygen levels are a primary concern in the Bow River (Golder 2004a and Golder 2007). To protect DO levels in our surface waters, Calgary has put significant effort into limiting the input of organic materials and nutrients into our rivers that could lead to dissolved oxygen depletion.

Figure 3.7A Dissolved oxygen in the Bow River

Median DO levels in the Bow and Elbow rivers are generally above the provincial minimum guidelines. However, daily and seasonal fluctuations can result in DO levels below the minimum guidelines at times.

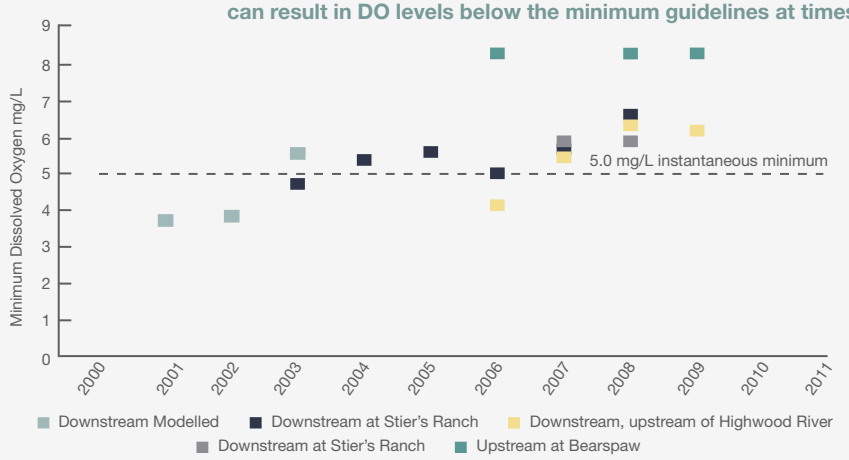
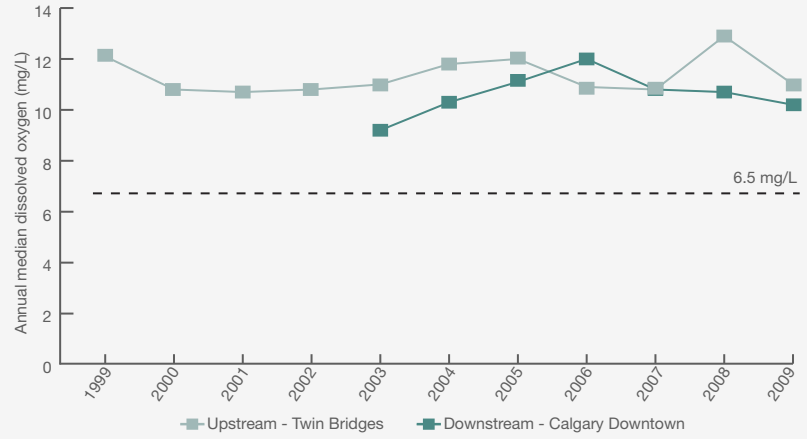


Figure 3.7B Median dissolved oxygen levels in the Elbow River



Source: City of Calgary Water Resources, Alberta Environment, and University of Calgary, 2009 and 2010.
Objectives: The Alberta Dissolved Oxygen guideline for the protection of freshwater aquatic life is 5.0 mg/L as an acute, 1 day minimum. The chronic guideline is 6.5 mg/L as a 7 day mean (AENV, 1999). The Bow Basin Watershed Management Plan, Phase 1 set a water quality objective for DO of 5.0 mg/L as an acute daily minimum for the Bow River Central reach. For the Bow River below Park Boundary and the Elbow River Central reaches, the objective is 6.5 mg/L as an acute daily minimum.

Nutrients in our rivers

Phosphorus and nitrogen are essential nutrients for aquatic plant and animal growth. However, in elevated concentrations, these nutrients can cause undesirable events in a river, including accelerated plant growth, algae blooms and low dissolved oxygen resulting in the death of fish, invertebrates and other aquatic animals. Sources of nutrients in surface waters can include treated wastewater effluent and stormwater outfalls, runoff from fertilized lawns and agricultural land, commercial and household chemicals, and malfunctioning septic systems. The City's Total Loading Management Plan has set a total loading objective for phosphorus based on its in-stream effects related to dissolved oxygen levels.

Total phosphorus (TP) concentrations downstream of Calgary on the Bow River have decreased, but are often higher than the

The concern related to phosphorus and nitrogen nutrient compounds is their cumulative effect on aquatic plant and algae growth and consequent in-stream dissolved oxygen levels, particularly at times of low river flow and higher water temperatures. Generally, phosphorous and nitrogen concentrations in Calgary's rivers have been well below Alberta's guidelines.

Bow Basin Watershed Management Plan's (BBWMP) water quality objective of 0.028 mg/L for the Bow River Central reach, but generally below the Alberta Surface Water Quality Guideline of 0.05 mg/L. Since 2003, phosphorus levels at the Carseland site have decreased substantially and are stabilized close to the BBWMP water quality objective.

Since monitoring began at the downstream Highwood site in 2004, phosphorus levels have fluctuated, but in 2008, the levels declined to the BBWMP objective. The site at Carseland is much further downstream, so phosphorus is more assimilated into the river once it reaches that site. TP levels in the Elbow River are well below surface water quality guidelines, although levels are consistently higher in the lower reach.

Nitrogen levels in the Elbow River have been well below provincial water quality guidelines. Upstream of Calgary, nitrogen levels in the Bow River have also been significantly below the guidelines. Since monitoring began at the Highwood site downstream in 2004, concentrations of nitrogen have increased somewhat, but further downstream at Carseland, nitrogen levels have decreased. The Pine Creek Wastewater Treatment Plant is designed to remove nitrogen and was the first facility in Alberta to have a limit for Total Nitrogen.

Total suspended solids (TSS)

Total suspended solids (TSS) includes the organic and inorganic solid materials that are suspended in stormwater and wastewater and enter our waterways. These materials can have adverse effects on the aquatic ecosystem by damaging fish

Figure 3.8A Total phosphorus in the Bow River

Generally, phosphorous concentrations in Calgary's rivers have been well below Alberta's guidelines, with the exception of some downstream monitoring locations.

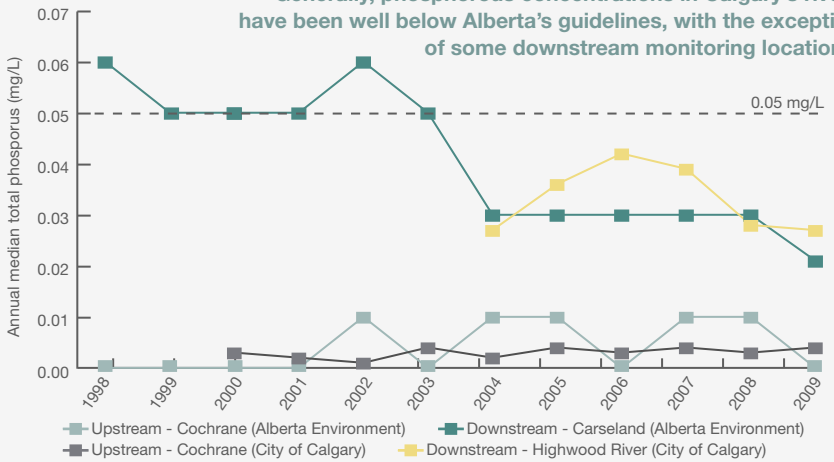
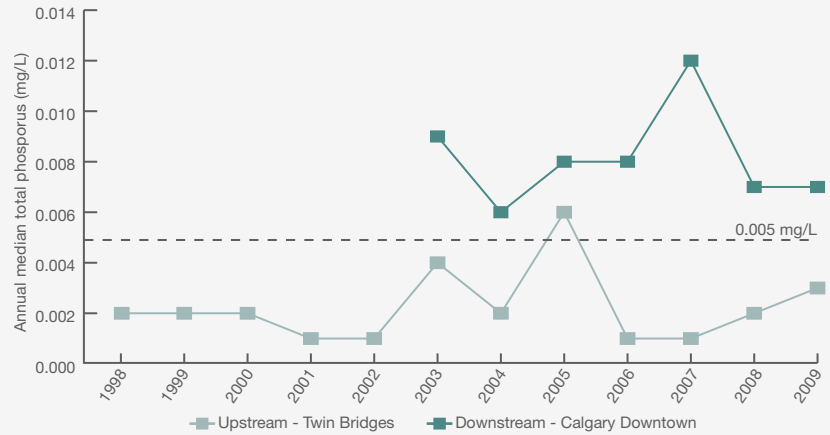


Figure 3.8B Total phosphorus in the Elbow River



Sources: City of Calgary Water Resources and Alberta Environment, 2009.
Objectives: Alberta Surface Water Quality Guidelines for the Protection of Freshwater Aquatic Life: Phosphorus as P (total inorganic and organic): 0.05 mg/L. This value can be applied as chronic guidelines (AENV, 1999). The Bow Basin Watershed Management Plan, Phase 1, set a water quality objective (WQO) for total phosphorus in the Bow River Central reach of 0.028 mg/L and a provisional WQO of 0.075 mg/L during the winter season. No water quality objective was set for total phosphorus for the Elbow River Central reach. The City's Total Loading Management Plan (2008) states that, including all wastewater loadings and estimated stormwater loadings, no more than 340 kg/day of phosphorus should enter our rivers. The total loading objective adopted for total phosphorus is based on maintaining the surface water quality guideline of 5.0 mg/L DO in the Bow River and protecting against nuisance aquatic plant growth.

spawning beds, impacting benthic invertebrate populations, reducing visibility for fish and reducing penetration of sunlight required for growth of aquatic plants.

Stormwater contributes approximately ten times more TSS to the rivers than treated wastewater (City of Calgary, 2008d). As Calgary grows, urbanization removes natural ground cover while building hard, impervious surfaces. This increases surface runoff and TSS that flows into our watershed. For example, very high concentrations of TSS can be found in runoff from construction sites.

High total suspended solids (TSS) in runoff can also mean higher concentrations of bacteria, nutrients, pesticides and metals reaching our rivers. Urban growth is the main factor that could cause TSS loadings to increase.

Policy references and targets

The City's Total Loading Management Plan 2008 established a total loading objective for total suspended solids (TSS) of an average value of 52,920 kg/day.

The City has taken a step beyond the total loading objective by setting a more ambitious target. The Stormwater Management Strategy aims to:

- Reduce sediment loading from stormwater to the Bow River to or below the 2005 level (36,900 kg/day) by 2015.
- Protect watershed health by reducing the rates and volumes of stormwater runoff, controlling sediment loads and developing sustainable stormwater management solutions for new development areas

Trends

Total suspended solids (TSS) loadings are not forecast to reach or exceed the objective until about 2018 or later. Calgary's three wastewater treatment plants contributed an average of 3,709 kg/day of TSS to the river in 2008. This is considered a minimal contribution relative to the TSS contribution from stormwater (City of Calgary, 2008e). Stormwater contributes approximately 90 per cent of TSS loadings, and efforts to manage pollutant loadings are therefore focused on stormwater.

Stormwater loadings are difficult to measure because there are over 400 stormwater

Figure 3.9A Nitrogen in the Bow River

Generally, nitrogen levels are below provincial guidelines, with the exception of some Bow River locations upstream and downstream of Calgary.

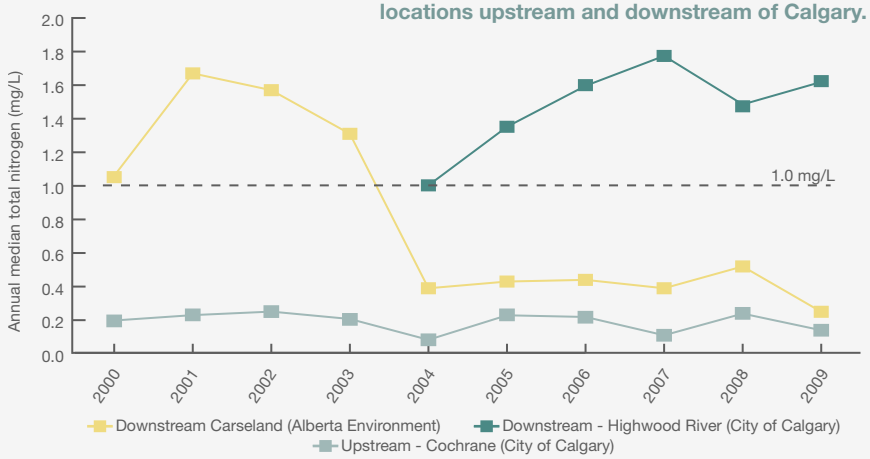
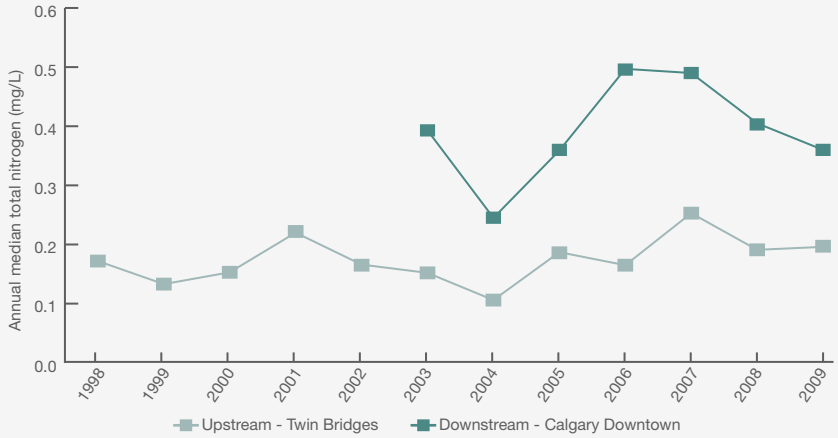


Figure 3.9B Nitrogen in the Elbow River



Sources: Alberta Environment and The City of Calgary Water Resources, 2009.
Objectives: Alberta Surface Water Quality Guidelines for the Protection of Freshwater Aquatic Life: Nitrogen (total inorganic and organics): 1.0 mg/L. Although not directly toxic to freshwater aquatic life, this value is included due to its broader influence on conditions that affect aquatic life. This value can be applied as chronic guidelines.

outfalls in Calgary, and loadings depend on precipitation distribution in the watershed. TSS loadings from storm sewer outfalls are estimated from a combination of representative water quality sampling, water flow measurements and computer modelling.

Some older areas of Calgary are being retrofitted with stormwater retention facilities, which help to reduce TSS from entering Calgary's rivers. New subdivision developments are required to include retention facilities that remove at least 85 per cent of TSS (City of Calgary, 2008d). TSS loadings from new developments are expected to be offset by the retrofitting of older areas of Calgary with stormwater retention. Wetlands are also effective in reducing TSS loading.

Since 2005, TSS loadings from stormwater have increased to the Bow River by an estimated 1,800 kg/day – mostly due to new development and the diversion of flows from the Western Headworks Canal to the Shepard Stormwater Diversion. Loadings to the Bow River have decreased by approximately 1,800 kg/day with the completion of four stormwater quality retrofit projects and the storm ponds near Highway 22X, located west of the Bow River. Two more retrofit projects were completed in 2010, and it is estimated that TSS loadings will be reduced by an additional 1,300 kg/day (City of Calgary, 2008f).

The next phase of stormwater management in Calgary is the implementation of Low Impact Development (LID), which focuses on better site design practices for stormwater control options, such as green roofs, stormwater capture and re-use, and landscaping that increases the absorption and filtering of rainwater. These new approaches will protect our watershed by reducing the pollutants and volume of stormwater runoff to Calgary's creeks and rivers.

WETLANDS

Wetlands are the transition zone between land and water. Wetlands provide food, habitat and shelter for local wildlife, migratory birds and aquatic species. The protection of wetlands is critical, as they contribute significantly to the biodiversity of the North American semi-arid glaciated plains. This includes breeding grounds for more than half of all the ducks in North America.

Today, it is estimated that 90 per cent of the pre-settlement wetlands in Calgary have been lost to development. Some activities related to urban development in Calgary, which can negatively impact wetlands include: dredging, draining and/or filling wetland areas for conversion to agricultural, industrial or residential lands; waste disposal; storm-water pollution and water contamination, and nutrient loading (Wetlands Alberta, 2009).

There are several classifications for wetlands, and depending on their classification, there are municipal and provincial mechanisms in place for wetland protection. The Calgary Wetland Conservation Plan has a No Net Loss policy for Environmental Reserve Wetlands (Stewart and Kantrud, Classes III to VI). This protection is in addition to the provincial *Water Act*, which has mechanisms in place to protect all waterbodies, or require compensation for their loss. The City's guidelines require a setback from wetlands in subdivisions,

Within a watershed, wetlands provide important ecosystem services, including protection during floods, water storage, groundwater recharge and water filtration.

an important step toward protecting these areas. In addition, steps are being taken to reduce the residual impacts of construction and development on remaining wetlands.

Key indicator

- Environmental Reserve and Natural Area wetlands in Calgary

Policy references

The 2009 Municipal Development Plan includes policies that call for the protection of biodiversity within wetlands and the protection of aquatic habitats through preservation, restoration and the creation of wetland bank sites.

Environmental Reserve Setback Guidelines 2007 establish a 30 m base setback for Wetlands (Class III to VI) and a 6- to 50-metre base setback adjacent to streams and rivers to prevent aquatic pollution.

The 2008 Bow Basin Watershed Management Plan was developed by the Bow Basin Watershed Management Plan Steering Committee and issued several recommendations to protect wetlands and restore wetland health. The plan has had a desired outcome that riparian and wetlands systems are intact, restored, healthy and valued.

The Wetlands Conservation Plan 2004 defines priorities and best practices for wetland protection, identifying planning measures to protect high priority wetlands while still allowing development to occur.

Targets

Calgary Wetland Conservation Plan: The City's target is to ensure no net loss of Calgary Wetlands by promoting their conservation and/or mitigation within areas of future urban development and within transportation and utility corridors.

Trends

The establishment of the Wetland Conservation Plan made Calgary one of the first cities in Canada to define priorities and best practices for wetland conservation. The plan allowed for the consideration of wetlands' environmental significance prior to development within the city – an important step given Calgary's growth and the loss of wetlands from 1999 to 2003. Updated data since the 2006 SOER reporting year are not yet available. However, since the Wetlands policy was implemented, when a wetland loss is approved, it is either relocated onsite or The City is financially compensated to invest in wetland establishment in other areas.

Riparian health

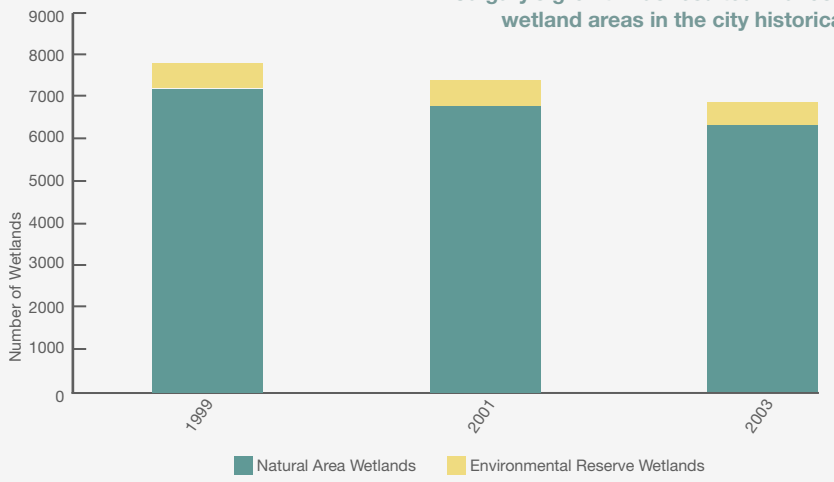
Riparian areas are transitional lands between aquatic ecosystems (rivers, creeks, lakes, wetlands, ponds) and terrestrial ecosystems. They are vitally important to fish and wildlife, water quality, water availability and the long-term sustainability of our watersheds. Over 80 per cent of Alberta's wildlife rely on healthy riparian areas to survive (Fitch, 2003). Urban expansion, road development and recreational usage can all contribute to the degradation of these precious areas.

Trends

In 2009, the Alberta Riparian Habitat Management Society (Cows and Fish) conducted a riparian health inventory for The City of its creeks and rivers within city limits. The inventory assessed publicly owned riparian zones, commercial/industrial owned riparian zones and some private residential riparian zones. The total length inventoried

Figure 3.10 Environmental Reserve and Natural Area wetlands in Calgary

Calgary's growth has resulted in a loss of wetland areas in the city historically.



Source: City of Calgary Parks, 2009

Calgary's Wetland Conservation Plan, approved in 2004, made Calgary one of the first municipalities in Canada to adopt a wetland protection policy that provides procedures for the protection of our priority urban wetlands.

is approximately 30 per cent of the total length of riparian areas along creeks and rivers within Calgary. Cows and Fish looked at various vegetative and physical condition parameters to establish a health score for each riparian area.

The overall riparian health of the Bow River in Calgary was classified as unhealthy (rating of 54 per cent) based on 25 sites (16 unhealthy and nine healthy, but with problems). Bow River riparian areas vary from large relatively undisturbed riparian areas in natural environment parks to confined banks, paved surfaces and historic riparian areas. Calgary's downtown has preserved a narrow strip along the riverbank that remains a functional riparian habitat. However, the total area of native riparian habitat has been significantly compromised in some sites due to confined banks and flood control. Recreational use of the riverbanks has contributed to increased erosion and soil compaction.

The Elbow River, Nose Creek and West Nose Creek had health ratings of 66 per cent (healthy, but with problems; 10 sites), 60 per cent (healthy, but with problems; six sites), and 71 per cent (healthy, but with problems; five sites), respectively. The main concern for Elbow River riparian areas is human disturbance leading to loss of vegetation, increased bare ground and the introduction of invasive plants.

Despite the unhealthy rating for some riparian sites, many still maintain good total canopy cover of trees and shrubs, good regeneration of preferred shrubs and minimal amounts of dead woody material.

Improving riparian health is possible. In 2008, a 200-metre long riparian area along Sandy Beach Natural Environment Park was adopted as part of The City of Calgary Parks' Riverbank Rescue program. This project included restoration work to improve native shrub cover and restore human-caused bank alterations.

TREATED WASTEWATER QUALITY

Background

Calgary's wastewater treatment plants help ensure that the ecological integrity of the Bow River – particularly downstream of our urban centre – is protected from bacteria, chemicals, nutrients and solids. Treated wastewater in Calgary consistently complies with Alberta Environment regulations.

Calgary's significant growth has generated an increase in wastewater flows and loads, requiring additional wastewater treatment capacity to meet the city's long-term needs. The City now owns and operates three municipal wastewater treatment plants. A new plant – the Pine Creek Wastewater Treatment Facility – will help alleviate existing pressures being placed on the two existing facilities (Bonnybrook and Fish Creek).

All three facilities are equipped to handle processes of screening, sedimentation, activated sludge treatment, biological and chemical phosphorus removal, anaerobic digestion and ultraviolet disinfection. The Bonnybrook and Pine Creek facilities also include a biological nutrient process that removes phosphorus and nitrogen by using microorganisms instead of chemicals.

Calgary's wastewater treatment plants are some of the most advanced facilities in the world. The three facilities treated a total of 161,768,233 cubic metres (m^3) of wastewater in 2009.

Per capita wastewater flow has decreased from 497 litres per day in 2000 to 393 litres per day in 2009.

Pine Creek wastewater treatment plant

The finished treated effluent is returned to the Bow River, where it must meet the standards set by provincial operating licences. A new operating licence was issued in 2008 that sets the standard for wastewater treatment in Calgary and works to protect downstream users and river water quality.

Key indicators

- fecal coliform bacteria in treated wastewater
- total phosphorous in treated wastewater
- ammonia (NH_3) nitrogen in treated wastewater
- five-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) in treated wastewater
- total suspended solids (TSS) in treated wastewater

Policy reference

The City's approval to operate the Bonnybrook, Fish Creek and Pine Creek plants was renewed by Alberta Environment in 2008 for a 10-year period. The approval sets concentration limits for contaminants in treated effluent. Under the approval, The City is also required to maintain a Total Loading Management Plan for total suspended solids (TSS) and total phosphorous. A discussion of total loadings for these two substances is included in the river water quality section of this report.

Targets

Regulatory requirements for wastewater effluent are specified under approval by the Province of Alberta. Internal City operating objectives are also used to go beyond regulatory requirements and maximize plant performance.

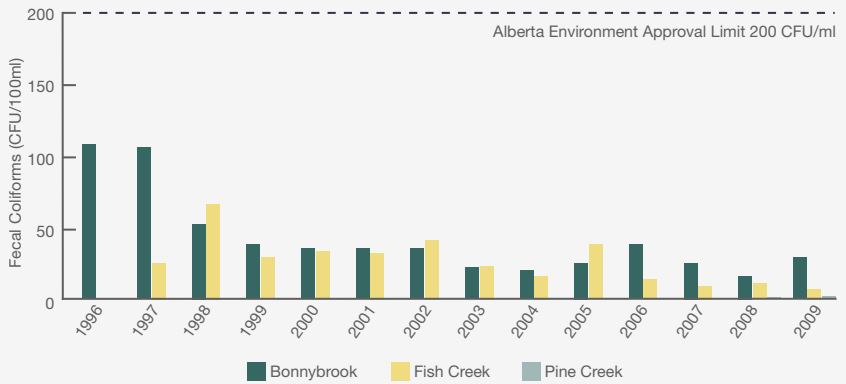
Calgary's new wastewater treatment plant – Pine Creek Wastewater Treatment Centre

The Pine Creek Wastewater Treatment Centre was built to meet the immediate need for additional wastewater treatment capacity for Calgary and surrounding area. The facility will allow for future expansions to include additional treatment capacity.

The Pine Creek facility is located in the southeast quadrant of The City. The liquid stream of the plant was commissioned in October 2008, and the solids stream in November 2009. The facility is currently operating with primary treatment, biological nutrient removal, ultraviolet disinfection, effluent filtration, anaerobic sludge digestion, biogas management and odour control. The effluent quality from Pine Creek has been consistently meeting Alberta Environment targets.

Figure 3.11 Fecal coliform bacteria in treated wastewater

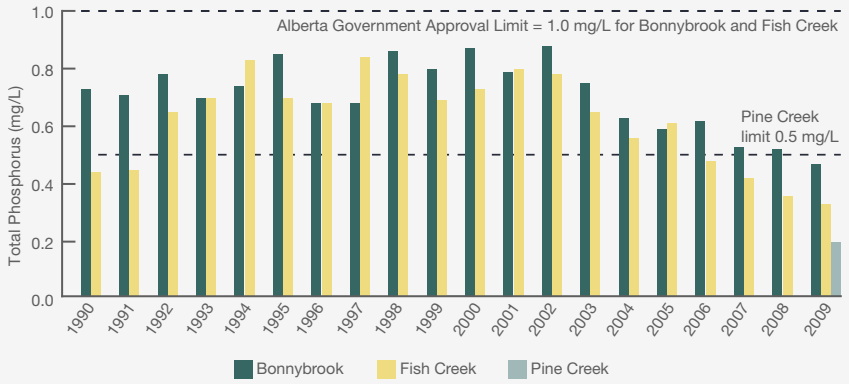
Fecal coliforms levels in treated wastewater effluent are well below the approval limit of 200 CFU/100 mL.



Source: City of Calgary Water Services, 2009. Note: Data from Fish Creek were unavailable before 1997. CFU/100 mL = Colony Forming Units per 100 millilitres.

Figure 3.12 Total phosphorus in treated wastewater

Total phosphorous concentrations in treated effluent from Calgary's wastewater treatment plants are consistently below provincial limits.



Source: City of Calgary, Water Services, 2009.

Trends

Coliform bacteria in treated wastewater

Fecal contamination in treated water can indicate a potential health risk for individuals exposed to this water. Fecal coliform testing identifies several genera of bacteria that can indicate a potential for harmful pathogens to be present.

At Fish Creek, significant improvements have been made, and 2009 marked the lowest levels of fecal coliforms detected since monitoring began.

Phosphorus in treated wastewater

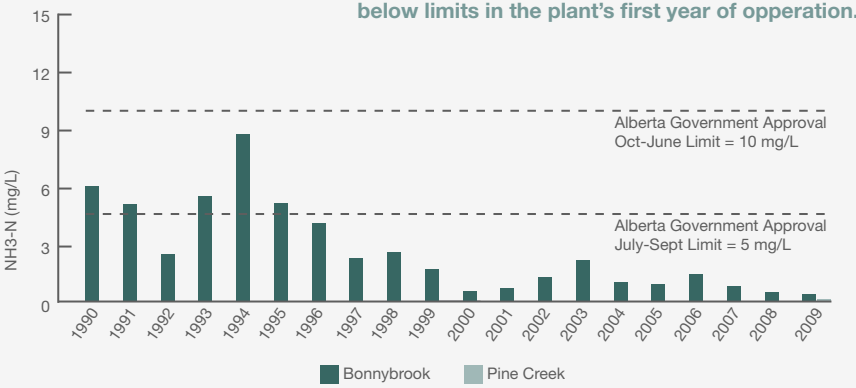
Inadequately treated wastewater can adversely impact receiving waters by contributing to high levels of nutrients, such as phosphorus and nitrogen. Large inputs of phosphorus can lead to eutrophication, which can be fatal to aquatic organisms.

Treated wastewater contributes approximately 82 per cent of total phosphorous (TP) loadings to the Bow River. Since 2002, phosphorus levels in wastewater effluent have dropped dramatically, reaching the lowest recorded levels at both facilities since 1990 in 2009.

The City began adding extra alum at the Bonnybrook Wastewater Treatment Plant to minimize TP discharges in 2004 and has been adding extra alum at the Fish Creek plant since 2007. This practice will continue until effluent filtration can be added at the Bonnybrook plant (City of Calgary, 2008d). Both Bonnybrook and Pine Creek plants are equipped with biological nutrient

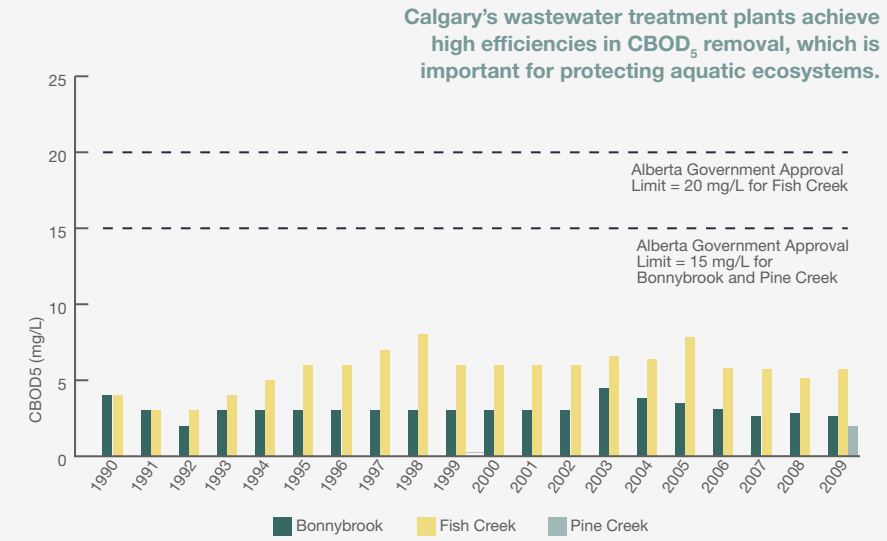
Figure 3.13 Ammonia (NH_3) nitrogen in treated wastewater

Ammonia levels have been consistently below provincial limits at Bonnybrook since the late 1990s. Ammonia levels at Pine Creek were significantly below limits in the plant's first year of opperation.



Source: City of Calgary Water Services, 2009.

Figure 3.14 Five-day carbonaceous biochemical oxygen demand ($CBOD_5$) in treated wastewater



Source: City of Calgary Water Services, 2009.

removal and the Pine Creek facility uses effluent filtration to further decrease phosphorus levels. The Pine Creek plant has the lowest effluent limit for TP ever required by The City (0.5 mg/L).

Ammonia in treated wastewater

Ammonia can be toxic to fish and, as a source of nitrogen, can also contribute to the eutrophication of aquatic water systems. Calgary's wastewater treatment plants contribute about 95 per cent of Calgary's total loadings of ammonia to the Bow River (City of Calgary, 2008d). Bonnybrook and Pine Creek are required by the Alberta government to limit ammonia concentrations in treated wastewater effluent for watershed protection.

Ammonia concentrations have dropped significantly since the mid 1990s. These improvements are credited to the use of advanced nutrient treatment technologies, such as biological nutrient removal (BNR) at the Bonnybrook and Pine Creek facilities.

Organics in treated wastewater

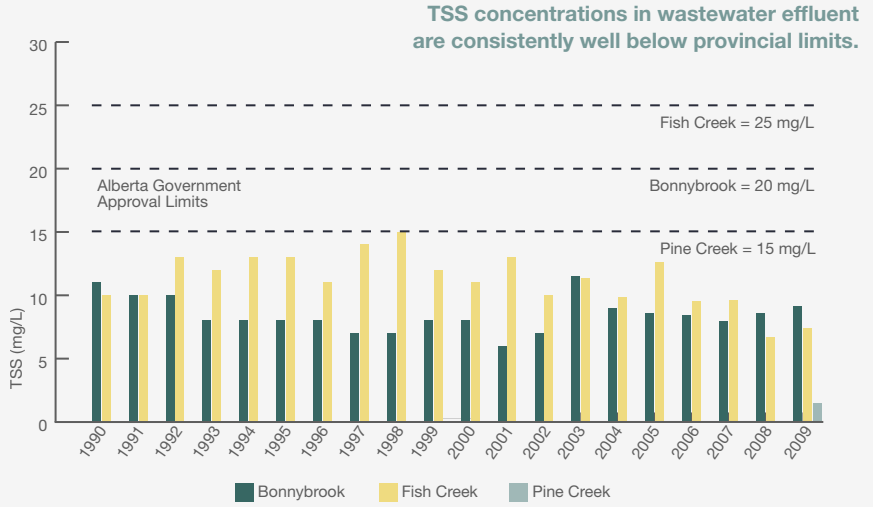
The five-day carbonaceous biochemical oxygen demand ($CBOD_5$) is a measure of the carbon content in treated water that may have an oxygen-depleting effect when released into a river. The major concern relating to $CBOD_5$ in wastewater is the potential for $CBOD_5$, phosphorus and nitrogen nutrient compounds to exert a cumulative depleting effect on in-stream dissolved oxygen levels. Minimizing carbonaceous biochemical oxygen demand is important to help maintain dissolved oxygen levels and protect aquatic life.

Stormwater and wastewater treatment plants contribute approximately 60 and 40 per cent of $CBOD_5$ loadings to the Bow River, respectively. Although the contribution from stormwater was unexpected, total $CBOD_5$ loadings remain a low impact issue (City of Calgary, 2008d). $CBOD_5$ concentrations in wastewater effluent have been significantly below the provincial limits at both the Bonnybrook and Fish Creek plants. The first full year of operations at the Pine Creek plant saw strong treatment performance from the facility, with $CBOD_5$ concentrations far below regulatory limits.

Solids in treated wastewater

Total suspended solids (TSS) are small particles present in treated wastewater effluent. Watershed health is compromised by high concentrations of TSS. High TSS levels in receiving waters can block the penetration of light through water and inhibit the growth of vegetation. These small solids can also settle on the bottom of a lake or river, burying bottom-dwelling organisms, such as fish eggs.

Figure 3.15 Total suspended solids (TSS) in treated wastewater



Source: City of Calgary Water Services, 2009.

References and Appendix

REFERENCES

Chapter 1. Land

Ecological Footprint

Calgary Horticulture Society, Personal Communication, 2010.

Global Footprint Network (GFN), 2009. The Ecological Footprint Atlas 2009. [Accessed at: www.footprintnetwork.org/atlas].

HarGroup Management Consultants, City of Calgary Local Food Questions - A HarGroup Omnibus Survey Report, May 2010

Natural Resources, 2009. Canada Urban Archetypes Project. [Accessed at: http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/eng/buildings_communities/communities/publications/calgary.html]

Statistics Canada, Spending Patterns in Canada 2008, Catalogue No. 62-202-X, Published December 2009, Table 7 p. 46-47

Wackernagel et al. 2006. The Ecological Footprint of cities and regions; Comparing resource availability with resource demand. Environment and Urbanization 18(1): 103–112.

The World Bank, World Development Indicators, vehicle ownership per 1,000 people. [Accessed at: http://data.worldbank.org/indicator/IS.VEH.NVEH.P3]

Built Environment

BOMA BESt. 2010. Certified Buildings in Canada. [Accessed at: http://www.bomabest.com/buildings.html].

Built Green Canada, 2010. Email correspondence

Canada Green Building Council (CaGBC). 2005. Green Buildings in Canada: Overview and Summary of Case Studies. [Accessed at: http://www.cagbc.org/uploads/Green%20Buildings%20in%20Canada.pdf].

Canada Green Building Council (CaGBC). 2009. Excel list of LEED CaGBC projects, Current to September 2010. [Accessed at: http://www.cagbc.org/leed/leed_projects/index.php].

Canadian Urban Institute. December 19, 2008. Energy Mapping Study. [Accessed at: http://www.calgary.ca/docgallery/BU/planning/pdf/plan_it/energy_mapping_study.pdf]

Canadian Urban Institute. 2005. Mapping the Sustainability Supply Chain for Sustainable Building Practices in Canada.

City of Calgary, 2009a. Calgary's Ecological Footprint Baseline Report 2008. [Accessed at: www.calgary.ca/esm].

City of Calgary. 2009b. 2009 census: Calgary keeps growing. [Accessed at: www.calgary.ca/census].

City of Calgary.2010a. Calgary Snapshots 2010. The City of Calgary, Land Use Planning & Policy Planning, Development & Assessment. June 2009. [Accessed at: www.calgary.ca/ planning/landuse].

City of Calgary. 2010b. Suburban Residential Growth 2010-2014: Monitoring Growth and Change Series. The City of Calgary, Land Use Planning & Policy. May 2010

City of Calgary, 2010c. Municipal Development Plan. [Accessed at: http://www.calgary.ca/docgallery/BU/planning/pdf/municipal_development_plan/municipal_development_plan.pdf]

City of Calgary. Calgary Geodemographics data, 2009.

City of Calgary. Calgary Transportation Planning data, 2009

Natural Environment

Alberta Environment, 2010. Fish Creek Park data.

Alberta Environment. 2009. Air, Land, and Strategic Policy Branch. Pesticide data.

City of Calgary. 2009d. Corporate Environment, Health & Safety 2009 Annual Report. [Accessed at: www.calgary.ca/esm]

City of Calgary. Parks data, 2009.

O2 Planning + Design Inc. 2010. 2009 Calgary Annexation Territory Study: Cumulative Effects Assessment. Presented to City of Calgary Parks.

Waste

City of Calgary. 1993-2009. Waste & Recycling Services Annual Reports. [Accessed at: www.calgary.ca/waste]

Conference Board of Canada. 2009. Municipal Waste Generation. [Accessed at: http://www.conferenceboard.ca/HCP/Details/environment/municipal-waste-generation.aspx]

Chapter 2. Air

Air Quality

Alberta Environment (AENV). 2010. Alberta Ambient Air Quality Objectives and Guidelines.

Alberta Environment (AENV). 2009. Air Monitoring Directive Exceedence Report.

Alberta Government. 2010. Alberta's State of the Environment. [Accessed at http://www3.gov.ab.ca/env/soe/index.html]

Calgary Region Airshed Zone (CRAZ) 2009. 2009 Annual Report. [Accessed at www.craz.ca]

Calgary Region Airshed Zone (CRAZ) 2008. CRAZ Particulate Matter and Ozone Management Plan. Stantec Consulting Ltd. [Accessed at www.craz.ca]

Clean Air Strategic Alliance (CASA). 2009 Data Reports. [Accessed at: www.casadata.org]

Ontario Ministry of Environment (MOE). 2009. Air Quality Ontario. [Accessed at: http://www.airqualityontario.com/]

RWDI Consulting Engineers & Scientists. 2006. Building an Air Quality Management Program for The City of Calgary. Phase 1: Assessment.

Climate Change and Energy

Alberta Utilities Board. Historical electricity data to 2009.

ATCO Gas. Revenue Forecast & Analysis Division. Historical data to 2009.

City of Calgary. 2009b. 2009 census: Calgary keeps growing.
[Accessed at: www.calgary.ca/census].

City of Calgary. 2009d. Corporate Environment, Health & Safety: 2009 Annual Report.

City of Calgary. 2006. Calgary Climate Change Action Plan Target Minus 50:
The City of Calgary Corporate and Community Outlook on Climate and Air Quality Protection.
[Accessed at www.calgary.ca/esm.]

City of Calgary, Finance Department. Motor fuel data to 2008.

City of Calgary. Waste & Recycling Services. Greenhouse gas emissions data to 2009.

ENMAX Energy Corporation. Energy Management Office. Historical data to 2008.

United Nations Environment Programme, 2010. Representative GHG Baselines for
Cities and their Respective Countries.
[Accessed at: http://www.unep.org/urban_environment/PDFs/Representative-GHGBaselines.pdf]

United States Forest Service (USFS). 1998. Urban Forests Effects Model: Calgary Study.

Transportation

Alberta Transportation 2010. Number of licensed drivers in Alberta as of March 31, 2006-2010.

City of Calgary Transportation Plan (CTP) 2009. [Accessed at: www.calgary.ca/transportation]

City of Calgary, 2009e. Mobility Monitor. Commuter Cycling in Calgary. September 2009. Issue #34
[Accessed at www.calgary.ca/transportation]

City of Calgary. 2008a. Mobility Monitor. Vehicle ownership and licensed drivers

in Calgary. February 2008 Issue #22. [Accessed at www.calgary.ca/transportation]

City of Calgary. 2008b. Mobility Monitor. Modal split for the trip to work. April 2008
Issue #24. Commuter Cycling in Calgary. [Accessed at www.calgary.ca/transportation]

The City of Calgary. 2008c. Mobility Monitor .Pedestrians, Facilities, and Access. July 2008 Issue #27
[Accessed at www.calgary.ca/transportation]

Calgary Transit data, 2010.

The City of Calgary, Transportation Planning and Parks pathway and bikeway data, 2010.

Steemers, K. 2003. Energy and the city: Density, buildings and transport. Energy and Buildings.
Vol. 35 pp3-15.

Statistics Canada. 2008. Commuting Patterns and Places of Work of Canadians, 2006 Census,
Cat. #97-561. [Accessed at: http://www12.statcan.ca/census-recensement/2006/as-sa/97-561/
pdf/97-561-XIE2006001.pdf]

Chapter 3. Water

Drinking water demand

The City of Calgary. 2005. Water Efficiency Plan. [Accessed at: www.calgary.ca/waterservices]

The City of Calgary. 2011. 2010 Year End Water Efficiency Report. [Accessed at: http://www.calgary.
ca/waterservices]

Water quality of our rivers

Alberta Environment. 1999. Surface Water Quality Guidelines for Use in Alberta.
Government of Alberta.

Alberta Environment. 2009. Water quality data.

Bow River Basin Council, 2008. Bow Basin Watershed Management Plan.
[Accessed at: www.brbc.ab.ca]

Canada Council of Ministers of Environment (CCME). 2003. Canadian Environmental
Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg

Canada Lands Company. 2008. News Release and Backgrounder: Calgary's Currie Barracks First in
Canada to Receive Top Environmental Certification. (October 27, 2008).
[Accessed at http://www.clc.ca/properties/currie-barracks]

City of Calgary. 2009. Water Resources data and map.

City of Calgary. 2008d. Calgary Total Loading Management Plan. The City of Calgary Water Resources.

City of Calgary. 2008e. Environmental Performance Plan. The City of Calgary, Water Resources.

City of Calgary. 2008f. Stormwater Management Strategy Update. The City of Calgary, Water Resources.

Golder 2004a: Bow River Impact Study - Phase 1: Model Development and Calibration (2004 June)
Final report submitted to the City of Calgary by Golder Associates Limited, Calgary, AB

Golder 2007: Bow River Impact Study - Phase 2: Development of Total Loading
Management Targets for The City of Calgary (2007 January) Final report submitted
to the City of Calgary by Golder Associates Limited, Calgary, AB

University of Calgary. 2010. Water quality data. Upstream at Bearspaw.

Wetlands

Alberta Riparian Habitat Management Society (Cows and Fish). February 2009. Prepared for: City of
Calgary Parks and Water Resources. City of Calgary. 2008 Riparian Health Inventory. Interim Report.

City of Calgary. 2009. Parks wetlands data.

Fitch, L., B. Adams and K. O'Shaughnessy. 2003. Caring for the Green Zone:

Riparian Areas and Grazing Management - Third Edition. Lethbridge, Alberta:

Cows and Fish Program. ISBN No. 0-9688541-2-5

Wetlands Alberta. 2009. Wetland Loss.
[Accessed at: www.wetlandsalberta.ca/wetland-loss/]

Treated wastewater quality

City of Calgary – Water Services. 2009. Wastewater Treatment Plants: Historical Data 2008.

Alberta Environment 2008. Approval Number 17531-01-00. Issued to The City of Calgary: Construc-
tion, Operation, and Reclamation of a wastewater system that uses wastewater treatment plants and
serves the City of Calgary.

LAND

2006 SOER Indicators	SOER Targets	imagineCALGARY Targets
Ecological Footprint	Council Priorities 2009-2011 - Council Strategic Goal 2 includes reducing the impact of our activities on our Ecological Footprint.	By 2036, Calgary's Ecological Footprint decreases to below the 2001 Canadian average of 7.25 hectares per capita. By 2036, sustainable urban food production increases to five per cent. By 2036, the consumption of urban- and regionally produced food by Calgarians increases to 30 per cent.
Built environment	The 2009 MDP specifies that new communities in future greenfield areas should achieve a minimum intensity threshold of 60 people and jobs per gross developable hectare and demonstrate how they will achieve 70 people and jobs per gross developable hectare over time (3.6.2).	By 2036, land use efficiency increases by at least 30 per cent, as measured by public transit threshold and increased density. By 2036, we are developing 'complete communities' that include providing daily goods and services within a reasonable walking distance from people's homes. By 2016, we will increase the residential population within walking distance (600m) of LRT stations and major transit notes by 100 per cent. By 2016, we will increase the number of jobs within walking distance (600m) of LRT stations and major transit nodes by 35 per cent.
	No specific community targets have been set for sustainable building construction. The City of Calgary's 2008 Sustainable Building Policy targets include meeting LEED® standards in newly constructed City facilities and major renovations.	By 2036, all new and retrofitted communities, buildings, vehicles, equipment and processes are built to be within five per cent of the highest energy-efficient design available out of all economically competitive products, as measured on a life cycle basis.
Natural environment	The 2009 Municipal Development Plan (MDP) established goals to conserve, protect and restore the natural environment (2.6); connect green infrastructure throughout the urban fabric (2.6.1); and maintain biodiversity and landscape diversity, integrating and connecting ecological networks throughout the city (2.6.4). The 2009 MDP includes a tree canopy target of 14 to 20 per cent over the next 60 years (5.3). Centre City Open Space Plan 2006 aims to ensure that the public realm – streets, squares, plazas, parks and sidewalks - are an essential part of the open space system in the Centre City and that open space should encompass a mix of spaces that fit with the surrounding land uses and needs of the neighbourhood. The City's Open Space Plan 2002 aspires to preserve significant, representative and high-quality natural areas; consider long-term sustainability in open space management; create an integrated open space system; and minimize the impact of urban development on parks and natural ecosystems. A supply standard of providing one tree for every two citizens and tree replacement for dead, dying, diseased, aging, hazardous or tree in conflict with their surroundings	By 2036, native biological diversity increases to healthy levels, as measured through Habitat Suitability Index indices and local key indicator species. By 2036, the number and/or size of protected or restored habitats increases to a state of health and functionality.
Waste and waste diversion	80/20 by 2020 – The City set a target in 2004 to diverted 80 per cent of waste from landfills, with just 20 per cent of waste going to landfills,by the year 2020.	By 2036, 85 per cent of waste generated within Calgary will be diverted from landfills. By 2036, 75 per cent of construction industry waste materials will be recovered for reuse and/or recycling. By 2036, 85 per cent of waste materials can be converted to other useful products. By 2036, increase the number of environmentally sustainable and commercially viable value-added products produced in Calgary by 100 per cent.

Additional information on imagineCALGARY can be found at: http://www.imaginecalgary.ca/

AIR

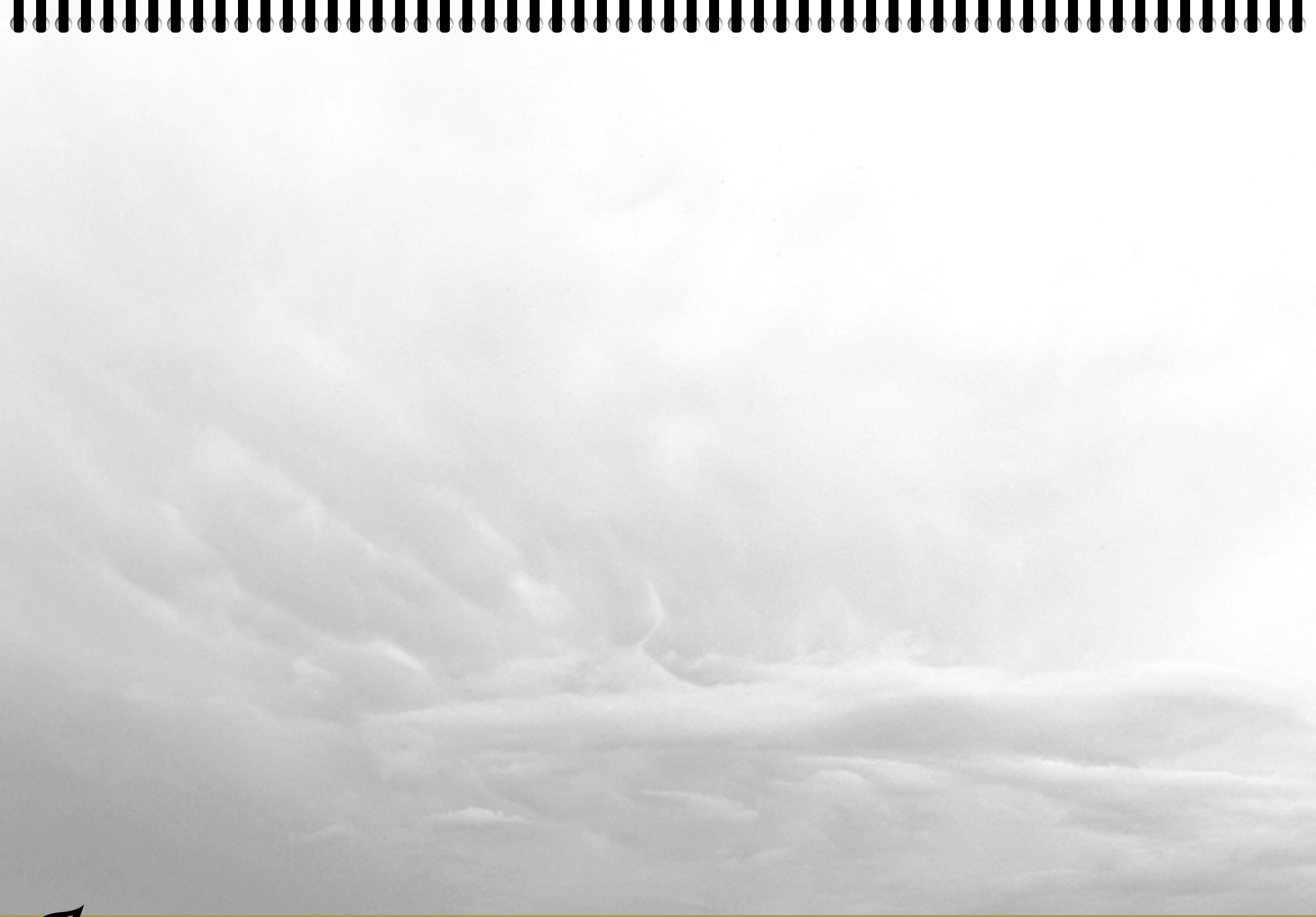
2006 SOER Indicators	SOER Targets	imagineCALGARY Targets
Air quality	Provincial and national limits for ambient concentrations of NO2 and CO have been set for Alberta by Alberta Environment, CASA and Environment Canada. Canada Wide Standards established by the Canadian Council of Ministers of the Environment (CCME) apply to SO2, PM2.5, and O3	By 2036, indoor air contaminants are reduced to zero per cent. By 2012…. criteria air contaminants are significantly reduced.
Climate change	Calgary Climate Change Accord: Reduce municipal GHG emissions by a minimum of 20 per cent by 2020, and by 80 per cent by 2050 compared to 2005 levels. Community GHG targets will be included in the Calgary Community GHG Reduction Plan.	By 2012, total community greenhouse gas emissions are reduced by six per cent from 1990 levels; by 2036, they're reduced by 50 per cent from 1990 levels and criteria air contaminants are also significantly reduced. By 2036, there will be a 50 per cent reduction in pollution (greenhouse gases) from 1990 levels associated with automobiles.
Energy consumption	No specific target set. The Calgary Community GHG Reduction Plan will address energy goals.	By 2036, 30 per cent of Calgary's energy derives from low-impact renewable sources. By 2036, all new and retrofitted communities, buildings, vehicles, equipment and processes are built to be within five per cent of the highest energy-efficient design available out of all economically competitive products, as measured on a life cycle basis. By 2036, the use of low-impact renewable energy increases by 30 per cent as a percentage of total energy use. By 2036, energy consumption is reduced by 30 per cent based on 1999 use.
Transportation	The Calgary Transportation Plan, 2009 established a 60-year target of 3.7 transit service hours per capita annually. The 60-year target for the transportation mode split was established in the Calgary Transportation Plan 2009. • Walking and cycling mode split 20 – 25 per cent • Transit mode split 15 – 20 per cent • Auto mode split 65 – 55 per cent The target of a 60 per cent transit mode split to downtown was introduced in the Centre City Plan.	By 2036, reduce the annual private vehicle kilometres traveled per capita by 20 per cent By 2036, increase the per cent of peak period transit, walking and cycling, and car-pool travel to downtown by 50 per cent, 40 per cent and 20 per cent respectively. By 2036, increase on-street bikeways by 200 per cent and pathways by 100 per cent. By 2036, transit trips per capita increase 40 per cent over 2006 levels. By 2016, we will increase the number of jobs within walking distance (600m) of LRT stations and major transit nodes by 35 per cent. By 2036, all new commercial buildings are designed to encourage the use of alternative forms of transportation (e.g. walking, cycling and transit).

Additional information on imagineCALGARY can be found at: http://www.imaginecalgary.ca/

WATER

2006 SOER Indicators	SOER Targets	imagineCALGARY Targets
Watershed health	Council Priorities 2009-2011: Protect the quality of water in our rivers and streams. • Conduct ongoing water quality testing. • Reduce the amount of runoff and sediment that enters our rivers and streams. The City's Total Loading Management Plan 2008 recommends general principles for managing total loadings of pollutant releases from Calgary to the Bow River. In 2007 Calgary's City Council approved the Nose Creek Watershed Water Management Plan to achieve specific water quality objectives. The Bow Basin Watershed Management Plan and the Elbow River Watershed Management Plan were approved in 2008. The Environmental Reserve Setback Guidelines 2007 require a minimum setback for development of 50 metres from Nose Creek, the Elbow River and the Bow River. Setbacks for developments adjacent to wetlands have been raised from six metres to 30 metres allowing for better protection of these waterbodies. The City's 2005 Stormwater Management Strategy seeks to develop sustainable stormwater management practices.	By 2036, watershed health – as measured by loss of wetlands, water quality, non-compliance with pollution standards, in-stream flow and groundwater levels – improves.
Drinking water demand	Reduce total (residential, business, and municipal) per capita demand to 350 litres per day by the year 2033. Achieve 100 per cent metering of all residential customers by December 31, 2014. Keep peak demand below 950 megalitres through to 2032. Achieve an Infrastructure Leakage Index (ILI) below 3 by following best management practices and through proactive leak monitoring.	By 2036, per capita water consumption is reduced by 40 per cent.
Water quality in our rivers	The City's Total Loading Management Plan 2008 established a total loading objective for Total suspended solids (TSS) of an average value of 52,920 kg/day. The Stormwater Management Strategy aims to: • Reduce sediment loading to the Bow River to or below the 2005 level (36,900 kg/day) by 2015. • Protect watershed health by reducing the rates and volumes of stormwater runoff, controlling sediment loads, and developing sustainable stormwater management solutions for new development areas	By 2036, maintain present rates of flow in the Bow River Basin to maintain aquatic ecosystems at present levels. By 2036, watershed health – as measured by loss of wetlands, water quality, non-compliance with pollution standards, in-stream flow and groundwater levels – improves.
Wetlands	The 2009 MDP includes policies that call for the protection of biodiversity within wetlands and the protection of aquatic habitats through preservation, restoration and creation of wetland bank sites. Environmental Reserve Setback Guidelines 2007 establish a 30 m base setback for Wetlands (Class III to VI) and a 6-50 metre base setback adjacent to streams and rivers to prevent aquatic pollution. The 2008 Bow Basin Watershed Management Plan has a desired outcome that riparian and wetlands systems are intact, restored, healthy, and valued. The Wetlands Conservation Plan 2004 defines priorities and best practices for wetland protection, identifying planning measures to protect high priority wetlands while still allowing development to occur.	By 2036, the number and/or size of protected or restored habitats increases to a state of health and functionality. By 2036, watershed health – as measured by loss of wetlands, water quality, non-compliance with pollution standards, in-stream flow and groundwater levels – improves
Treated wastewater quality	Treated Wastewater Limits are met as per the Government of Alberta Approval to Operate a Wastewater Treatment Plant.	No specific targets

Additional information on imagineCALGARY can be found at: http://www.imaginecalgary.ca/



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