WATER EFFICIENCY
BEST MANAGEMENT PRACTICES – FOREWARD

This publication was prepared by members of the Water Efficiency Committee of the Ontario Water Works Association. It is intended to provide a brief overview of twelve areas of efficient water management and set out the best management practices. Each has a listing of web sites and publications that will provide more in-depth information about the topic.

For more water efficiency information, please visit the Water Efficiency Committee webpage at http://www.owwa.ca/activities/committees.php and click on committee page under the Water Efficiency Committee. For information on how to develop a plan for a water efficiency program, consult the publication developed by the Water Efficiency Committee entitled Water Efficiency: A Guidebook for Small and Medium Sized Municipalities in Canada. This publication is available for a fee of $25 including all taxes from:

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The information contained in this publication comprises current research results available to the OWWA Water Efficiency Committee and is intended as an aid to decision making only. Readers are advised to evaluate the information for themselves and to consult professional resources where appropriate to determine whether the information and techniques are applicable for their municipality. Local factors such as the availability of Municipal resources, current water efficiency initiatives, and costs must be taken into consideration in designing and implementing a water efficiency program.

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BMP #1 METERS FOR ALL WATER USERS

Description
Universal metering is the installation of water meters on the service lines of all water customers. With a fully metered system, all customers are billed based on volume used, which is also referred to as a "user pay" system. Without metering, customers are billed flat rates or not at all for water use. With a flat rate system, users who consume a high amount of water can end up paying the same amount as those who use only a little. An Environment Canada survey indicates that 90%[1] of Ontario residential water systems were fully metered by 2001.

Strategic Significance
The water meter provides the essential tool for both the utility and the consumer to measure and monitor consumption. Metering is critically important in the management of the system as it provides the data needed to assess performance and efficiency, while providing the user with financial motivation for virtually all water efficiency initiatives. Water efficiency and environmental stewardship have been primary drivers for utilities to implement a metering program.

Fairness is an important secondary consideration. Metering means that users pay for only what they use. Low-volume users such as seniors, single person households, and those who are water efficient generally see their water bills decline as they move from the flat rate to a metered rate system.

Water efficiency, environmental stewardship, and equity are all significant reasons for metering. Other benefits to universal metering include:

- Deferring or eliminating major capital expenditures for plant expansion.
- Reducing summer peak demand.
- Ensuring both sustainability and accountability in the production and distribution of the water resource.
- Providing data to trace losses of the saleable commodity in transmission.

The "old" philosophy of keeping water rates low is changing with the introduction of government regulated cost-recovery programs.

[1] 2004 Municipal Water Use Report - Municipal Water Use 2001 Statistics – Environment Canada http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.htm

Implementing advanced meter reading technology also offers a wide variety of *Best Practice* benefits in overall system management. A cost/benefit analysis will assist utilities in determining when to allocate additional funds towards advanced technology. As the monetary and environmental value of this precious resource increases, the value of the meter data will also increase. Investment in automatic meter reading (AMR) technology, such as mobile radio frequency, will allow utilities to efficiently collect and apply the meter data towards maintaining tighter system control, supporting water conservation initiatives and proactively addressing infrastructure related issues, such as "non-revenue water."

Benefits

According to the 2001 Environment Canada study, flat rate customers in Canada use 475 litres of water per capita per day (lpcd) compared to metered customers who use only 272 lpcd - or 43% less. In southern Ontario, in 1996, customers in non-meter communities used 345 lpcd and those in metered communities used 253 lpcd meaning that users in metered communities used 27% less. For the same year comparable figures for northern Ontario are 459 lpcd for non-metered and 291 lpcd for those on meters - a difference of 36%.

Metering also has a special impact reducing peak day water use. One study* completed in a small Ontario community found that peak day water use declined 44% after metering, and wastewater flows declined by 15%. Universal metering has proven to reduce overall water demand between 15% and 30%, with the added benefit of reducing wastewater flows as well.

Cost

Installing residential water meters cost $250 to $400 per connection (on average) - depending on system size, reading technology selected, and whether or not backflow preventers are installed. Residential meters will last 15 to 20 years depending on usage and water quality.

Information Sources

- "Establishing a Metering Plan to Account for Water Use and Loss," Infraguide Best Management Practice, www.infraguide.ca
- "Water Meters - Selection, Installation, Testing and Maintenance," AWWA M6 Manual, 4th edition, 1999, www.awwa.org
- "2004 Municipal Water Use Report – Municipal Water Use 2001 Statistics," EnvironmentCanada, http://www.ec.gc.ca/water/en/info/pubs/sss/e_mun2001.htm
- "Meters Made Easy: A Guide to the Economic Appraisal of Alternative Metering Investment Strategies," CWWA, www.cwwa.ca

* Articles: "Do Water Meters Improve Water Efficiency", Pipeline, Sharratt Water Management, December 2000, www.owwa.com "Capital Expenditures Savings Resulting from a Water Conservation Program in a Small Ontario Community," and a paper presented at the American Water Works Association Conserve 99 Conference in Monterey California, February 2, 1999.

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BMP # 2. FULL COST PRICING

Description

Full cost pricing has two components - costs and pricing. For water and sewage systems full cost pricing could be defined as: the generation of sufficient revenues through appropriate *pricing* of the services to pay the *full cost* of water and sewage systems including operating, maintenance and administration (OM&A) expenditures and capital investments in facilities at a level sufficient to maintain acceptable or mandated service conditions and meet quality standards in a sustainable manner.

A. Costs and associated cost recovery methods

Cost Categories	Examples	Revenue Sources
Operations Maintenance and Administration	Operations and maintenance costs including labour, power, materials, billing & collecting etc., and administration directly related to operating the utility	User rates
Capital	Outstanding deficiencies and upgrades	User rates
	Replacement (ongoing to replace worn out facilities)	User rates
	Growth (system expansion to serve new customers)	Capital charges Provision by subdivider User rates
Municipal Overhead	Not directly related to utility, but could be shared by utility such as municipal management functions.	User rates
External	Where no actual service provided by utility; imposed by others (i.e. resource charges or source protection levy)	Not currently levied.

As systems age the cost of replacing infrastructure will grow. A forward-looking plan is needed if sufficient funding to meet this need is to be achieved. Government regulations to enhance water quality assurance, such as wellhead protection and other multi-barrier approaches will add costs not historically incurred.

Central to the establishment of full costs is the identification and funding of the investment levels needed to keep systems sustainable. Other investments for growth and upgrades to meet mandated standards also must be met. Life cycle investment analysis of maintenance programs, rehabilitation options and capital investments over the life of an asset can be used to optimize financial resources.

B. Pricing Options

Rate Component	Description	Comment
Two-part rates	Includes fixed & volumetric charges	Best practice
Fixed charge of two part rate	Usually covers billing, metering, customer service & possibly fire protection	Best practice
Single block rate	One rate for all consumption	Simple & applicable where there is no reason for more complex rates
Increasing block rates	Rate increase as consumption increases	Good for targeting individual high volume residential users
Decreasing block rates	Rates decrease as consumption decreases	Used to allocate peak demand costs to all residential users and decreased rates for large ICI users
Humpback rate	Rates first increase, then decrease with increasing usage	Combines increased charges for individual large residential users with decreasing rates for large ICI users
Excess use rate	Charge a higher rate for consumption exceeding a certain threshold (could be system wide or related to individual customer history)	Targets increased usage during the summer
Seasonal rate	Charge a higher rate for all usage during a defined period	Targets all usage during period
Fire protection charge	Water system fire protection costs are usually either charged in property taxes or part of fixed charges including service charges to all customers & fire line charges	Costs can be significant and are not related to volume used. Advantage of property tax is charge is related to property value. Advantage of fixed charge is keeping all costs in water rates.
Flat rate	A fixed charge where customer is not metered. Can vary based on other characteristics such as lot area and number of fixtures	Metering is best practice. Flat rates do not promote efficient water use and are not based on user pay.

Rate Component	Description	Comment
Sewage surcharge	Either a percentage mark-up on water bill or a separate sewage rate using customer water consumption	Separate sewer rate preferred for fairness, but simplicity of straight surcharge an advantage for billing purposes.

The best approach will depend on the local situation. The *Best Practice* is to try to achieve fairness through user pay. Other factors such as promoting conservation or targeting specific usage sectors can affect the method adopted.

Financing alternatives can be used to massage the timing of when funds are generated such as paying from current funds, debentures, or reserve funds.

Strategic Significance
Full cost pricing is essential for ensuring that sufficient funds are available to finance the investments needed to keep water and sewage systems sustainable now and in the future.

The full cost of achieving this goal must be identified in order that those with the responsibility for authorizing the needed investments (typically municipal councils) will be aware of the funding required and will authorize not only the needed expenditures, but also the recovery of the needed funds through appropriate pricing levels.

Full Cost Pricing is moving from a concept towards a requirement in Ontario with the passage of Bill 175 (note 2). Regulations under the Act are pending. However, in the interests of *Best Practice*, many municipalities are adopting policies aimed at funding water systems at sustainable levels.

Benefits
The obvious benefit of the measure is that utilities will have the resources to invest in systems to ensure that quality standards are met and customers are provided with acceptable levels of service continuously. Where customers are metered, another benefit of full cost pricing is customers will be encouraged to conserve water. This conservation should have a beneficial affect on water and sewage systems by allowing more customers to be served by existing facilities, reducing expansion costs over the long term and spreading existing costs over a larger number of customers.

Costs
As systems age the need for investment will also increase. Typically this will be passed on to customers through user rates. User rates are expected to increase significantly as full cost recovery is achieved.

Affordability is a growing public issue. This is especially true for smaller systems which typically have higher rates with many now charging more than $1,000 annually for water and sewage (combined) to average single family dwellings. Affordability will increasingly become a problem in such systems, particularly for those on fixed incomes. User rates have gained importance in recovering water and sewage system costs, growing from 75% in 1989 to 88% in 1999 in Ontario (note 1). The increase primarily reflects less water revenue from property taxes.

There are two approaches to establishing the required annual investment levels to achieve this. An accounting approach to defining the necessary investment level involves tracking historic capital costs and calculating depreciation. A more needs-oriented approach to determine the funding level required to preserve assets at a sustainable level uses an infrastructure management system that includes an up-to-date inventory assessment, Life-cycle costing is a complex financial planning process that aims to identify the most efficient investment approach by trying to minimize operating, maintenance and capital costs over the life of an asset.

Information Sources

1) Financing Water Infrastructure, Walkerton Inquiry, Commissioned Paper 16, Table 3-1. The figures cover the revenue fund and exclude growth-related costs and development charges revenues. CD ROM of commissioned papers available from Publications Ontario (http://www.gov.on.ca/mbs/english/publications/)
2) Sustainable Water and Sewage Systems Act, 2002 - Full cost recovery is required and defined in Section 3 (7) http://www.e-laws.gov.on.ca
3) A Water and Sewage Systems Full Cost Recovery *Best Practices* guide is pending from Infraguide http://www.infraguide.ca
4) "Municipal Water & Wastewater Rate Manual," CWWA, http://www.cwwa.ca
5) "Principles of Water Rates, Fees, and Charges" (M1) and "Developing Rates for Small Systems" (M54), AWWA, www.awwa.org and look in the bookstore
6) "Water Rates in Ontario, Principles & Practices – A Manual for Developing Water Rates," OMWA/OWWA www.owwa.com

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BMP # 3. PUBLIC INFORMATION AND EDUCATION PROGRAMS

Description
Public outreach and education is crucial to the success of any water efficiency program. An educated consumer is the best ally in support of your programs.- that means understanding the “why’s and how’s” of choices with regards to water efficiency.

There are many ways to engage the public in your program. Some suggestions include: direct contact (door to door), public forums (local events such as fall fairs and home and trade shows), drinking water reports to users via mail or web site, calendars, newspaper ads, mobile signs, media release and offering education programs to the school board, board of trade or other public interest groups. Before beginning a program it is best to identify your target audience, develop your key messages, and determine your communication needs.

Many citizens do not realize that water is a precious resource, and it must be protected. They also do not realize that water requires treatment before it is delivered to their homes. There is also the misconception that water utilities can provide boundless water supplies and the mistaken belief that because there is a lake or aquifer in the community the water should just appear at their tap. Thus a public information program should educate the public about:

- the source of drinking water
- source protection
- water treatment procedures
- quality assurance including laboratory testing
- safety of drinking water (public health aspect)
- the link between water quality and wastewater treatment, including storm sewers and the proper disposal of hazardous wastes (all pipes lead to the lakes, rivers etc).

The program should encourage users to become more water efficient with links to

- water quality
- water quantity
- cost savings to the consumer and the utility,
- the possibility of the deferral of infrastructure expansions
- practical advice on ways to reduce water use and to use water more efficiently

Strategic Significance
An educated consumer is the best ally in support of a water efficiency program and therefore more likely to actively participate**.** If the consumer understands the intricacies of water treatment and delivery, and the vulnerability of the drinking water sources to depletion or contamination, they will appreciate conservation measures.

Benefits
Though it is difficult to attribute measurable water saving to a public information/education program, it does provide a framework for public acceptance and participation in subsequent programs. A public information/education program is an excellent means of maintaining contact with users and building support for future utility initiatives including water efficiency programs. It also educates consumers on what the utility does for consumers and allows them to understand changes in the water rates and why metering is important. As well, education programs will at reduce public complaints during water restrictions or bans. Basically it provides consumers the background necessary to understand why water is important.

We must remember before 1984 no one really recycled. A strong education campaign motivated people through the understanding of the "waste stream" of why it is important to the environment to participate. The program evoked an environmental consciousness - the same must be done for our water. We must tell the whole story of water not just how to conserve.

Sources of Information
Educational support materials can be obtained from various municipalities. Halton Region offers facility tours on an ad hoc basis. Peel Region offers an education program to grades 2 and 8 and is involved in school classroom presentations and facility tours. Staff also attends public events to disseminate information to consumers.
The City of Toronto has an Information Officer that attends malls and public events to disseminate information.

Ontario Clean Water Agency www.ocwa.com/information.asp?mode=main,
Environment Canada http://www.ec.gc.ca/water/
Peel Region www.peelregion.ca,
York Region http://www.waterfortomorrow.com/,
Waterloo Region
www.region.waterloo.on.ca/web/Region.nsf/0/e6533ab22c888ab385256b0300596181?OpenDocument,
Halton Region
www.region.halton.on.ca/ppw/water/WaterEfficiency/water_efficency.htm,
City of Hamilton www.hamilton.ca/public-works/water/Water-Distribution-Wastewater/Wise-Water-Use/default.asp,
City of Toronto www.toronto.ca/watereff
Ottawa www.ottawa.ca/city_services/water/efficiency/index_en.shtml
Peterborough http://www.greenup.on.ca/index.php?option=content&task=view&id=32

Free brochures on water efficiency can be obtained through Environment Canada at http://www.ec.gc.ca/water/.

Costs
Staff Time – dependent on number of events
Brochures – Budget a minimum of $5,000 for printed material for year of events. Give-aways such as pens do attract people but should not be the sole reason they visit your display or kiosk.
Display – Budget $5000 approx., depending on features included. An effective display can be created with simple poster boards at a cost of only a few hundred dollars.

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BMP # 4 SCHOOL PROGRAMS

Description
Several municipalities offer educational programs for school-aged children. For example, the Region of Peel offers an educational enrichment opportunity for grade 2 and 8 classes that includes a staff member attending the classrooms and providing a water-based program that complements the Ontario curriculum. The visits are solicited in the fall months by direct mail to the schools, with appointments booked on a "first-come first-serve" basis and limited to two days per week to accommodate staffing.

In the Ontario curriculum, water concepts are covered in all grades; however, connections are strongest in the elementary grades of 2 to 8. (Waterloo, York and Peel Regions have formal curriculum-based educational materials for schools).

Classroom programs should educate the students about:

- the source(s) of their drinking water
- protecting the source
- water treatment processes
- quality assurance including laboratory testing
- the safety of drinking water (public health aspect);
- the link between water quantity and water quality, wastewater treatment, storme sewers and the proper disposal of hazardous waste
- water efficiency and conservation

The program can be enhanced with guided visits to a water or wastewater treatment facility or hosting a Children's Water Festival which brings together different parties with a stake in water education (e.g. water service providers, teachers, Conservation Authorities, local environmental groups, private individuals, etc) The Water Festival is designed as an outdoors, educational, hands-on learning event that provides students with an entertaining look at the importance of water.

There are currently more than 10 Water Festivals in the province of Ontario. For more information on how to start a Water Festival, visit the Children's Water Education Council web site at: www.cwec.ca/eng/Festivals/HowToStart.asp. The Regions of York, Waterloo, Durham, and Peel - to name a few - hold Water Festivals each year. The Region of Peel's Water Festival has over 50 interactive centres in which students in Grades 2 -5 have the opportunity to learn about:

- the physical properties of water
- Peel's water treatment and distribution systems
- surface water and groundwater as natural resources
- the interactions between people and water and its effects on the environment
- source water and environmental protection
- environmental stewardship

- waste disposal alternatives

The Peel Children's Water Festival is also home to the Peel EcoFair, a new annual event with the purpose of showcasing, motivating, and celebrating community action projects initiated by youth from Peel's schools and community groups. These projects demonstrate a benefit to Peel's watersheds. For more information on the EcoFair, visit www.peelregion.ca/news/events/waterfestival/ecofair/index.htm

Strategic Significance

A school education program is an excellent means of maintaining contact with water users and building support for future utility initiatives, including water efficiency programs. The school program will reach families through the children and fits within the context of science and technology and social studies curricula. It also has the distinction of complementing the Ontario school curriculum in grades 2 and 8. Support materials consistent with provincial curriculum requirements need to be developed if there is any hope of them being adopted by the school board. It is necessary to work directly with teachers in the development and in-class testing of a program prior to roll-out. It is also important to establish a rapport with the school board to add value to your outreach program.

Water Festivals are a great education tool and allow you to reach many children (and adults) at one time. They are best organized through a joint effort of the municipality, the conservation authority, teachers and other partners. Although the Water Festival is tailored to school age children you do reach many parents through school chaperone requirements. Also, a day or evening for the public is a great way to invite the community to your event.

Benefits

Reaching children at an impressionable age is very important as you can affect their thinking as adults. Also children put pressure on parents once they understand the importance of the issues at hand i.e. water efficiency in the home. (AWWA attributes a water savings of 4% to public education) In general, educational programs in schools are an ideal tool to reach reaching water users and build support for water efficiency programs.

Information Sources

Peel Region www.watersmartpeel.ca
York Region http://www.waterfortomorrow.com/,
Waterloo Region www.region.waterloo.on.ca/water
Ontario Curriculum Centre www.curriculum.org

Giveaways can be effective but also can add significantly to the cost. Models, props and posters can be used to enhance the program but also come with a cost.

Costs

This program can be run on a very small budget with one staff member occasionally visiting schools or providing tours, or it can become a fairly significant budget item when involving Water Festivals, curriculum development etc. Funding can be attached to the utility budget or through a public/private partnership where the festival and outreach programs are run by non-governmental organizations such as green city groups that may or may not be privately funded. Financial assistance can also be sought through the Trillium Foundation, TD Friends of the Environment, Shell, local businesses etc.

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BMP # 5 COMPILE A WATER-USE DATABASE

Description

A water-use database stores water supply information and customer data including consumption and number of customers. The data is stored as it is generated and is available for future systems analysis. Additional water use data is often collected and catalogued for day-to-day operations.

The data can be useful for many purposes, including:

- Determining where, how and by whom water is being used as an aid to the development and assessment of water efficiency programs
- Determining non-revenue water (NRW) so that programs to reduce water waste can be targeted
- Projecting demands to determine future system needs
- Tracking actual revenues versus budget
- Developing user rates
- Calculating impact of user rates
- Benchmarking

The table below provides a list of water supply and consumption information that typically might be recorded and stored for later analysis:

Parameter	Calculated Value	Use
Supply (from flow meters and totalizers on production works)		
Daily production	- Annual pumpage - Average day usage - With max day and max hour to calculate peaking factors	- With annual consumption used to calculate % non-revenue water (NRW) - Analysis of seasonal use - Projecting demand
Maximum day of year	Selected from daily production records	- Identify supply capacity requirement - Compare max day to average day requirement, compare to benchmark
Maximum hour on max day	Analyze hourly supply records adjusted by changes in reservoir levels to arrive at max hour	- Mains designed for greater of max hour or fire demands - Storage includes volume needed to meet max

Parameter	Calculated Value	Use
	demand	demand period in excess of production
Consumption – including related number of customers and units billed (from metered customer billing records totalized for each billing period)		
Total consumption	From detailed data	Calculate % NRW
By customer class including: - Residential (if possible separate by type such as single family dwelling, duplex, row housing, apartments) - Industrial - Commercial - Institutional - Other	- Breakdown of usage by class - Consumption per unit for different residential development types - Information reported by billing period would be summarized monthly and annually	- Calculate rates by block - Calculate consumption revenues - Analyze consumption trends for future projections that can be used for system design, revenue trends and impact of conservation programs
Usage by largest customers	Annual usage by top 10 customers (number depends on types of large customers and municipality size)	- Assessment of need for rate blocks - Impact of rate changes on customer - Projecting demand
Usage profile for residential customers i.e. how much usage falls into different consumption ranges	Percent of consumption and bills that fall into a suitable breakdown of consumption ranges	- Determining need for and limits of volumetric rate blocks - Determining proportion of customers that are impacted in different amounts when rate format changes. - Determining “typical”, small and large customer usage values

The information is entered in a spreadsheet database on an annual basis. Although individual municipalities may have specific needs, all systems need a certain amount of historical data. The format should provide the basic raw information for most applications. For example, by recording daily supply volumes, sequential day demands can be analyzed to determine local emergency storage needs where the supply source is remote. The list can be modified and information categories added with experience.

The water use information is best compiled on a regular basis, in a suitable format, as it becomes available, because later it can be difficult or impossible to obtain, either because it was not generated in a usable format or because the records are lost or impractical to access.

Strategic Significance
Information on historical water usage is useful in many ways as noted in the table above, including:

- projecting future demand
- establishing system capacity requirements for sizing facilities
- projecting revenues
- setting metered water rates
- analyzing system performance (benchmarking) such as the calculation of UFW
- identifying opportunities for undertaking water efficiency programs.

Good water usage data is an essential element in managing water systems so that sound decisions can be made on the effectiveness of current programs, on future investments, identifying areas where improvements can be made and projecting financial needs.

Expected Savings
Probably the most fertile area for savings would be the ability to adjust future capital investment levels to account for changes in actual water demand trends. For example, the impact of water conservation measures on demand can only be established if changes in historical consumption patterns can be tracked. Reduced demand per customer would free up capacity for development and delay the need for investment in system expansion.

Costs
There are costs, although they are likely less than the cost of generating needed usage data from stored raw data at a later date. The costs include the installation of appropriate flow metering and totalizer equipment on supply lines (now common) and computer programming of billing systems to summarize the data at the end of billing periods. Some staff time is also needed to maintain the water use database which could vary from a few days a year in small systems to perhaps a few weeks a year for an analyst in large systems.

Sources of Information

- Water Efficiency Guidebook for Small and Medium Sized Utilities – Available from OWWA – 905-530-2200 – Price $25
- Infraguide Best Practice – Developing Indicators & Benchmarks – www.infraguide.ca
- Generation and Utilization of Water System Data for System Management and Planning – Loudon & Struthers – OWWA Seminar Instrumentation and Control in Water Supply – November 1986

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BMP # 6 WATER LOSS MANAGEMENT

Description
A utility receives its revenue from a combination of billed metered, and billed non-metered customers. These revenues are termed Revenue Water.

Water losses in the past were commonly referred to as “Unaccounted For Water” (UFW). A more updated term is “Non-Revenue Water” (NRW). However, there is a whole range of types of NRW that could be significant for each individual supplier of water. Environment Canada’s 2004 Municipal Water Use Report (2001 statistics) found that system water losses averaged 13%, and varied from 6% to 25% across Canada.

The Non-Revenue Water can be divided into:

A. Unbilled Authorized Consumption
- Fire fighting
- Flushing of mains and sewers
- Cleaning storage tanks
- Filling water tankers
- Water taken from hydrants
- Street cleaning
- Parks irrigation
- Public fountains
- Frost protection
- Building water

B. Apparent Losses
- Unauthorized consumption
  - -Theft from hydrants
  - -Illegal connections
- Metering inaccuracies
  - -System input meters
  - -Under/over registration of customer meters
  - -Accounting procedure errors

C. Real Losses
- Leakage on distribution and transmission mains
- Leakage and overflows at storage tanks
- Leakage on service connections up to the point of customer metering

As water utilities become larger, and more complex with amalgamations, there is added potential for increases in Unbilled Authorized Consumption and Apparent Losses. Furthermore, as water systems become older there is normally an increase in Real Losses of water from main breaks and service leaks.

Management of this water loss should now be part of every utilities normal method of working. The best approach involves completing a water audit and balance, to identify and quantify all areas of revenue and non-revenue water. This helps to focus on the most cost effective techniques for each individual water system. The most current water balance technique being used in North America is the AWWA/International Water Association (IWA) Water Loss Control methodology.

Normally, Real Losses form a key part of water loss management. Real Losses reduction programs can include the following four areas:

- Active leak detection
- Speed and quality of repairs
- Pressure management
- Pipeline and asset management

Strategic Significance

Non-Revenue Water can have a significant impact on the budgets of utilities. Operating budgets can directly be reduced, as Apparent Losses are accounted for. Capital budgets can be affected, in the medium to longer term, as Real Losses of water are found and eliminated. Capital improvements can either be deferred for a period, or kept on program for increased water supply capacity, and future growth.

Reducing infiltration into the sewer system from Real Losses of water can also have a positive effect on wastewater treatment quality and capacity

Benefits

The traditional approach of giving percentages of "Unaccounted For Water" is being moved away from. A number of performance indicators are now recommended to establish the relative levels of NRW, and hence potential savings. However, it is reasonable to assume that most utilities will have NRW that is economical to find and eliminate. Furthermore, reducing NRW is normally extremely cost effective, when compared with other water efficiency measures.

Cost

The cost of the measure will vary according to the size and complexity of the water system. Implementation will require the involvement of several key utility departments – operations, billing, engineering, and more. The tasks will involve the initial water audit and balance, followed by measures to identify and eliminate the NRW. The process will then be repeated, with feedback of results into the balance, and then further actions on NRW. This process will continue for the life of the water system.

Information Sources

The AWWA is currently in the process of re-writing the Water Audits and Leak Detection Manual (M36). The new manual will incorporate the AWWA/IWA Water Loss Control methodology. The AWWA's Water Loss Control Committee is responsible for this work, and it is anticipated the new manual will be available in 2006. Reference web sites are:
www.awwa.org/Sections/committee go to Technical & Education Council – Water Loss Control
www.leakage2005.com
www.iwahq.org
www.infraguide.ca go to Best Practices / Potable Water / Published Best Practices

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BMP # 7 DEVELOPING A WATER EFFICIENCY PROGRAM/PLAN

Description

A water efficiency plan is built around a set of coherent water efficiency initiatives that will achieve a quantifiable goal such as a 10% reduction in water use over a specified time period. The goal is usually established to deal with a specific water problem; for example, increasing population leading to water use outstripping available supply, a summer drought or wastewater plant by-passes. A water efficiency plan is supported by a water efficiency program that sets out a number of cost effective actions involving a range of participants including municipal staff, the media, teachers, plumbers, nurseries and others to achieve the water efficiency goal.

Strategic Significance

A water efficiency plan does not save water by itself but instead sets a goal, time-frame and budget that will address a municipality's water or wastewater problem. A plan is used to identify the most cost effective program of initiatives for reaching the goal. The principal steps to developing a successful water efficiency plan are as follows:

- Determine current water use/wastewater flows – assess system capacity, current demand, current max day to average day ratios, plant overloads and other pertinent data (See note #5 on this website that discusses the creation of a water system database)
- Forecast future water use – project the water use and wastewater flow generation based on implications of new housing, new commercial/industrial, existing housing not yet connected.
- Define the problem – When does demand/flow equal or exceed available system treatment capacity. How frequently does it happen? System capacity should not be less than demand and expansion should take place while there is still a margin available. Projections should be constantly up-dated and appropriate action taken when the threshold is approaching.
- Define the goal – what amount of water use/wastewater flow reduction is required? The amount of reduction is geared to dealing with the problem faced by the utility. It may be one of holding total water use constant by reducing usage by existing customers while accommodating projected growth, or it may be a reduction of water or wastewater use by 10 or 15% over a specified period of time to avoid water shortages, water use restrictions or to cut costs. The amount saved and the timing depends on the utility's needs.
- Identify measures for achieving the goal - A wide range of tried and true measures are available for reducing water use and wastewater flows. It is critical to match the measures to the problem and identify those most cost effective.
- Evaluate the measures – Measures should be chosen that are practical, easy to apply and meet the selected goal at minimum cost. If a municipality is considering a new water or wastewater plant, least-cost water efficiency measures (based on per cubic metre of water/wastewater treatment capacity)

should be considered before the plant is built. Measures aimed at reducing environmental pressures or assisting in maintaining the water table should be assessed on their own merits. Each measure should be evaluated on a cost/benefit basis as well as ease of implementation, time to implement and public reaction. Several benefits should be considered including value of water saved, value of wastewater reduction achieved, operating cost savings such as chemicals and energy, including the energy saving to the end user, as well as more general societal benefits such as the reduction of greenhouse gases. .

- Develop alternative approaches. Cluster the most promising measures into different plans - minimum, moderate and maximum - in terms of water savings. Cost each.
- Arrange for public input at various stages in the plan development and seek necessary approvals
- Implement the selected approach
- Monitor progress towards goal and make changes if necessary

Benefits

The principal benefits of developing and successfully implementing a water efficiency plan are the saving of time and money through focussed action. A plan provides a degree of assurance that measures undertaken will lead to the achievement of the goal in the most efficient manner. It provides an understandable framework for discussion between the water efficiency planner, council members and the public.

Some practitioners try to save money and time by copying another municipality's water efficiency plan which can be appropriate if the situation and water problem are the same. In most cases, the situations and problems vary and there is no guarantee that the municipality being copied has got it right in the first place. In addition, if a practitioner does not prepare a clearly articulated plan, there is a risk that it will not have a long run destination. Residents and council members will be suggesting priority measures and the water efficiency planner will have no way of deciding which is more appropriate than another.

The development of a clearly articulated water efficiency plan deals with this by providing a focus and rationale for the plan components and by setting out the overall benefits including deferral of the need to build water and wastewater infrastructure, energy savings and reduction in carbon dioxide.

Cost

The costs of preparing a plan vary widely but are very small in relation to the cost of implementing a water efficiency program. Some utilities choose to prepare plans internally meaning that 3-6 months of staff time will be required. Others retain consultants. The cost of the program that emerges from the plan will depend on its objectives and contents.

Information Sources

Key Sources of information for a practitioner compiling a water efficiency plan include the following:

- Water Efficiency Guidebook for Small and Medium Sized Utilities, Ontario Water Works Assn. (OWWA) - $25 – Contact OWWA at 905 530 2200.

- Handbook of Water Use and Conservation by Amy Vickers, published by the AWWA and available in the AWWA bookstore through www.awwa.org.
- Environment Canada at www.ec.gc.ca/water/en/manage/effic
- Canada Mortgage and Housing Corporation at www.cmhc-schl.gc.ca/en/imquaf/himu/wacon.
- Water efficiency information can be found at www.awwa.org/waterwiser. An AWWA Water Conservation Manual is expected to be published by AWWA in early 2006 and will be available through the AWWA website when published.
- Environmental Protection Agency Water Conservation Plan Guidelines, August 1998, US EPA, Office of Water, Washington, D.C. 20460. Publication # EPA-832-D-98-001. See the EPA website for other water conservation information at www.epa.gov/seahome/watcon.html.
- Municipal water efficiency plans can be seen at: www.toronto.ca/wateff, www.region.peel.on.ca/watersmartpeel and by entering water efficiency in the search feature of the following web sites, www.region.york.on.ca/. www.region.waterloo.on.ca. and www.region.durham.on.ca.

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BMP # 8 IMPLEMENTING A UTILITY / MUNCIPAL WATER EFFICIENCY PROGRAM

Description
In order to garner public support for a Water Efficiency Program the utility/municipality or government agency needs to get its own house in order with respect to efficient toilets, faucets, fountains etc. With this is mind, any Water Efficiency Plan should include measures aimed at reducing water use and wastewater flows in the facilities owned by the utility and the host municipality i.e. swimming pools, parks, municipal gardens, municipal garages and municipal office buildings, public housing etc. This not only shows a commitment to the plan but also makes water efficiency more visible to the municipal employees.

A key factor in the success of the plan is the need to secure senior management support within the municipality, including a directive promoting water efficiency from senior management to all departments. This measure should include information gathering, auditing and ensuring the metering of all municipal and public buildings as well as seasonal installations for parks and landscaping (see landscaping below for further information). An audit of facilities should be made to determine what are the best options for achieving water savings, and a cost/benefit analysis should be completed prior to developing plans for implementation and monitoring.

Auditing is the physical assessment of all water usage in a building. It includes gathering information on construction dates, whether fixtures have been updated, how many fixtures exist in each building (toilets, sinks, showers) and may include other items such as washing machines, water-cooled equipment and air conditioning units. The audit should include whether the buildings are landscaped and if that landscaping is automatically watered through a sprinkler system including frequency and duration of watering. Site visits will be required to verify that information is accurate and up to date.

Once the information on each facility is gathered a spreadsheet can be created prioritizing the buildings by age, number and type of fixtures to be replaced, and number of tenants and/or public access. **Note: Any construction prior to January 1, 1996 will not have water efficient fixtures.**

Next you must assess water use which can easily be done by metering or tracking the monthly water bills. Metering a building through a data logger allows you to develop a water use pattern that can also allow you to assess possible leakage in the building. This is done by establishing a base night water use i.e. establishing how much water is expected to be used between 2 a.m. and 4a.m. in the building then subtracting it from the water measured (see case study for more detail) This is leakage.

From the information gathered a plan of action can be established. You will need to budget or allocate funds to replace inefficient fixtures (These are municipal buildings –

this is about getting your own house in order!) Toilets, showerheads and faucet aerators are the primary targets but the plan could also include education of the building maintenance staff and tenants.

Education of the tenants is also valuable and should include both indoor and outdoor tips such as avoiding watering when it is raining and avoiding watering driveways. And of course if a sprinkler system is used for landscape watering it should be set correctly so that it does not water more than 2.5 cm (1 inch) per week, or twice a week for ½ hour. Again, as these are municipal buildings it is part of the implementation plan.

Case Study

A toilet change-out program was implemented in an apartment building located in Mississauga, owned and operated by Peel Region, and managed by Peel Living, the Region's Housing Department. The following data was collected.

The building has 112 suites.

- Average pre-change-out demand: 120.0 m3/day, or 1,071 L/suite/day
- Average post-change-out demand: 66.7 m3/day, or 595 L/suite/day

Analysis of the water demand data collected indicated that a total of 53.3 m3/day of water has been saved in this building (44.4 percent of previous demands) as a result of the toilet change-out program.

Flush Volume Savings vs. Leakage Savings

It was noted that the analysis indicates a large portion of the savings (70.1 percent) is related to the elimination of toilet leakage, whereas 29.9 percent of the savings is the result of reduced flush volumes.

Leakage reduction was calculated as 37.3 m3/day, i.e., the difference between the minimum flow rate occurring during the pre- and post-monitoring extended for a 24-hour period.

When this leakage reduction rate is subtracted from the total demand reduction of 53.3 m3/day the remaining savings (i.e., the savings related to flush volume reduction) is 16.0 m3/day. As verification, the savings directly related to the lower flush volumes of the new toilets can be estimated as follows:

2.8 persons/suite x 5 flushes/person/day x 10 litres savings/flush x 112 suites
*= **15.7 m3/day***

Summary

- **Total Savings: 53.3 m3/day; 475 L/suite/day; 100%**
- **Savings related to Leakage: 37.3 m3/day; 333 L/suite/day; 70.1%**
- **Savings related to reduced Flush Volume: 15.9 m3/day; 142 L/suite/day; 29.1%**

To sustain the savings related to reduce leakage at the site it is recommended that the building be periodically monitored and any increase in base flow identified. An increase in base flow would indicate leakage at the site.

Strategic Significance
To garner public support for a Water Efficiency Program the municipality/utility or government agency needs to get its own house in order. With this in mind, any Water Efficiency Plan should include measures aimed at reducing water use in the utility and the host municipality, e.g. City of Brampton facilities in The Region of Peel, Town of Newmarket facilities in Region of York.

Benefit
The major benefit of this program is the message that it sends to the public. It shows that the utility is prepared to "walk the walk" and to build credibility for a program aimed at other users.

The savings will be relatively minor in the larger utility picture. However, the savings have an important public information value and the savings to the municipality are real in this era of tight budgets.

Savings
The above figures include water savings realized not only from the lower flush volume, but also from the elimination of leaks from aging toilets.
There are approximately 5,700 inefficient toilets in Peel Living buildings. Replacing these toilets with efficient models would save the Region 372.5 million litres of water per year and approximately $320,233 in yearly water and wastewater expenditures.

Cost
The costs will be recovered largely through savings. The cost of the toilet/ fixture change outs runs 100 to 200 dollars per unit. Pay back period for the toilet change outs is relatively short, one to two years.

Information Sources
The Ontario government, the City of Toronto, and the Region of Peel (in process) have developed and carried out such programs.

Ontario Government **Publications** available www.ene.gov.on.ca
"Water conservation tips for Ontario Public Service facilities managers"
"Water conservation tips for industry"

Federal Government Facility Audit Guide
http://www.ec.gc.ca/water/en/info/pubs/arwcp/e_plan.htm.

Peel Region, www.watersmartpeel.ca

Canadian Mortgage and Housing Corporation http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/97112.htm

City of Toronto, http://www.toronto.ca/watereff

York Region, http://www.water4tomorrow.com

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BMP # 9 INDUSTRIAL/COMMERCIAL/INSTITUTIONAL WATER EFFICIENCY

Description

Reducing water use, and in most cases energy use, is usually at the bottom of the prioritization list for a plant, building or facility manager. Water and energy can be in many cases less than 5% of the facility's operating expense. Plant managers are usually focused on increased production and quality. Many plant managers are concerned that if they change a process to reduce water that it could impact production and/or quality. As such, influencing the industrial/commercial/institutional (ICI) sector is a long and somewhat challenging market sector although a rewarding one in the end.

The first strategy to be included in an ICI water efficiency plan is to encourage the facility manager to carry out an audit.

The self-audit is usually conducted by the environmental manager or plant manager and is completed by doing a "walk about" of the facility taking note of visual observations pertaining to water consumption. The observations may relate to a physical condition, e.g. an opened tap, to a condition established through habit or attitude. A self-audit can lead to the implementation of some water saving measures or perhaps training of individuals to change habits and attitudes. A second approach, utilized by some municipalities, is to offer a training program and a set of spreadsheets to plant or facility staff to assist them in carrying out a more comprehensive internal audit.

A full comprehensive audit of a facility is usually completed with the services of an engineering professional. Following the audit a report is provided listing the recommendations that the client can undertake in order to realize water savings. Typical facilities benefiting from a comprehensive audit include commercial laundries, hospitals, steel fabricators, auto parts manufacturers, and other facilities where large quantities of water are used as part of every day operations.

Once the audit is complete, encouragement towards implementation may be necessary. Several approaches are possible. One approach is to develop a recognition program whereby a company taking that first step of having a water audit completed would receive a certificate of recognition from perhaps the mayor of the municipality. A company actually implementing some of the recommendations could receive a higher level of recognition, perhaps a handsomely framed print with an appropriate plaque of recognition mounted on the frame. Also, the company might receive recognition from local media outlets. This approach not only congratulates the participating company but also creates "peer" pressure on other companies in the area to become involved.

A major barrier faced by clients to implement water efficiency measures is the capital cost associated with implementation. An approach that helps overcome this barrier is what is commonly called “a capacity buy-back.” The utility would increase its capacity to supply others by providing incentives for the installation of water efficiency technology.

The incentive offered to each site will vary depending upon the amount of water *actually* saved rather than upon *potential* water savings. To qualify, the water savings must be sustained and must be the result of a change in process or equipment rather than a change in water using habits. The water savings will be verified at each site prior to the incentive being provided.

The combined unit cost to expand water and wastewater infrastructure can range from $1.12 to $4.40 per litre per day. Therefore any incentive less than the combined cost would be cost effective. This of course assumes the measure reduces both water demand and wastewater flows. An incentive of so many cents per litre per day savings up to a maximum of 50% of the cost of the water efficiency measure is recommended.

The ICI sector requires a longer time to realize success than any other market sector. It may take a year or more to complete the audit and convince the decision makers of the merits. In addition, it could take a year or more to get the necessary funds in the capital budget.

Strategic Significance

Fully 35% of water supplied by municipalities in Ontario (EC 2001) is used in the ICI sector with industry accounting for 17% and commercial and institutional facilities using 18%. The key water use areas are the facility, the landscape and the industrial processes.

Benefits

Water efficiency in this sector can provide reductions on both the supply and wastewater sides. Landscape irrigation can be prominent and any efficiency programs can assist in managing summer peaks. For the facility, in addition to financial benefits, water efficiency can also provide process efficiencies and health and safety improvements.

Cost

A comprehensive water audit can cost from $1,500 to $3,000 depending on the size and complexity of the facility. Cost for the customer to implement the list of recommendations could range from several hundred dollars to several hundred thousand dollars.

Information Sources

York Region Water for Tomorrow	www.waterfortomorrow.com
Toronto Water Efficiency Plan	www.toronto.ca
Region of Waterloo Water Efficiency Plan	www.region.waterloo.on.ca
Region of Waterloo Audit Manual	www.region.waterloo.on.ca
Environment Canada	www.ec.gov.ca

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BMP # 10 INDOOR RESIDENTIAL WATER CONSERVATION

DESCRIPTION

A variety of steps can be taken to reduce residential indoor water use. Factors that affect indoor water consumption include the age of the home, the type of dwelling, the water use habits of residents, the age of water using appliances, and the state of repair of water using appliances. *Best Practices* in indoor residential water conservation include home audits, education, leak repair, gray water systems, and retrofit devices.

STRATEGIC SIGNIFICANCE

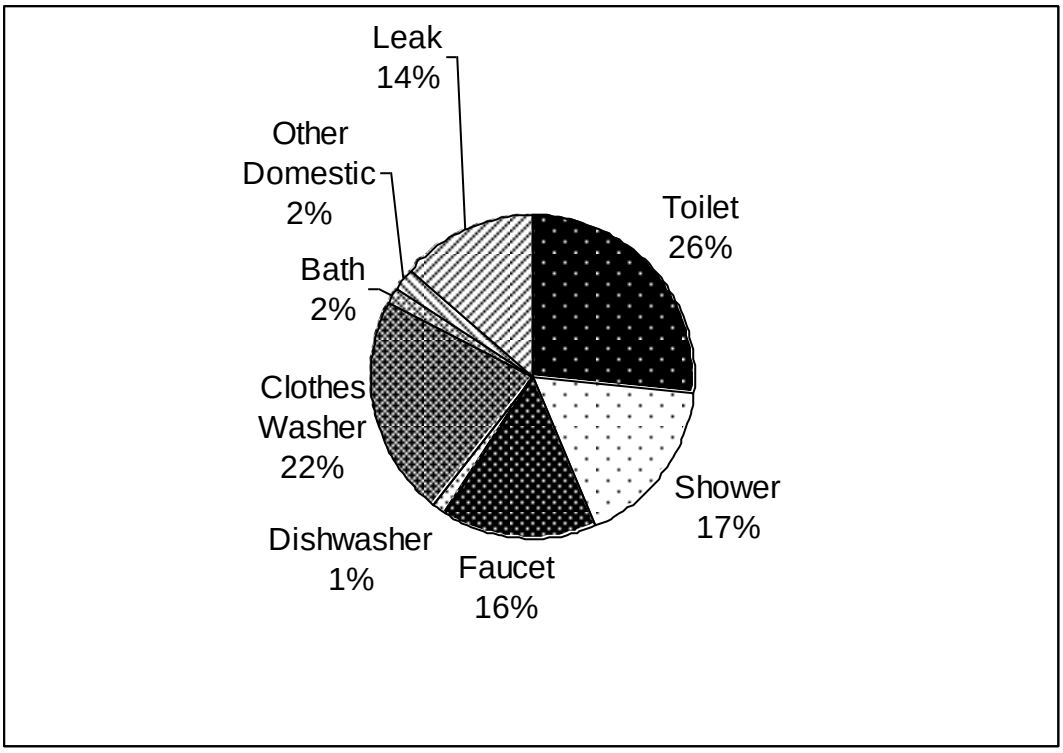
Households consume about 60 percent of the potable water produced in Ontario with an estimated 95 percent of this occurring indoors (Environment Canada, 2004). The breakdown of indoor water use is set out in the chart below. An average household with three residents in Ontario currently consumes about 813 litres per day of drinking water (CMHC, 2000). It is estimated that with the installation of water efficient fixtures and appliances alone, the average household demand could be reduced by 35 percent to 707 litres per day (Vickers, 2001).

Measures commonly attempted by municipalities to reduce indoor water consumption include rebates or financial incentives for the items listed below.

- Water saving toilet flapper replacements
- Replacement of 13+-litre toilets with low flow 6-litre or dual-flush 3-litre/6-litre toilets
- Low flow shower head replacements
- Low flow faucet aerator replacements
- Water-efficient front load washing machines

Educating residents about conserving water may help increase the intrinsic value of water, and promoting/subsidizing efficient fixture retrofits encourages manufacturers to produce better water using appliances. Utilities that promote indoor residential water conservation may also gain a strategic advantage when it becomes necessary to find new sources of water. For example, an Ontario municipality attempting to gain government approvals to build a pipeline to one of the great lakes may face less opposition if residential water consumption has been reduced to a minimum.

Breakdown of Indoor Water Use



Source: AWWA Research Foundation – Residential End Use of Water

BENEFITS

Both residential property owners and utilities will realize benefits from an indoor residential water conservation program. The potential benefits include:

- Water savings
- Reduced wastewater flows
- Deferred capital infrastructure costs due to reduced water use and wastewater flows
- Reduced water and sewer charges for customers
- Reduced costs for energy and chemicals to treat drinking water and wastewater
- Reduced costs for water, sewer, and associated electric and gas utility services
- Reduced costs for clothes-washing and dishwashing detergents
- Reduced size and extended septic system life
- Improved safe yield and pumping reliability in wells
- Improved local environment
- Pollution prevention

COSTS

The potential costs of implementing an indoor residential water conservation program include:

- Cost of advertising, promotion and direct customer contact
- Cost of incentives
- Cost of conservation hardware
- Cost of any plumbing-related renovations required
- Cost of reduced utility revenue due to lower volume water sales

INFORMATION SOURCES

- Water Conservation Guidebook for Small and Medium Sized Utilities, 1998, Ontario Water Works Assn., $25. Water efficiency information at the OWWA website www.owwwa.direct.com, click on activities, click on Water Efficiency Committee
- Handbook of Water Use and Conservation, Amy Vickers, May 2001, WaterPlow Press available in the AWWA bookstore, www.awwa.org.
- Residential End Uses of Water, Mayer et al, American Waterworks Association Research Foundation, 1999, available in the AWWA bookstore at www.awwa.org
- Household Guide to Water Efficiency, Canada Mortgage and Housing Corporation, 2000, available at www.cmhc
- 2004 Municipal Water Use Report – Municipal Water Use 2001 Statistics, Environment Canada

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BMP #11 LANDSCAPE WATER EFFICIENCY PROGRAM

Description

In Ontario and the rest of Canada, water efficient landscape programs have developed with the goal of reducing peak summer demand for water. The typical approach applied by municipalities operating residential landscape water efficiency programs is to encourage residents to adopt water efficient landscape design and maintenance practices.

Strategic Significance

In the summer months, residential water use can more than double average daily use. The increase during hot, dry periods places a huge demand on the water supply system. In order to meet this increased demand, the entire water supply system including plants, pipes, pumping stations and reservoirs are built with significantly larger capacity – at a much higher cost - than is needed throughout the remainder of the year. The cost per water unit sold of this excess capacity is much higher than that for day-to-day usage.

The primary focus of municipal water efficient landscape programs is to reduce residents' use of water for irrigation.

Residential water efficient landscape programs got their start in the southern and mid-western American states where summer drought and water scarcity has long been a reality. Although water scarcity may be less apparent in Ontario, it certainly does exist. Consequently, many Ontario municipalities have adopted the approach used in the US to achieve residential landscape water-use efficiency, reduce the pressure on capital investment funds, and reduce the demand on strained or limited water supplies. A two-part approach to municipally managed residential water efficient landscaping programs can be described as follows:

- Develop and implement water efficient landscape design and maintenance principles.
- Through marketing and education initiatives, encourage residents to employ these principles with their own landscape.

Principles of water efficient landscape design and maintenance

1. Landscape planning
   By proper planning, residents can achieve a landscape that meets their aesthetic and functional requirements while minimizing the water required for maintenance.

2. Soil preparation
   Augmenting soil with organic matter enhances its ability to hold water. Encourage residents to use a composter.

3. Plant selection
   Selecting the right plant for the location on the landscape reduces or eliminates the need for irrigation (e.g. plant species that thrive in full sun and are drought tolerant should be planted in dry, sunny locations while shade and moisture loving plants should be located in the naturally wet, shaded areas of the landscape).

4. Applying mulch to gardens
   The application of mulch such as wood chips, stones, leaves, etc. to gardens helps conserve soil moisture.

5. Limiting turfgrass areas
   Limit the amount of turfgrass in the landscape to areas for which grass provides a functional benefit, such as a play area for children and pets, and design those areas for easy watering.

6. Use drought tolerant turfgrasses
   Utilize a mix of drought tolerant turfgrasses such as fescue and rye grasses, which have deep root systems, to reduce watering requirements and help prevent weeds and other infestations from taking hold.

7. Properly maintain turfgrasses
   Grass should be kept at a height of 6 to 10 cm and never more than one-third of the grass height should be cut at any one mowing. Never cut grass in the heat of the day or use a lawn mower with dull cutting blades. Leave grass clippings on the lawn to decompose providing an excellent source of organic nitrogen.

8. Fertilize annually
   Fertilize once each year, in either the early spring or fall using compost or other natural source of organic material. Grass should be aerated and over-seeded in the spring to encourage lush full growth and to choke out weeds.

9. Properly irrigate
   Apply a maximum of 2.5 cm of water, including rainfall to lawn areas each week. Utilize a rain gauge to measure water application and set sprinkler timers to the length of time required to apply a maximum of 2.5 cm of water.

   For gardens, use trickle or drip irrigation systems and only water if absolutely required. Choosing the right plants for the location should eliminate or significantly reduce the need to apply water beyond the time required for the plant to establish.

Marketing and Public Information

Various methods have been employed by municipalities to get the messages out to residents about water efficient landscaping. To date, there is minimal data on the effectiveness of these programs in reducing water use amongst residents for landscape maintenance. Public and stakeholder outreach and education are the common tools utilized by most municipalities operating outdoor water efficiency programs. In Ontario, several municipalities have augmented their outreach and education programs with

some form of direct residential visits by post-secondary students trained on outdoor water use efficiency and social marketing techniques.

Two types of direct visit programs used by Ontario municipalities:

In some municipalities post-secondary students are hired and trained to discuss with homeowners outdoor water use efficiency and in particular, landscape maintenance. The students are trained in Community-Based Social Marketing (CBSM) and are provided with educational and informational resources to provide to residents. A selected, high water use, homogeneous residential area(s) is targeted each year and a control group is established. Metering of water supply inflows to both the control group and the targeted group is undertaken. Residents in the targeted group are asked at the outset of the summer program to sign a commitment to reduce their outdoor water use and are furnished with an outdoor water use reduction information kit. Students make subsequent visits to discuss progress with the homeowners and to visually monitor the outdoor water use in both the target and control groups.

Another type of direct-to-resident program employs an integrated, cross-marketing approach to secure outdoor water use reductions amongst residents. The program is well recognized with good participation by residents and includes the following components:

- Workshops with gardening experts.
- Participation of area garden centres, which provide water efficient plants and related supplies and information on water efficient landscaping.
- Pre-booked visits by “landscape advisors” (horticultural students and graduates) who provide residents with advice and information on reducing water used for landscape maintenance.

It should be noted that to date limited data is available on the effectiveness of direct-to-resident municipal water efficiency programs in reducing residential water use for lawn and garden maintenance. Actual or potential water savings are not known.

Other outdoor water use reduction initiatives include:

- Odd-even watering days: Residents with house numbers ending in an odd number are to water on odd numbered days while those living in a home with an even number are to water on even number days of the week.
- Requesting residents not to water on a set day of the week:
- A municipal subsidy given to residents to off-set the cost of a rain barrel. No actual, sustained water savings documented.

Water restrictions are frequently used to deal with emergency water shortages. They are often successful in dealing with a short-term problem but do not appear to bring about a long-term reduction in usage. A more concerted strategy is needed.

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BMP # 12 REDUCING THE FLOW IN THE WASTEWATER SYSTEM

Description
Water Conservation reduces wastewater flows by optimizing the amount of water used by plumbing fixtures such as toilets and faucets or industrial processes that discharge to sanitary sewers. By reducing base demand (or average day demand) we can also reduce our wastewater flows thus saving money in wastewater treatment costs and often resulting in deferred wastewater infrastructure expansion costs.

Another source of flow in the sewers to be addressed for conservation purposes is extraneous inflow and infiltration (I/I). Inflow is a direct connection of surface water flows to the sanitary sewer such as a roof leader; foundation drains, sump pump, manhole covers or catch basins. Infiltration is the seeping of groundwater water through joints, laterals, etc. All of these sources of ground or storm water entering the sanitary system are unwanted – adding to the cost and in some cases reducing or disrupting the effectiveness of treatment.

There are measures that can be taken to reduce flows to wastewater treatment plants:

- residential metering of water reduces water wastage
- replacement program for toilets and other water-using fixtures reduces flows to the wastewater system
- promote the disconnection of downspouts in areas identified to have roof leaders connected to the sanitary sewer. This initiative may be coupled with a rain barrel program which reduces water going to the sewer and at the same time creates a public awareness of outdoor water use
- Identify and disconnect storm drains or foundation drains where feasible

Many municipalities have also undertaken programs that specifically target the sources of unaccounted for wastewater entering the system through flow metering and rain flow monitoring which allows the system operator to calculate and differentiate between dry weather and wet weather flows. The operator can then establish an acceptable I/I allowance and target areas for repair. Closed circuit television (CCTV) inspection of the sewers also enables operators to identify problem areas, followed by repairs to alleviate larger sources of infiltration by excavation and replacement or sewer relining

Strategic Significance
Wastewater is an often-overlooked piece of the water conservation puzzle. Reducing wastewater flows will increase the savings realized by your water efficiency program.

Benefit
The reduction of wastewater flows postpones the need for new wastewater facilities and thereby saves on the capital budget. It also saves on energy as less pumping and treatment is required and chemical use is reduced. Finally, by reducing wastewater flows the reliability of the treatment process is increased thus protecting the water sources – fewer overflows and by-passes.

Costs
Costs will vary with the scope and size of the program.

Sources of information
Infraguide publication "Infiltration/inflow control/reduction for wastewater collection systems." www.infraguide.ca.
Region of Peel www.peelregion.ca
City of St. Catherine's www.st.catharines.com
City of Toronto City of Toronto, www.toronto.ca/watereff