Part II – Fact Sheets

II

Description of Fact Sheets

Part II of this handbook provides a description of selected pollution prevention and flow reduction measures and fact sheets for each measure. The details on each measure include discussions to assist with the application of the measure including:

- **Description** of the measure and what it includes.
- **Approach** used in the application of the measure. It may include the steps taken and different methods that are available.
- **Benefits** associated with the measure are outlined. This includes any general benefits, the pollutants that are removed or reduced, associated benefits to uses on improved conditions and, where available, information on the performance or effectiveness of the measure.
- **Requirements** for implementation are outlined. These include cost implications, necessary program support, equipment needed (if any), and the policies and/or by-laws generally required for implementation.
- **Public Education/Involvement** opportunities to assist in the application of a measure or development of a program are described.
- **Linkages** of each measure with other programs or related practices are outlined.
- **Limitations** related to each measure that can affect their application and/or performance.
- **Application Experience** is provided in the form of case studies that demonstrate how the measures have been applied and any relevant experiences.
- **References** are listed that are relevant to each measure and provide additional information.

The measures are divided into four categories depending upon the type of application. The four categories and the measures applicable to each are outlined below. Because some measures provide a benefit in more than one area, there are some commonalties between categories.

These Fact Sheets provide a description of the measure discussed, approaches that can be taken, potential benefits, cost and staffing implications, public involvement and application experience.

DESIGN OF FACTSHEETS: LIND DESIGN

Four categories of measures are included and presented below:

Category	Symbol
Pollution Prevention at Source	SP
Flow Reduction at the Lot Level	FR
Municipal Operation Measures	MO
Local Drainage and Inlets	LD

Pollution Prevention at Source (SP)

These measures involve the change in practices or use of chemicals that contribute to pollutants building up on surfaces for wash-off, or that are directly discharged to the storm drainage system. The measures can relate to any type of use including residential, commercial, industrial and municipal practices. The measures outlined include:

SP1 Used Oil Recycling
SP2 Household Hazardous Waste Collection
SP3 Reduced Pesticides Use Through Plant Health Care or Alternative Landscaping
SP4 Safer Alternative Products
SP5 Business Education and Awareness
SP6 Material Storage Control
SP7 Vehicle Use Reduction
SP8 Litter and Pet Control
SP9 Yellow Fish Road Program
SP10 Pool Drainage
SP11 Erosion and Sediment Control
SP12 Modifying Engineering Standards

Flow Reduction at Lot Level (FR)

The measures in this category provide flow reduction to the sewers or conveyance system and provide a corresponding reduction in overall pollutant loadings. Measures address both flows to the sanitary sewer system (water conservation methods) and the storm drainage system (to reduce flows to surface drainage and combined sewers). The measures outlined include:

FR1 Water Conservation Program
FR2 Downspout Disconnection
FR3 Rain Barrel Program
FR4 Storm Garden Development
FR5 Infiltration Measures on Site
FR6 Vegetation Measures – Buffers
FR7 Urban Forests
FR8 Rooftop Treatments

Municipal Operation Measures (MO)

These measures focus on the operations of municipalities in maintaining and rehabilitating infrastructure systems such as the sewer systems, roadways and public lands such as parks. The measures outlined include:

MO1 Sewer Use By-laws
MO2 Road De-icing/Salt Application
MO3 Leaf Cleaning/Removal
MO4 Street Cleaning
MO5 Catchbasin Cleaning
MO6 Storm Drain Flushing
MO7 Municipal Yard Operation
MO8 Municipal & Residential Housekeeping Practices
MO9 Tank Spill Prevention and Control
MO10 Illicit Connection to Storm Sewer – Prevention and Detection
MO11 Leaking Sanitary Sewer Control – Combined and Sanitary (exfiltration)

Local Drainage and Inlets (LD)

Local drainage and inlet measures and practices relate to controls that are applied to urban drainage systems including both surface drainage and local sewer systems. These are generally not "at-source" measures, but relate to the control of how stormwater is conveyed in the upper or early stages of the sewer system, often before entry into the piped storm or combined sewer system. The measures outlined include:

LD1 Grassed Waterways
LD2 Inflow and Infiltration Control (I/I)
LD3 Detention and Infiltration Device Maintenance
LD4 Natural Drainage Elements
LD5 Inlet Controls – Flow Reducers

Pollution Prevention at Source

These measures involve the change in practices or use of chemicals that contribute to pollutants building up on surfaces for wash-off, or that are directly discharged to the storm drainage system. The measures can relate to any type of use including residential, commercial, industrial and municipal practices. The measures outlined include:

SP1 **Used Oil Recycling**
SP2 **Household Hazardous Waste Collection**
SP3 **Reduced Pesticides Use Through Plant Health Care or Alternative Landscaping**
SP4 **Safer Alternative Products**
SP5 **Business Education and Awareness**
SP6 **Material Storage Control**
SP7 **Vehicle Use Reduction**
SP8 **Litter and Pet Control**
SP9 **Yellow Fish Road Program**
SP10 **Pool Drainage**
SP11 **Erosion and Sediment Control**
SP12 **Modifying Engineering Standards**

Used Oil Recycling

SP1

FACTSHEET

DESCRIPTION

Used oil recycling is a responsible alternative to improper disposal practices, such as dumping in the sanitary sewer or storm drain system, applying oil to roads for dust control, placing used oil and filters in the trash for landfill disposal or simply pouring used oil on the ground.

APPROACH

The following approaches may be effective for used oil recycling:

- Integrate efforts with existing municipal solid waste program.
- Set up a municipal collection centre.
- Contract out the collection and hauling of used oil to a private hauler/recycler.
- Utilize the automobile service industry for collection of used oil.
- Work with automotive parts supply stores to reduce incidents of automotive fluids left on paved areas by customers.
- Refer to Disposal Alternatives – Quick Reference Table in Appendix C of this Handbook.

BENEFITS

- **Pollutants Reduced:** Heavy metals, oil and grease.
- **Beneficial Uses Improved:** Aesthetics, contaminated soil and sediments.

REQUIREMENTS

- **Cost Implications:** A collection facility or curbside collection may result in significant costs. Using commercial locations (such as automobile service stations and fast-oil-change businesses) as collection centres reduces hauling and recycling costs for a municipality.
- **Program Support:** If collection and recycling are contracted out, staffing costs are minimal.
- **Policy/By-laws:** Sewer Use By-laws, environmental laws relating to spills, and illegal discharge of contaminants.

Oil booms like these on a storm sewer wouldn't be necessary if used oil recycling programs were in place

PUBLIC EDUCATION/ INVOLVEMENT

- Create procedures for collection such as collection locations and schedule, acceptable containers and maximum amounts accepted.
- Promote public participation through the use of posters, handouts, brochures and announcements in print and broadcast media; provide a list of the commercial recyclers.
- Develop incentive programs for commercial locations and used oil recyclers.

LINKAGES

- **Related practices:** Household hazardous waste collection.

LIMITATIONS

- The availability of reliable, licensed used oil haulers and recyclers may be limited. The program requires frequent public education/ notification messages. The used oil/hazardous waste separation requirements under federal and provincial law may also be a limitation. Meeting zoning, fire, health and safety laws associated with collecting used oil may not be possible at all locations.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

RECYCLE USED OIL

Household Hazardous Waste Collection SP2

FACTSHEET

Type of Measure
- FLOW REDUCTION
- SOURCE CONTROL
- DRAINAGE SYSTEM CONTROL

Program Element
- RESIDENTIAL
- COMMERCIAL ACTIVITY
- INDUSTRIAL ACTIVITY
- MUNICIPAL ACTIVITY

DESCRIPTION

Household hazardous wastes (HHWs) are defined as waste materials that typically are found in homes or similar sources and exhibit characteristics such as corrosivity, ignitability, reactivity and/or toxicity, or are listed as hazardous materials. This source control also focuses on the collection of deleterious chemicals that sometimes are disposed of in a manner that threatens stormwater or sanitary sewage quality.

APPROACH

Integrate efforts with existing municipal solid waste program. Optimize collection method(s) (for example, permanent, periodic, mobile (toxic taxi) and curbside) and frequency (for example, monthly and quarterly) based upon waste type, community characteristics, existing programs and budget.

BENEFITS

- **General:** While it is generally recognized that the potential exists for hazardous household materials to come in contact with stormwater runoff or be discharged to sanitary sewers, it is unclear at present how significant this source of contamination is. As such, it is difficult to quantify the benefits to water quality from a household hazardous waste collection program. However, HHW collection is a preventative, rather than curative measure and may reduce the need for more elaborate treatment controls. Pollutants also end up in combined sewer discharges, biosolids from the sewage treatment plant in sewage effluent, and for volatile organics, as an air pollutant.
- **Pollutants Reduced:** Heavy metals, toxic materials, oil and grease. Most common HHWs products include: drain openers, oven cleaners, wood and metal cleaners and polishes, automotive oil and fuel additives, grease and rust solvents, carburetor and fuel injection cleaners, starter fluid, batteries, paint thinners, paint strippers and removers, adhesives, herbicides, pesticides, fungicides and wood preservatives.
- **Beneficial Uses Improved:** Human health, sediment quality, water quality, aquatic life.

Environmental day household hazardous waste collection and proper disposal

Household hazardous products typically found in every home

- **Performance:** Various studies have been undertaken to categorise the quantity and quality of HHWs in the municipal solid waste stream. These studies indicate that 0.5% to 2.0% of the total municipal solid waste stream is household hazardous waste; the number typically used is 1.0% of the total municipal solid waste stream. Although the percentage of these materials is small, the large volume of solid waste generated daily indicates that a substantial amount of HHW is generated.

  The benefits to stormwater quality from HHW collection is unknown at present, but best engineering judgement indicates a potential of up to 15% reduction in specific contaminants. (California Storm Water Best Management Practice Handbooks, 1993, Fact Sheet SC31).

FACTSHEET

Household Hazardous Waste Collection

REQUIREMENTS

- **Cost Implications:** The following cost implications may apply:
  - Both collection and disposal can be expensive and are partly a function of frequency of collection, which depends on the collection program implemented. Many communities have deferred hazardous household waste (HHW) programs because of the high cost. Cost depends on the type of program chosen and available disposal costs.
  - Trained operators are required.
  - Laboratory and detection equipment is necessary.
  - Extensive record keeping is required including dates, types and quantities.
- **Program Support:** This best management practice (BMP) may require a minimum of six highly trained persons per collection site or event to handle traffic, waste drop-off, characterization and disposal.
- **Policy/By-laws:** Sewer use by-laws limit discharge to storm and sanitary sewers.

PUBLIC EDUCATION/ INVOLVEMENT

- The following considerations may be applicable for this BMP:
  - Public education about hazardous materials in the home and consequences of improper use or disposal.
  - Identification and promotion of the use of non-hazardous alternatives.
  - Identification of proper storage and disposal methods.
  - Promotion of participation in local HHW collection programs.
  - Distribution of posters, handouts and educational efforts aimed at local schools.
  - Using public service announcements on local television, radio and newspapers.
  - Adding utility bill inserts.
  - Making video or slide presentations to community organizations.
  - Developing a “speaker bureau” of local environmental professionals and recycling experts.

LINKAGES

- **Program:** Solid waste program, sewer use by-law enforcement, and used oil recycling.
- **Related practices:** Safer alternative practices.

LIMITATIONS

- This BMP may be limited to areas with convenient access to hazardous waste disposal facilities and recycling facilities because of the cost associated with transport. This BMP can be a high-cost option compared to the other source controls. There are significant liability issues involved with the collection, handling and disposal of household hazardous waste.

APPLICATION EXPERIENCE

The Household Hazardous Waste Program for the Regional Municipality of Waterloo is based at the Regional Land Fill Site and has designated public dates for receiving waste. Dates are publicized in public information flyers distributed throughout the region.

REFERENCES

- David V. Galvin, *Household Hazardous Waste in Municipal Wastewater and Storm Drains: An important Target for Comprehensive Pollution Prevention Programs*; WPCF Conference Proceedings Toronto, AC91-068-004, 1991.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Reduced Pesticide Use

SP3

Through a Plant Health Care Program or Alternative Landscaping

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Rather than work against nature, Plant Health Care Programs (PHCP) can be designed to work with it. By consistently employing organic horticultural practices, healthy turf growth can be encouraged while having the smallest possible environmental impact. Pesticides in this context include insecticides, fungicides and herbicides.

Naturescaping promotes natural lawn care techniques and encourages lawn replacement with alternatives, including drought-tolerant plants. Xeriscape landscaping is an alternative landscape method that emphasizes water conservation.

APPROACH

- A PHCP has ten component parts:
  1) Monitoring/Scheduling
  2) Mowing
  3) Fertilizing
  4) Aerating
  5) Top-dressing
  6) Overseeding
  7) Irrigating
  8) Dethatching
  9) Alternatives
  10) Education/Training
- Natural lawn care techniques are available that offer natural solutions to some of the most common lawn problems.
- Xeriscaping can be defined as “quality landscaping that conserves water and protects the environment”. Seven principles are applied: 1) Planning and design, 2) Soil analysis, 3) Appropriate plant selection, 4) Practical turf areas, 5) Efficient irrigation, 6) Use of mulch, and 7) Appropriate maintenance.
- An integrated Pest Management Program can include biological controls using “beneficial” insects as alternatives to pesticides (e.g. ladybird beetles, praying mantis).

BENEFITS

- **General:** Healthy vigorous turf is less susceptible to pest invasion; water use is reduced; there is less runoff; and maintenance costs are often reduced.
- **Pollutants Reduced:** Nutrients, Oxygen Demanding Substances, pesticides, herbicides and fungicides.
- **Beneficial Uses Improved:** Contaminated sediments, aesthetics, water quality.
- **Performance:** Consistent implementation of proper cultural practices will reduce the need for pesticide use and reduce negative environmental impacts.

Pesticide-free lawn care

REQUIREMENTS

- **Cost Implications:** Costs may be reduced for lawn care chemical applications and water use. There may be more initial labour involved than in pre-program practices.
- **Program Support:** Primarily related to education in using alternate techniques.
- **Equipment:** Specialized lawn care equipment may be needed for dethatching and aeration.
- **Policy/By-laws:** A PHCP need not advocate a complete ban on pesticide use, but can recognize that there may be occasions when spraying is necessary.

FACTSHEET

Reduced Pesticide Use Through a Plant Health Care Program or Alternative Landscaping

PUBLIC EDUCATION/ INVOLVEMENT

Promotion through media, local newspapers, and television stressing the positive aspects of reducing pesticide use.

- Interpretive signage in demonstration areas.
- Staff contact available to deal with queries and concerns.
- Positive reinforcement community activities such as the Dandelion Festival, in Waterloo.

LINKAGES

- **Program:** Flow reduction, water conservation.
- **Related practices:** Integrated pest management.

LIMITATIONS

- Some neighbourhood groups or individuals may be strongly opposed to the program because of their aesthetic preferences for traditional lawns.

APPLICATION EXPERIENCE

- "Innovative Turf Management" is a Plant Health Care Program (PHCP) implemented by the City of Waterloo gradually over many years. The program has successfully reduced pesticide application from 73% of the City's total land area in 1979 to 0.5% in 2001. For further information contact Mr. Brian Detzler, Team Leader Parks at (519) 747-8611.
- The Don Watershed Program distributed "No Pesticide" lawn signs with the popular Don Frog logo.

REFERENCES

- *Alternatives to Pesticides* is a publication available courtesy of the City of Cambridge, City Green Cambridge and Health Canada.
- *Naturescaping* is a brochure offering alternatives to the traditional lawn including a list of plants suitable for southern Ontario and is available from the Region of Waterloo by calling (519) 575-4423.
- *Xeriscape Landscaping – Preventing Pollution and Using Resources Efficiently*, EPA-840-B-93-001, April 1993.
- *How to Get Your Garden off Drugs. Friends of* the Earth, 701-251 Laurier Avenue West, Ottawa, Ontario, K1P 5J6. (613) 230-3352.

Safer Alternative Products

SP4

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Promote the use of less harmful products. Alternatives exist for most product classes, including fertilizers, pesticides, cleaning solutions and most automotive and paint products.

APPROACH

- Pattern a program after the many established programs from municipalities across the country. Integrate this best management practice (BMP) as much as possible with existing programs within your municipality.
- This BMP has three key audiences: municipal employees, the general public, and small business.

BENEFITS

- **General**: Promoting the use of less harmful products can reduce the amount of toxic and deleterious substances that enter storm and sanitary sewers and ultimately reach receiving waters.
- **Pollutants Reduced:** Nutrients, Toxic Materials, Oxygen Demanding Substances, and Oil and Grease.
- **Beneficial Uses Improved:** Human health, water and sediment quality, aquatic life.
- **Performance:** Quantified pollutant reduction.

REQUIREMENTS

- **Cost Implications:** The primary cost of this BMP is for staff time. Use of some alternative products may result in cost savings.
- **Program Support:** Staff is needed to educate municipal employees and coordinate public education efforts. Municipal employees who handle potentially harmful materials should be trained in the use of safer alternatives. Purchasing departments should be encouraged to procure less hazardous materials.
- **Equipment:** There are no major equipment requirements to this BMP.
- **Policy/By-laws:** This BMP has no additional regulatory requirements. Existing regulations already require municipalities to reduce the use of hazardous materials. Safer alternatives for use by the general public are presented through education.

Special alternative product tags on retail store shelves

PUBLIC EDUCATION/ INVOLVEMENT

- Awareness is the key to successful implementation of this BMP. It promotes a willingness to try alternatives and modify old behaviours.
- The following are examples of topics to be covered under a public education program:
- Automotive products – Less toxic alternatives are not available for many automotive products, especially engine fluids. But there are alternatives to car polishes, degreasers and windshield washer solution. Re-refined, recycled oil is also available.
- Cleaners – Vegetable based or citrus-based soaps are available to replace petroleum-based soaps/detergents.
- Paint products – Water based paints, wood preservatives, stains and finishes are available.
- Pesticides – Specific alternative products or methods exist to control most insects, fungi and weeds.
- Fertilizers – Compost and soil amendments are natural alternatives.

LINKAGES

- **Program:** Pesticide Use Reduction, Household Hazardous Waste Reduction.
- **Related practices:** Naturescaping.

FACTSHEET

Safer Alternative Products

LIMITATIONS

- Safer alternative products may not be available, suitable or effective in every case.

APPLICATION EXPERIENCE

City of Waterloo promotion of alternatives to pesticides through literature for homeowners and a commitment to an Environment First policy for city operations.

REFERENCES

- *Hamilton-Wentworth Enviro-Guide for Students and Residents* (1996). Hamilton-Wentworth Regional Environment Department, Waste Management Division. (905) 546-4417.
- *Home Green Home – Your Guide to Homemade Alternative for Household Use*. Communication Services, Region of Peel, 10 Peel Centre Dr., Brampton, ON L6T 4B9.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- Toronto and Region Conservation Authority web site: www.trca.on.ca

RECIPES FOR THE ENVIRONMENT

(Reference: Toronto and Region Conservation Authority)

Helping to protect the environment starts in your own home. You can make environmentally friendly cleaners from products in your kitchen cupboards and refrigerator. These products are easy to make, and they don't contain any harmful chemicals.

MAKE THE RIGHT CHOICE

Instead of:	Try this!
Flea collars	Add garlic tablets, vitamin B or brewer's yeast to your pet's diet. (Consult your veterinarian.)
Ant poison	Place red chilli powder, paprika, dried peppermint leaves at entry points to deter entry of ants.
Fertilizers	Use unfinished compost, mulch.
Insecticides	**Inside** – spray plants with mixture of 1/2 capful of dish detergent and 500ml of water, rinse when insects are dead, repeat every 2 weeks. **Outside** – introduce predators like ladybugs and preying mantis, companion planting.
Slug/snail poison	Saucer of beer or brewer's yeast in garden.
Air fresheners	Boil cinnamon and cloves in water, place out an open box of baking soda.
Swimming pool chemicals	Ozone or ultra-violet light systems.
Abrasive cleaners	Rub area with lemon dipped in borax, rinse and dry.
Ammonia-based cleaners	Mix vinegar, salt and water for surface areas. Baking soda and water for bathroom tiles.
Drain declogger	1-2 handfuls of baking soda, half cup of vinegar, allow to set for 1 hour, run water.
Floor & furniture polish	Mix 1:2 parts lemon juice to olive oil or vegetable oil.
Silver polish	Soak in boiling water with baking soda, salt and a piece of aluminum foil.
Window cleaner	Mix 2 tablespoons of vinegar in 1 litre of water in an empty spray bottle.

Business Education and Awareness SP5

FACTSHEET

DESCRIPTION

Promotion of education to the business and industrial community on the impact of pollution on the environment and the pathways of pollution in an industrialized watershed. Fostering an environment where expertise and information can be shared on pollution prevention at source.

APPROACH

Components of a business education program can include:

- Surveying area businesses to determine what potential presently exists for at-source pollution control.
- Identification of key business individuals that may become involved in an "umbrella" association to review the needs of the business community, education on pollution prevention and applicable Best Management Practices (BMPs). The focus of the group can include information sharing, networking and contacts that will assist small business by providing low cost expertise.
- Provision of seminars, fact sheets and information packages on BMPs related to area businesses, and also on ISO 14001 Environmental Management Systems.
- Evaluation of the need and/or opportunities in a municipality to provide financial incentives to businesses to implement BMPs.
- A newsletter to provide BMP updates, technical advice and contact information.
- Media coverage of success, business co-operation and participation.

BENEFITS

- **General**: Measures adopted for pollution prevention can also improve safety and reduce energy costs.
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Human health, water and sediment quality, and aquatic life.
- **Performance:** Measured in terms of program performance, i.e. the degree to which a targeted sector or group of industries adopts programs such as pollution prevention or Environmental Management Systems (EMS).

ISO 14001 standards for environmental management systems

REQUIREMENTS

- **Cost Implications:** A municipal staff person is needed to assist in co-ordination of surveys of area businesses, formation and support of any committees, and provision of educational materials, seminars, etc. Costs will vary according to educational materials provided and method of distribution, seminar expenses and other outreach projects.

  All costs involved in implementing new practices are borne by the company concerned. Changes to industrial and business practices may also reduce costs for some operations as well as providing environmental benefits.
- **Program Support:** Staff time will be needed for business outreach programs and preparation of materials.
- **Equipment:** Equipment needed will depend on the BMPs implemented and costs will be borne by the business concerned.
- **Policy/By-laws:** The need to develop education programs and awareness of pollution issues is driven by due diligence concerns or as part of a in-house program to develop a pollution prevention program, spill control plan, environmental management system or a best management practices plan.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Business Education and Awareness

PUBLIC EDUCATION/ INVOLVEMENT

- This program is in essence a public education program geared to a specific segment of the population. An "advisory committee" of members of the public business sector will be invaluable in promoting Best Management Practices (BMPs) throughout local industries and providing technical advice and influence. Some form of mentorship will be a valuable tool to provide advice and experience to small businesses. Public recognition should be given to participating businesses through media events, newspaper articles, awards, etc.

LINKAGES

- **Program:** Hazardous Waste Reduction, Spills Control, Material Storage Control, Use of Alternative Products.
- **Related practices.** Water conservation, workplace health and safety.

LIMITATIONS

- There may be some perception in the business community that remedial action may be too costly to implement. Lack of understanding about watershed connections and individual responsibility for pollution prevention may prove difficult to overcome.

APPLICATION EXPERIENCE

Emery Creek is a tributary of the Humber River draining a mixed industrial-commercial-residential area in Toronto. The Emery Creek Environmental Association is an industrial association that was formed in 1993 to address watershed concerns.

Regional Municipality of Waterloo. A Water Resource Protection Liaison Committee was formed in 1994, and includes regional staff and business, environmental and agricultural interests. Working groups focus on promoting voluntary resource protection in urban business and industries with a special focus on groundwater protection areas. BMP Fact Sheets have been developed for some industries in the areas of concern.

REFERENCES

Toronto and Region Conservation Authority and Environment Canada, 1998, *Your Business, the Don, Your Watershed, Making the Connection*, a special publication brochure directed at company presidents or general managers.

MOE, 1993, *Pollution Prevention Planning Guidance Document and Workbook*. Queen's Printer, ISBN 0-7778-1441-2

Canadian Centre for Pollution Prevention, 1998, ISO 14000 Guidance Document for a Business Community, prepared for the Ministry of the Environment and Emery Creek Industrial Association.

Material Storage Control

SP6

FACTSHEET

DESCRIPTION

Material storage controls can prevent or reduce the discharge of pollutants to stormwater from material delivery and storage areas. This can be done by reducing the storage of hazardous materials on site, storing materials in designated areas, installing secondary containment, conducting regular inspections and training employees and subcontractors.

This Best Management Practice (BMP) primarily applies to material delivery and storage for municipal and commercial operations.

APPROACH

The key is to design and maintain material storage areas that reduce exposure to stormwater by:

- Storing materials inside or under cover on paved surfaces;
- Using secondary containment, where needed;
- Minimizing storage and handling of hazardous materials and inspecting storage areas regularly;
- Keeping an ample supply of absorbent spill clean-up materials near the storage area.

BENEFITS

- **General**: With preventative BMPs, benefits include reduced liability, due diligence, and improved public image for commercial operations.
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Oil and Grease.
- **Beneficial Uses Improved:** Aesthetics, sediment and water quality, aquatic life
- **Performance:** This is a preventative technique.

REQUIREMENTS

- **Cost Implications:** Costs will vary depending on the size of the facility and the necessary controls.
- **Program Support:** Accurate and up-to-date inventories should be kept of all stored materials. Employees should be well trained in proper material storage. Employee education is paramount for successful BMP implementation.

Inside materials storage reduces washoff

- **Equipment:** Spill response equipment and supplies.
- **Policy/By-laws:** Sewer use by-law, environmental laws relating to spills.

PUBLIC EDUCATION/ INVOLVEMENT

- Promote awareness of appropriate “at home” material storage.

LINKAGES

- **Program:** Pollution Prevention and Control; Environmental Management System; Spill Control; Building Codes; and Fire Codes.
- **Related practices:** Business Education and Awareness.

LIMITATIONS

- Storage sheds often must meet building and fire code requirements.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

Vehicle Use Reduction

SP7

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Reduce the discharge of stormwater pollutants from vehicle emissions by highlighting the stormwater impacts; promoting the benefits to stormwater of alternative transportation; and integrating initiatives with existing regulations and programs.

APPROACH

- **Integrate efforts with:**
  - government agencies, business and municipal programs to reduce vehicle use to improve air quality and public health;
  - transit system redesign, expansion, and public transit use promotions;
  - residential street redesign such as the addition of bicycle lanes and traffic calming initiatives;
  - subdivision planning through community trail design, neighbourhood focused services;
  - local bicycle and road safety programs.
- Establish ride-share and trip reduction programs at government offices, major employers and universities.
- Promote car-pooling between urban centres by the provision of no-cost commuter parking, commuter lanes and toll reduction incentives.

BENEFITS

- **General**: Reduced pollutants entering storm drains and local waterways from roadways. Public health benefits through improved air quality and personal exercise. Reduced energy consumption and reduced cost to participants. Less highway congestion with reduced potential for accidents.

  Marsalek (1999) reported on the toxicity of urban drainage, including highway runoff. Severe toxicity occurs due to metals, hydro-carbons, sodium and calcium chloride. Many of these materials are traffic related so a reduction of traffic can reduce toxicity.
- **Pollutants Reduced:** Toxic materials (including antifreeze), rubber, carbon compounds, oil and grease.

Multiple occupancy vehicle use encouraged

- **Beneficial Uses Improved:** Public health, swimming, fishing, aesthetics, and contaminated sediments.
- **Performance:** Studies show that reducing vehicle deposits on roadways is likely to have a significant impact on local water quality, with potential improvement in aquatic habitat. There should be a reduction in the amount of pollutants entering major lakes and rivers, and some reduced costs of pollutant removal at water intake plants. Highway expansion needs and road maintenance costs may also be reduced.

REQUIREMENTS

- **Cost Implications:** A staff person is needed to track, review and comment on emerging legislation and programs, and provide coordination of proactive efforts. Other costs will be determined by the level of integration with related programs and services, and the type of remediation undertaken. Projects can vary from the simple installation of donated bicycle racks to the construction and maintenance of major commuter parking facilities.

FACTSHEET

Vehicle Use Reduction

- **Program Support:** The cost of proactive preventative programs will vary and may be shared with other programs and agencies. This again will be determined by the level of integration with other programs and the remediation measures undertaken.
- **Equipment:** Requirements will vary according to the program required.
- **Policy/By-laws:** Anti-idling By-law can reduce some vehicle use impacts.

PUBLIC EDUCATION/ INVOLVEMENT

The following considerations may be applicable:

- Educate the public about the problem of pollutants from vehicles transported via stormwater from the roads to local waterways.
- Promote and co-ordinate the use of alternative transport arrangements such as ride sharing, "bike to work" days, and workplace car-pool networks.
- Promote the advantages of local or inter-city public transport.
- Promote healthy activities such as walking and cycling. Use bicycle rodeos, community rides and peer influence to promote the enjoyment of cycling.
- Promote good cycling practices and road safety through school and youth programs and driver education.
- Use public workshops or public meetings to identify opportunities for improving community trails and municipal transit.
- Distribute promotional materials through libraries, recreation centres and public facilities.
- Use radio and television promotions and community group sponsorship for special campaigns or programs.
- Promote proper maintenance of vehicles in use.

LINKAGES

- **Program:** Pollution Prevention and Control; Energy and Traffic Reduction Programs; 20% Club for Sustainable Cities; International Council for Local Environmental Initiatives (ICLEI) and Cities for Climate Protection. Development of community walking trails, and bicycle lanes.
- **Related practices:** Public health promotion (ParticipAction).

LIMITATIONS

- Economic restraints and lack of cooperation may limit the level of integration between departments and programs.
- The use of alternative transportation is highly dependent on its convenience and relative cost.
- Erratic work hours may limit opportunities for "car-pooling" and ride sharing.
- Lack of workplace shower and locker facilities deter some employees from cycling or walking to work.
- Climate conditions limit walking and cycling opportunities.
- City traffic conditions inhibit cyclists from undertaking neighbourhood trips.

APPLICATION EXPERIENCE

- Toronto Cities for Climate Protection emissions reduction program. Contact ICLEI, World Secretariat, City Hall 16th Floor, West Tower, Toronto. Phone (416) 392-1475. The Toronto Case Study is posted at the website: www.iclei.org

REFERENCES

- Marsalek, J., Q. Rochfort, B. Brownlee, T. Mayer and M. Servos (1999*). An exploratory study of urban runoff toxicity*. Wat. Sci.Tech. Vol. 39. No. 21, pp. 33-39.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Litter and Pet Control

SP8

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Litter, usually consisting of packaging material, is discarded by individuals over the urban landscape. Pet feces (often called pet litter) are deposited primarily by dogs and left uncollected by owners. Both types of litter end up in storm drainage and cause problems.

Control programs involve changing individual behavior by preventing the littering action. By-laws making the littering illegal, supported by fines, are the "backbone" of the prevention programs.

Vegetation from lawn and gardens is another source of litter that should be reduced.

APPROACH

- Municipal ordinances (by-laws) exist in most municipalities making littering an offence.
- Several municipalities have dog litter control by-laws. Part of the old City of Toronto has a "Stoop and Scoop" by-law, with a $105 fine for not picking up after your pet.
- Public education to prevent the littering activities by individuals and their pets has the most promise.
- Municipal programs to post signs informing the public of the result of illegal littering helps prevent the activity.
- Municipalities and commercial businesses can provide litter disposal containers to make it convenient for the user.
- Education, garden/yard waste pick-up programs and composting programs can all reduce lawn and garden litter from entering drainage systems.

BENEFITS

- **General**: Aesthetic improvement in the urban landscape is the most obvious benefit. Pollution prevention in watercourses is also important.
- **Pollutants Reduced:** Floatable materials, oxygen demanding substances, nutrients, and bacteria.
- **Beneficial Uses Improved:** Swimming, and aesthetics.

Pet litter bylaws to control animal wastes

High bacteria levels lead to beach closures

REQUIREMENTS

- **Cost Implications and Program Support:** The municipality is the driving force in this measure with support for programs to pick up and dispose of lawn and garden wastes, maintenance of catchbasins and street sweeping programs, litter control through signage, provision and emptying of litter containers, and by-law enforcement.
- **Policy/By-laws:** Stoop and Scoop and Anti-Litter by-laws should be enacted and enforced.

FACTSHEET

Litter and Pet Control

PUBLIC EDUCATION/ INVOLVEMENT

- Summer student programs can incorporate park survey and public education by interviewing dog owners about litter control benefits and by-laws.
- By-law signage should be extensive.
- Bag dispensers can be located in parks.
- Trash cans should be readily available and emptied frequently.

LINKAGES

- **Related practices:** Street sweeping, catchbasin cleaning.

LIMITATIONS

- The program success is dependent on public education and enforcement of the By-law. Although many municipalities have Stoop and Scoop by-laws, enforcement may be limited because of staff shortages. Fines vary significantly throughout Ontario with ranges from over $200 to small fines of a few dollars.

APPLICATION EXPERIENCE

- In the City of St. Catharines' experience, bags for the Stoop and Scoop program cost $160 per 1500 for a sophisticated type of bag. Costs are lower for simple plastic bag printed with a reference to the by-law. See the City of St. Catharines Case Study for more information on this program, see Part III.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Yellow Fish Road Program

SP9

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Stencilling of storm drain system (inlets, catchbasins, channels and creeks) with warnings/advisories and graphic icons, such as yellow fish, discourages the illegal dumping of unwanted materials. Advisories are distributed to homes in stencilled areas.

APPROACH

Create a volunteer workforce, preferably school children, to reflect the initial principle of the program to stencil storm drain inlets. Municipal staff should erect signs near drainage channels and creeks and in heavy traffic areas.

BENEFITS

- **General**: An effectively implemented stencilling program encourages change in personal behavior and helps minimize non-point source pollutants from entering the storm drain system. Catchbasin maintenance is simplified through the reduction of disposed materials into storm drain inlets.
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Floatable Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Aesthetics, sediment and water quality.
- **Performance:** Program performance is indirect and measured by the level of participation of both the students carrying out the program and the education and involvement of the residents in the area where the measure is applied. Many youth volunteers have participated in this activity with the Toronto and Region Conservation Authority (over 3500 in 1999). Yellow Fish Road is endorsed and supported by many organizations including Trout Unlimited Canada, The Toronto and Region Conservation Authority, The City of Toronto, Regions of York, Peel and Durham, Girl Guides of Canada, Scouts Canada, and many Boards of Education.

REQUIREMENTS

- **Cost Implications:** A volunteer workforce serves to lower the program costs.
  - Stencilling kits require procurement of durable and disposable items.

Children participating in the yellow fish road program

  - The storage and maintenance of stencilling kits requires planning.
  - The program should aid in the cataloguing of the storm drain system.
- **Program Support:** The primary staff demand is for program setup to provide marketing and training. A minimum of two persons is required for stencilling in high-traffic areas and commercial and industrial zones with appropriate safety measures in use (for example, reflective vests, flag person and signage).
- **Equipment:** Storm drain stencilling kits which include stencil, paint, paint brush, plastic gloves, catchbasin map, clipboard, instructions, liability release form, identification form, rags, whisk broom or brush, paper towels, trash bags, safety vest and a 5 gallon bucket to hold materials. Storm drain marking kits are now available that use plastic plaques or markers and adhesive rather than stencils.
- **Policy/By-laws:** Develop, implement and enforce an ordinance that requires inlets, catchbasins, channels and creeks to be fitted with anti-dumping, pollution prevention signs. Sewer use by-laws prohibit certain discharges to storm sewers.

PUBLIC EDUCATION/ INVOLVEMENT

- Promote participation through schools and scouting and guiding groups. Promote volunteer services (individual and business) through radio, television and mail-out campaigns. Encourage public reporting of improper waste disposal by a publicized hotline number (or stencilled onto the storm drain inlet). Training sessions of

FACTSHEET

Yellow Fish Road Program

approximately 10 to 15 minutes will cover stencilling procedures, including how to stencil, record keeping and problem drain notation. Also consider proper health and safety protocols (such as the buddy system, traffic and health concerns).

LINKAGES

- **Program:** Flow reduction; pollution prevention and control; Environmental Management System.
- **Related practices:** Used oil recycling, household hazardous waste disposal.

LIMITATIONS

The following limitations may apply:

- Private property access limits stencilling to publically owned areas.
- This program is dependent on volunteer response.
- Storm drain inlets that are physically blocked will be missed or require follow-up.
- High-traffic, commercial, industrial zones will be the responsibility of city staff.

APPLICATION EXPERIENCE

- Grand River Conservation Authority. See the website at www.grandriver.on.ca.
- Toronto Region Conservation Authority. See the website at www.trca.on.ca.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Pool Drainage

SP10

FACTSHEET

Winter pool drawdown

DESCRIPTION

Pools and spa water containing chlorine can be toxic to aquatic life. Pool backwash water containing sediment can cause sediment pollution of surface waters. The drawdown of pools prior to winter may release a large volume of water to the surface water or to combined sewers.

Outdoor swimming pools require regular maintenance, involving chemical treatment, backwashing (rinsing the filter with clean water), and winterizing. Chemical additives include chlorine or bromine to maintain pool quality, and products such as pH-up or muratic acid, which are occasionally used to maintain acid balance. Weekly backwashing is necessary to remove particles from the pool filter. Backwashing can draw down the pool water level by about one inch, and the backwashed water, containing sediments collected on the filter, is usually discharged to the lawn or driveway. In the fall, owners must blow out the pool lines (i.e. circulation, pump and filter) to avoid freezing and cracking over the winter. This winterizing activity usually results in the drawdown of in-ground pool water level by about one quarter of the pool volume, while above ground pools and spas are completely emptied.

Advice should be given to landowners by municipalities, conservation authorities and resident associations on environmentally acceptable ways to discharge pool backwash water and drawdown water for winterizing.

APPROACH

In order to have the least environmental impact, pools should be emptied at least three days after the last intense chemical application. The chlorine residual should be virtually absent.

- Backwash water is contaminated by filtered sediments and pool operators should discharge this water either to the sanitary sewer, or across the lawn to the storm sewer. By allowing pool water to flow across a lawn, some water will be lost through infiltration, some sediments will be filtered, and most remaining pool chemicals will volatilize to the air.
- If backwash water is discharged to the sanitary sewer, residents should take care to not also discharge winter drawdown water to the sanitary sewer because of the potential impacts of increased flow volume.
- In combined sewer areas, where no storm sewer exists, residents should be aware of the impacts of additional flow on the conveyance and treatment system. In these areas, infiltration measures should be encouraged to reduce the volume of water draining to the sewer system.
- Residents should be advised not to discharge the pool water onto neighbouring properties.
- Residents should be discouraged from discharging pool water into ravines to avoid erosion and slope failure.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Pool Drainage

BENEFITS

- **General**: Potentially toxic discharges will be avoided, groundwater infiltration will be enhanced, and nuisance avoided. In combined sewer areas, flow reduction will result in reduced operational costs for conveyance and treatment.
- **Pollutants Reduced:** Sediments, toxic chlorine discharges.
- **Beneficial Uses Improved:** Aesthetics, water quality, and aquatic life.

REQUIREMENTS

- **Cost Implications:** Minimal. An information flyer could be developed for distribution with water bills (since pool owners use a substantial amount of water).
- **Program Support:** Municipal staff should be aware of the recommended pool discharge method in order to respond to queries from residents.
- **Equipment:** None.
- **Policy/By-laws:** The sewer use by-law could contain a prohibition for draining pools into sanitary sewers. A discharge policy should be developed.

PUBLIC EDUCATION/ INVOLVEMENT

- Resident groups should be advised of the discharge policy. Residents with pools are the primary targets of the policy.

LINKAGES

Program: Flow reduction, source control.

- **Related practices:** Infiltration measures, natural drainage system.

REFERENCES

- *Residential and Commercial Source Control Programs to Meet Water Quality Goals*, Water Environment Research Foundation, Project 95-IRM-1, 1998, page 4-18.
- *Swimming Pool Discharge Water*, staff report, Toronto Region Conservation Authority, Nov. 11, 1996.

Erosion and Sediment Control SP11

FACTSHEET

Erosion silt fencing at a construction site

DESCRIPTION

This measure is primarily developed for construction sites where erosion and sedimentation rates are usually very high. It aims at preventing erosion on the site, and preventing sediment from leaving the site boundary.

APPROACH

Erosion and sediment control should be practiced on every construction site before and during construction. Planning of effective erosion and sediment control should follow these basic principles.

- Install sediment and erosion controls before removal of vegetative cover.
- Minimize the extent of the disturbed area and the duration of exposure.
- Stabilize and protect disturbed areas as soon as possible.
- Keep runoff velocities low.
- Protect disturbed areas from runoff.
- Retain sediment within the corridor or site area.
- Implement a thorough maintenance and follow-up program.

Erosion and sediment control practices can be classified as:

1. Temporary Cover Practices (e.g. seeding, mulching).

Stormwater outlet designed to reduce sediment discharge

2. Permanent Cover Practices (e.g. sodding, vegetative buffer strips).
3. Erosion Control Using Vegetative Practices (e.g. silt fencing, straw bales, sediment basins, sediment traps, sewer inlet traps).
4. Sediment Control Practices (e.g. temporary runoff controls, rock check dam, interception berm/swale).

An erosion and sediment control plan should be prepared by a professional engineer or technician. A municipal inspector should check the practices after installation as well as after major storm events.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Erosion and Sediment Control

BENEFITS

- **General:** Nearby drains and watercourses will be protected from sediment loads during rainstorms, preventing negative impacts on water quality. Soil loss from the site will be reduced. There may be some reduction in flow volumes.
- **Pollutants Reduced:** Sediment, Nutrients, Floatable Materials, and Oxygen Demanding Substances.
- **Beneficial Uses Improved:** Aesthetics, water quality, and aquatic life.

REQUIREMENTS

Cost Implications

Construction and maintenance costs of erosion and sediment control practices should be incorporated into the project cost. Municipal staff costs are incurred with the provision of site inspections and reviewing planning permits if necessary.

Program Support

- **Staff:** Conservation authorities and municipal reviewers assist developers by providing guidance on design of sediment and erosion control works.
- **Equipment:** There is no particular equipment requirement, except for landscaping materials and equipment while constructing some types of silt barriers.
- **Policy/By-laws:** Sediment and erosion control are usually required as conditions on subdivision or site plan development. Some municipalities require sediment and erosion control by adopting a Topsoil Removal By-law under Ontario's Topsoil Preservation Act.

PUBLIC EDUCATION/ INVOLVEMENT

- Construction site workers may need some education on the value of sediment control measures and their relationship to a healthy watershed. At some larger, possibly municipal, construction sites there may be some public education value in an interpretive message board explaining the methods used to prevent water pollution.

LINKAGES

- **Program:** Pollution prevention and control, Environmental Management System.
- **Related Practices:** Detention and Infiltration Device Maintenance, and Street Cleaning.
- **Application Experience:**

  The Town of Aurora, Ontario has adopted a Topsoil Removal By-law which requires plans to be submitted for erosion, sedimentation control and rehabilitation including monitoring and maintenance, and sedimentation basins and other measures to be in place prior to any development.

  Mississauga has a by-law regulating earth works on urban construction sites. To obtain a permit the developer must submit an erosion and sediment control plan and provide financial securities to the City to ensure that the required works are properly installed and maintained. A fee is charged to offset the City's costs for plan review and site inspection.

REFERENCES

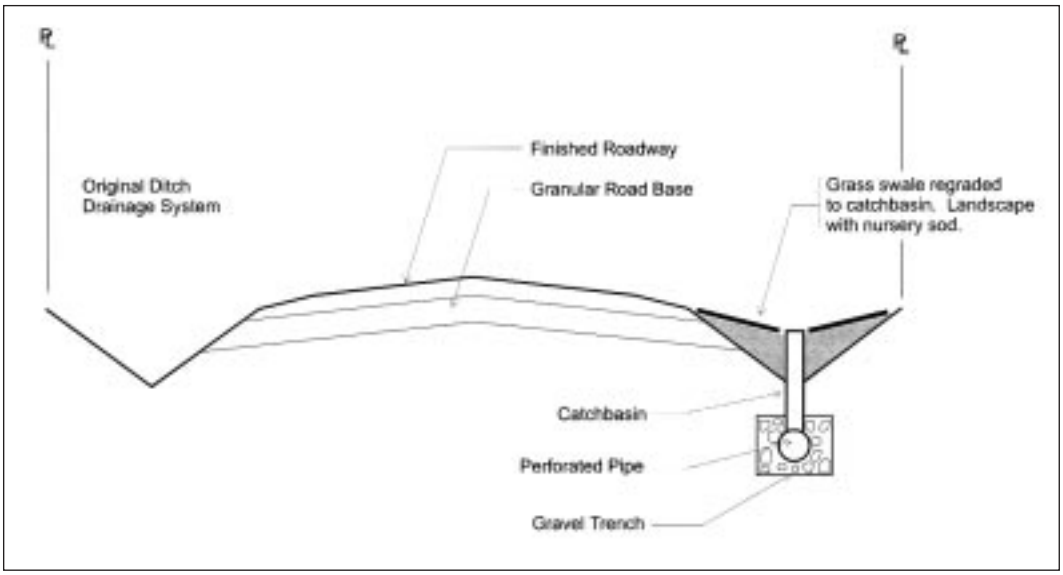
Ontario Ministry of the Environment, Ministry of Natural Resources, et. al., 1987, *Guidelines on Erosion and Sediment Control for Urban Construction Sites*

Credit Valley Conservation Authority, 1990, *Sediment Control Guidelines for Development*

Janice Teare, Michael Won, 1993, *Erosion and Sediment Control on Urban Construction Sites*. City of Mississauga.

Modifying Engineering Standards SP12

FACTSHEET



DESCRIPTION

Changes to engineering standards to allow use of and promote natural drainage systems and grassed waterways which reduce pollutants near the source through absorption and filtration of pollutants. Reduce runoff through encouraging infiltration.

APPROACH

Promote the use of surface storage and drainage (through grassed areas). Use grading standards to promote surface ponding and/or increase the detention time of surface water on grassed areas. Reduce the minimum and maximum surface slopes and provide retention areas. Change road design standards to promote roadside swales. These can include measures that promote infiltration such as rock or stone filled bases for trenches.

Care must be exercised in applying infiltration methods that might cause contaminated water to enter aquifers. Infiltration methods are best applied to residential drainage, and for rooftop drainage from other areas. Water should not be infiltrated from commercial or industrial rooftops that have building ventilation systems that release gases from volatile petroleum.

Engineering standards have to be changed to allow for alternatives to roadside ditches

BENEFITS

- **General:** Nearby drains and watercourses will be protected from sediment loads during rainstorms, preventing negative impacts on water quality. There may be some reduction in flow volumes.
- **Pollutants Reduced:** Reduced pollutants entering storm drains and local waterways from roadways include sediment, nutrients, oil, antifreeze, rubber and other vehicle residues.
- **Beneficial Uses Improved:** Aesthetics, water quality, and aquatic life.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Modifying Engineering Standards

REQUIREMENTS

- **Cost Implications:** Roadside ditches have been used historically, and are currently applied in some municipalities. Grassed swales have been evaluated for effectiveness. Some research has concluded that capital and operating costs are lower for roadside ditch applications than for conventional curb and gutter systems combined with conventional storm sewers.
- **Program Support:** Municipal staff support will be needed through the planning process to encourage developers or municipal operations managers to make the necessary modifications.
- **Equipment:** Equipment needs will be dependent on the type of measure used, and the amount of landscaping or construction required.
- Policy/By-laws: Will require the revision to engineering standards and site plan standards (and approval process).

PUBLIC EDUCATION/ INVOLVEMENT

Many measures used with this type of source control will require public education for the acceptance of periodic surface ponding (and conveyance).

LINKAGES

- **Program:** Flow reduction; pollution prevention and control; Environmental Management System.
- **Related practices:** Alternate conveyance controls (roadside ditches); at source controls (storm gardens; surface storage/infiltration).

REFERENCES

J.F. Sabourin and Associates Inc. 1997 and 2000, *An Evaluation of Roadside Ditches and Other Related Stormwater Management Practices*, Second edition revised with cost analysis and selection tool, Published by Toronto and Region Conservation Authority.

Flow Reduction at Lot Level

The measures in this category provide flow reduction to the sewers or conveyance system and provide a corresponding reduction in overall pollutant loadings. Measures address both flows to the sanitary sewer system (water conservation methods) and the storm drainage system (to reduce flows to surface drainage and combined sewers). The measures outlined include:

FR1 **Water Conservation Program**
FR2 **Downspout Disconnection**
FR3 **Rain Barrel Programs**
FR4 **Storm Garden Development**
FR5 **Infiltration Measures on Site**
FR6 **Vegetation Measures – Buffers**
FR7 **Urban Forests**
FR8 **Roof Top Treatments**

Water Conservation Program

FR1

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Water conservation and water efficiency programs are used to reduce the volume of household and industrial water entering combined and sanitary sewers and wastewater treatment plants.

APPROACH

- Integrate efforts with naturalization and pesticide reduction programs for public lands;
- Integrate water efficiency planning into municipal water supply and wastewater treatment strategies;
- Use social marketing or educational programs for householders, businesses and industries to change water use habits and attitudes;
- Produce and distribute water conservation educational brochures and printed information;
- Develop media contacts, press releases and promotional events to promote water conservation;
- Integrate public outreach programs or publication development with agencies or organizations with a compatible agenda;
- Develop incentive programs to facilitate the installation of residential low flush toilets and water saving devices;
- Use metering and water pricing strategies to provide a cost saving incentive for the end user;
- Reduce operational water use on public parks and municipal lands;
- Promote alternative landscaping or gardening practices which reduce the need for summer peak watering;
- Develop industrial and commercial information materials, workshops and water audit kits to promote water efficiency in the workplace;
- Develop school programs and provide materials such as shower timers and small water saving devices. Incorporate a monitoring component as assigned homework; and
- Reduce water leaks where possible.

BENEFITS

- **General:** The total volume of water moving from households and industrial buildings through sanitary and combined sewers is reduced by a considerable margin. This lowers the risk of combined sewer overflows during rainy weather and improves the operating efficiency and long-term performance of wastewater treatment facilities and septic tanks. Water conservation programs also reduce the demand on groundwater resources especially in dryer seasons and provide a cost-saving benefit for industries and other large volume users.
- **Pollutants Reduced:** Pollutant loads in combined sewer overflows (CSO) and sewage effluents are reduced including bacteria, nutrients, and oxygen demanding substances.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments.
- **Performance:** The use of residential low-flow toilets in one case study area achieved a 20% to 30% reduction in water use. In the same monitoring program, it was found that toilet flow reduction devices achieved only up to a 9% reduction.

Low flow showerhead

Low flush toilet

REQUIREMENTS

- **Cost Implications:** The cost of public outreach programs will be determined by the type of outreach undertaken, the level of integration with other programs and the amount of volunteer help available. Water conservation can be incorporated into municipal operational

FACTSHEET

Water Conservation Program

policies and should result in long-term cost savings.

- **Program Support:** A staff person is needed to track, review and provide coordination of efforts. Other support will be determined by the type of water conservation program undertaken and the level of integration with related program services.
- **Equipment:** Municipal water use reduction may include the retrofitting or changing of public toilets, drinking fountains and other facilities. Industrial programs may require redesign of some operations and changes to existing facilities.
- **Policy/By-laws:** Water Use By-laws are in place in some municipalities specifically to control lawn watering and pool filling during drier seasons. Municipal operation policies may be used to promote maintenance practices that reduce water use on parks and other public lands. A water use surcharge may be used to "tap" large water users, with the funds used for water/sewer system maintenance, operation and rehabilitation.

PUBLIC EDUCATION/ INVOLVEMENT

- Public outreach and education is the most significant component of a water conservation program. This can range from providing information with utility bills to a major social marketing program to reach a specific reduction target.

LINKAGES

- **Program:** Pollution prevention and control, flow reduction program.
- **Related practices:** Xeriscaping (use of drought-tolerant plants), environmentally friendly lawn maintenance programs.

LIMITATIONS

The success of the program is dependent on voluntary actions by the public.

APPLICATION EXPERIENCE

A Master Plan for Water Efficiency is a large component of the Water Resources Protection Strategy for the Regional Municipality of Waterloo. The Master Plan sets water reduction targets for the next ten years and determines what programs will be carried out to achieve these. To date the Region has facilitated the retrofitting of 7,000 low flush toilets per year through a $50 per toilet rebate incentive. Other programs include Industrial Water Audit kits and assistance, publication materials, school programs and public information displays. A total budget of $520,000 has been allocated for the next five years for the Water Efficiency Program. Preliminary data from an American Water Association Research Foundation end user study shows that toilets are the heaviest year round residential water users, and water softeners are also large water users.

- The Watershed Infrastructure Ecology Program (WIEP) in Toronto included the "5 Things You Can Do" program framework, www.ilap.com/wilson/Don/WIEP/WIEP.html.
- The City of Toronto Go Low Flow Program incorporated water conservation retrofit devices. The cost for a basic kit of several small devices for public distribution is approximately $10.15 per kit, www.city.toronto.on.ca/water.
- The Region of Durham, Ontario has produced a Household Guide to Water Efficiency as public education material for their Water Efficient Durham program. For information contact Glen Pleasance, Coordinator at (905) 668-7721, or 1-800-372-1103.

REFERENCES

Eco-Efficiency Resource Manual, EDCO. Trish Johnson Cover. Water Efficiency Branch, Environmental Services Department. Ottawa-Carlton Centre, Cartier Square, 111 Lisgar Street, Ottawa, ON K2P 2L7.

Ontario Water Works Association, 1999. *Water Efficiency: A Guidebook for Small and Medium-sized Municipalities in Canada*.

Downspout Disconnection

FR2

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Downspout disconnection describes the practice of disconnecting roof leader downspouts from the storm, sanitary or combined sewer system.

Flow is redirected to a grassed or vegetated area, soak-away pits, or stored in rain barrels. Storm water directed to grassy or planted areas can be used by the vegetation (evapotranspiration), or may percolate into the ground, eventually to discharge as a groundwater spring into a local creek.

Any surface flow, which may still reach the storm sewer system will be filtered by the grassed surfaces and carry less pollutants to the surface streams.

APPROACH

Many municipalities passed sewer use by-laws in the late 50's or early 60's to prevent foundation drains or weeping tiles from draining into the sanitary sewer system. This coincided with a change in the Ontario Building Code. Typically connections installed prior to passage of such by-laws are exempt from the by-law.

St. Catharines, Ontario has passed a by-law (By-law 91-364) to regulate sanitary and storm drainage, which prohibits connection of roof downspouts to sanitary/combined sewers without exemption; however, foundation drains connected prior to the by-law may remain connected. A grant program is available to subsidize foundation drain disconnection in areas subject to basement flooding.

For voluntary disconnection programs, residents must be convinced that the measure is beneficial, and preferably at no or minimal cost to them. For mandatory programs, by-law enforcement becomes a necessity, since lack of enforcement could leave the city liable for flood damages.

In general, lot size and soil types affect the application and success of this method.

Specific Criteria

- Lawn to lot area ratio should be greater than 0.5.
- Lot grading slope should be gentle.
- Low density residential areas preferred.
- Sandy soil is preferred but is not essential to success.

Downspout disconnect and redirected to ground

- Ground water table should be more than 2.5 metres below grade.
- Linkage to other measures that can offset some limitations (e.g. rain barrels, soak-away pits).

Additional enhancements include provision of rain barrels and advice on storm gardens and on-site infiltration measures. (See the fact sheets on these related measures.)

With the City of Toronto program, residents that were willing to be disconnected received an inspection to see if the site was suitable. If suitable, the disconnection was carried out either by a private contractor or by the resident at no cost to the resident.

BENEFITS

- **General:** The disconnection will have varied benefits depending on the original connection and the use made of the water.

  Disconnection from the sanitary or combined sewer systems will:

  - reduce overflows of combined sewer overflows (CSOs) and sanitary sewers;
  - reduce basement flooding;
  - reduce treatment costs at the sewage treatment plant;
  - reduce costs and increase effectiveness of measures such as sewer separation, storage tanks and treatment systems;

FACTSHEET

Downspout Disconnection

- provide additional benefits given below for storm sewer disconnection, if the water is not simply diverted to the storm sewer system.

Disconnection from the storm sewer will:

- reduce heavy flow rates that cause channel erosion and flooding;
- reduce the potential for flooding caused by storm sewer back-ups;
- increase the amount of water available to the groundwater system;
- increase the amount of baseflow in watercourses;
- reduce pollutant loadings to local streams and rivers;
- conserve water if rain barrels are used to store water;
- provide water for lawns and gardens and enhancing natural systems.

- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Toxic Materials, Floatable Materials, Oxygen Demanding Substances, Oil and Grease, and Bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, water and sediment quality, and aquatic life.
- **Performance:**
  - The City of Toronto has achieved disconnection of approximately 8% of the households contacted by direct mailings in its voluntary disconnection program. Some of the residential properties could not be disconnected for reasons given below under "Limitations." As a result of the disconnections, the Western Beaches Storage Tunnel was reduced in size by 8% at a significant cost saving.
  - In a demonstration study of non-structural stormwater management practices in an area of Toronto that was partially separated with the installation of road storm sewers, it was estimated that disconnection of 25% of existing downspouts would reduce the average number of remaining CSOs by 50%. Disconnection of 2/3 of downspouts would reduce the number of CSOs to less than one occurance per year, J.F. Sabourin and Associates Inc., 2000.
  - The City of St. Catharines has achieved 95% compliance with a mandatory downspout disconnection program of 11,500 residential homes in targeted areas.

REQUIREMENTS

- **Cost Implications:** The average cost for disconnecting a private property in the City of Toronto was between $180 to $220 depending on the area where the property is located and the number of downspouts on the property. Mississauga has initiated a mandatory disconnection program for the Park Royal area to combat flooding at a per household cost of $100.
- **Program Support:** A total of eight full-time staff members were dedicated to the old City of Toronto program, involved in managing the program, developing and delivering public involvement materials, inspecting properties for disconnection and managing contracts with private contractors carrying out the disconnection work. Total cost of the program is $1.6 million annually.
- **Equipment:** Private contractors provide the equipment, typically associated with installation of roof eavestroughs and downspouts.
- **Policy/By-laws:** Many municipalities are reluctant to make disconnection of downspouts mandatory, because the connections were made legally, and because sewer use by-laws, which prohibit connection of downspouts to sewers for new development, often specifically exempt the older connections.

PUBLIC EDUCATION/ INVOLVEMENT

- Voluntary programs require extensive public involvement. The City of Toronto Program included: direct mailings of letters and brochures, posters at transit shelters, fridge magnets, videos, media coverage, and school curriculum development.

LINKAGES

- **Program:** Flow reduction, water conservation.
- **Related practices:** Rain barrels and cisterns, lot level infiltration, roof top storage, downspout disconnection by-law.

FACTSHEET

Downspout Disconnection

LIMITATIONS

- Inspections of properties in the City of Toronto of residents willing to disconnect revealed that 18% were unsuitable for disconnection because:
- there was no suitable discharge area;
- the property was graded towards the house;
- there were physical obstructions on the property;
- there was risk of flooding of neighbouring property;
- the downspout was shared with an adjacent property owner (semi-detached or multiple unit dwelling) who objected to the disconnection;
- there was an internal roof drainage system (schools);
- the property was close to a ravine;
- there was contaminated sub-soil;
- soil conditions were unsuitable (limited infiltration capacity); and
- the existing fascia board and/or eavestrough was in poor condition.

APPLICATION EXPERIENCE

- See City of St. Catharines and City of Toronto case studies, in Part III.

REFERENCES

- Shelley Grice, *The Development and Promotion of "Recycle Your Rain": A City of Toronto Lot Level Stormwater Diversion Initiative*, in Stormwater Technology Transfer Conference, Stormwater Assessment Monitoring and Performance Program, MOE, 1998.
- Werner Wichman, CSO control at Toronto's Western Beaches, in *Stormwater Technology Transfer Conference*, Stormwater Assessment Monitoring and Performance Program, MOE, 1998.
- Cindy Toth, *Best Management Practices – Program Implementation*, City of St. Catharines, in Stormwater Technology Transfer Conference, Stormwater Assessment Monitoring and Performance Program, MOE, 1998.
- J.F. Sabourin Associates, *Demonstration of Non-Structural Stormwater Management Practices – Implementation Plan Overview* – Moore Park/North Rosedale Demonstration Area, Oct. 1998.
- *Demonstration of Non-Structural Stormwater Management Practices*. J.F. Sabourin and Associates Inc., 2000.

Rain Barrel Program

FR3

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Downspouts, also known as rainwater leaders, which when connected directly to the sanitary/combined sewer system, contribute to a major pollution problem at our beaches and in our creeks. Clean roof water discharge into the sanitary sewer can result in an overloaded system, which results in sewage discharge into local water bodies or household basements. An increased tax burden is also borne by the municipality faced with paying to treat an increased volume of sewage effluent. The use of rain barrels makes downspout disconnections possible in some areas where it would be difficult to disconnect.

APPROACH

The major problem areas are in homes found in the older parts of most cities. The sewers are undersized to accommodate the sewage flows and the increased wet weather flows attributed to the downspouts. In the case of combined sewer overflows (CSOs) the excessive flows outlet to a nearby drainage ditch or watercourse. If downspouts are removed in all of the sanitary/combined sewer areas, the frequency of CSOs could be reduced.

The introduction of rain barrels to store the volume of water, which previously went down the drain, provides a means of water conservation. The water collected can be used for watering plants, flowers, lawns and gardens. Some residents use their water for washing hair, laundry and cars.

A more costly method of storing larger volumes of water, including that generated by the weeping tiles around the foundation, is the installation of a cistern complete with a pumping system. In most cases the payback on the $5,000 investment to install such a system does not warrant the original investment.

BENEFITS

- **General:** Stormwater is diverted from the sanitary and combined sewers. Wastewater treatment facilities use controlled biological processes to treat sewage and the presence of sewage diluted with rainwater compromises the effectiveness of the treatment process. Rain barrels are attractive to many homeowners and can be used as an incentive to disconnect downspouts.

Downspout disconnected and redirected to a rainbarrel

- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Toxic Materials, Floatable Materials, Oxygen Demanding Substances, Oil and Grease, and Bacteria.
- **Beneficial Uses Improved:** The presence of sewage in a watercourse is reflected in the bacterial count. An acceptable count of 100 E. coli organisms per 100 milliliters of water is considered safe for swimming. Beaches are closed for counts in excess of this. Reducing the frequency of CSOs discharged into the watercourses will dramatically reduce the bacterial counts.
- **Performance:** Performance depends on the co-operation by the homeowners. To be effective the barrel must be empty at the beginning of

FACTSHEET

Rain Barrel Program

storm events. The most effective barrel is one that has a continuous slow discharge to a garden area. Rain barrels should not be used in the winter. Barrels in Toronto range from 225 to 565 litres. In combination with downspout disconnection, the application of rain barrels would result in a volume reduction of approximately 8.4% for a one year storm event, which in turn would reduce the volume of CSO storage requirements at the outlet.

REQUIREMENTS

- **Cost Implications:** Cost for subsidizing rain barrel purchase.
- **Program Support:** Program support staff need to make the assessments as part of a downspout disconnection program.
- **Equipment:** Rain barrels. It may be necessary to install an overflow to the sewers in some areas or a diversion valve to redirect winter flow.
- **Policy/By-laws:** Mandatory downspout disconnection programs can provide an incentive to use rain barrels.

PUBLIC EDUCATION/ INVOLVEMENT

- Public involvement is necessary in gaining acceptance in the voluntary use of rainbarrels. The primary message to deliver is the benefits of rainbarrels, plus the availability of rainbarrels from the municipality or private sector, and technical advice on installation and operation.

LINKAGES

- **Program:** Flow reduction, Water conservation.
- **Related practices:** Downspout disconnection, storm gardens.

LIMITATIONS

- During winter, the rainbarrels should be bypassed. A downspout bypass valve may be necessary at the connection point to the rain barrel.

APPLICATION EXPERIENCE/ REFERENCES

- City of St. Catharines
  Downspout Disconnection Campaign.
  Contact Cindy Toth,
  (416) 688-5600 Ext. 693 or (416) 935-2722.
- City of Toronto, Rain Barrel Pilot Project
  Contact Robert Klimas, (416) 394-8455.
- City of Toronto Downspout Disconnection Program
  Contact Ted Bowering
  (416) 338-5473

Storm Garden Development

FR4

FACTSHEET

This resident will have reduced pesticide, fertilizer and water use

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Reduction of stormwater volume entering the storm sewer system by on-site management practices, such as downspout disconnection with diversion to rainbarrels, ponds and infiltration areas. On-site management includes creating permanent or temporary ponds to hold stormwater for infiltration into the soil or evaporation to the atmosphere. Landscaping and plants suitable to the site conditions are used to facilitate absorption and transpiration. Other measures may include the use of perforated pipes or a soak-away pit to allow absorption; and the use of porous paving material or grassed areas to facilitate percolation of stormwater.

APPROACH

- Disconnect downspouts from storm sewer system and capture the roof water in constructed ponding areas, which provide long-term storage or short-term infiltration, depending on the site conditions and desired facility.
- Locate and avoid disruption of underground utilities such as telephone, hydro and gas lines.
- Protect basements, buildings, neighbouring properties, public sidewalks and roads with positive drainage. Ponds or infiltration facilities should be at least 3 metres from building walls.
- Use sufficient appropriate lowland vegetation to improve absorption and transpiration.
- Provide an emergency "spillway" for unusually heavy rainstorms.
- Be aware of by-laws and safety considerations regarding permanent standing water, especially for young children.
- Use natural or non-chemical insect and weed control to minimize soil and groundwater contamination.

BENEFITS

- **General:** The total volume of water moving from households and industrial buildings through sanitary and combined sewers is reduced by a considerable margin. This lowers the risk of combined sewer overflows during rainy weather and improves the operating efficiency and long-term performance of wastewater treatment facilities and septic tanks. Other benefits include recharge of local aquifers, and the improvement in water quality in local streams due to the filtering of contaminants and sediment. Bank erosion may be reduced with reduction of the volumes of stormwater into local watercourses.
- **Pollutants Reduced:** Reduction of volume of silt and chemicals washing from roadways to local streams and watercourses.
- **Beneficial Uses Improved:** Increased diversity of plants and wildlife species in urban areas. Improved property appearance, visual interest and aesthetics. Increased environmental

FACTSHEET

Storm Garden Development

education opportunities especially about the hydrologic cycle. Improved urban air quality due to the increased vegetation.

REQUIREMENTS

- **Cost Implications:** The cost of a storm garden creation will be determined by the type of project undertaken, the availability of volunteer labour and expertise, and the local site conditions. Storm gardens can be effectively incorporated into municipal, industrial and commercial landscaping projects. A household storm garden can be created at low cost with careful design and the use of native plants and seeds for landscaping.
- **Program Support:** The storm garden alternative can be incorporated as part of a downspout disconnection, water conservation or naturalization programs. Some staff hours should be dedicated to providing a resource for interested householders and to coordinate and monitor the success of demonstration projects. Other support can be determined by the level of integration with related programs and services.
- **Equipment:** Basic home gardening and landscaping equipment may be sufficient in many cases, depending on the aspirations of the homeowner or the site conditions. Some areas may require professional grading, landscaping and installation of perforated piping or porous paving.
- **Policy/By-laws:** Mandatory downspout disconnection by-laws can provide an incentive for homeowners to consider storm gardens as an alternative to rainbarrels. Some by-laws may be applicable regarding safety requirements for standing water of a certain depth, and the direction of water to neighbouring properties and roadways.

PUBLIC EDUCATION/ INVOLVEMENT

- Public outreach programs and available expertise are essential to create strong public support for urban storm gardens and other stormwater diversion measures. This can range from providing information with utility bills to a major social marketing program to reach a specific reduction target.
- Some public education is necessary on the relationship of plants to the hydrologic cycle, and the relationship of surface contamination to the health of the groundwater system. Participants will need access to clearly presented information about drainage, soil conditions, landscaping considerations and appropriate plantings.
- Volunteer involvement may be possible with municipal or school projects. Local horticultural or naturalists groups may be interested in working on demonstration sites, and providing advice on appropriate plantings.

LINKAGES

- **Program:** Flow Reduction.
- **Related practices:** Water conservation. Environmentally friendly gardening practices. Naturalization projects.

LIMITATIONS

- Some sites do not have the space or soil drainage conditions to make storm gardens a feasible project. Drainage plans must include protection of house foundations, neighbouring plantings, properties, public walkways and roads.
- Other considerations include public perceptions about the safety and health hazards of standing water, for example, mosquito breeding areas, or deeper ponds posing drowning hazards for small children. Algal growth may also be perceived an undesirable product in some storm gardens, although mitigative measures are available and public education may dispel some misconceptions.

REFERENCES

- *Development of Brochure Information for Storm Gardens*. Prepared for the Rain Water Diversion Program, City Works Services, City of Toronto, by David Orsini and Associates, December 1997.

Infiltration Measures On Site

FR5

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Infiltration practices are encouraged as a best management practice to increase the infiltration of rainwater. The practice is primarily applied to mitigate infiltration loss with the increase in impervious cover. The method is also used to increase infiltration in areas where groundwater supply is to be augmented (i.e. for water supply or seepage to streams).

Infiltration is provided through either surface or subsurface measures. Surface measures include ponding areas, infiltration basins and trenches. Subsurface measures include soak-away pits, subsurface trenches, and pervious pipes.

Flows to infiltration systems generally require sediment removal systems to reduce maintenance requirements.

APPROACH

The effectiveness of this measure is dictated by the permeability of the soil and sediment removal prior to flows entering the facility. Groundwater protection is of concern depending upon contaminants in the surface flows and groundwater protection requirements.

Specific Criteria

Criteria to be used in the application of infiltration measures are available in various documents. Effectiveness is primarily dependent upon soil permeability and requires soils testing. Specific criteria are provided in several references such as Sabourin (1997) and Ferguson (1994).

To account for blockage of infiltration basins and trenches, some agencies only calculate infiltration through the sides of the facility to determine the infiltration capacity.

BENEFITS

- **General:** The effectiveness of this measure is dependent upon permeability, groundwater level and depth to bedrock as well as control of sediment in flows.

  Overall benefits are as follows:

  - Reduced volume of inflow to a storm or sanitary sewer system;
  - Reduced combined sewer overflows (CSOs);

Soak-away pit for downspout disconnect

  - Reduced sanitary treatment costs (with combined sewers);
  - Provides recharge to groundwater to replenish groundwater levels, water supply and groundwater flows to surface water such as springs feeding streams and wetlands;
  - Reduced erosion in streams.
  - Pollutants Reduced: Will reduce pollutant loadings associated with surface runoff.
- **Beneficial Uses Improved:**
  - Maintain groundwater supply sources.
  - Protect low flows in streams.
  - Reduce flows in sewers.
- **Performance:** This depends on many variables, e.g. soil type, slope, intensity of rain, etc.

REQUIREMENTS

- **Cost Implications:** Requires capital cost for installation and maintenance. Sediment control facilities should be provided upstream of facility (e.g. catchbasins or sediment forebays). Capital costs reported from Sabourin (1997) included:
  - Costs of basins in the order of $28/cu.m of storage;
  - Cost of infiltration trenches $20,000/ha;
  - Cost of multi pipe exfiltration system $1,000/m.

  All facilities will require a regular maintenance program primarily for sediment removal.

FACTSHEET

Infiltration Measures On Site

- **Program Support:**
  - Maintenance includes removal of accumulated trash every 6 to 12 months;
  - Infiltration bed may require sediment removal unless inflow has a pre-treatment sediment removal system;
  - Sediment disposal costs could be high if sediment is contaminated;
  - Vegetation should be kept to height below 450 mm.
- **Equipment:**
  - Vegetation maintenance equipment;
  - Trash removal equipment;
  - Sediment dredging and trucking;
  - Sewer flusher/truck mounted vacuum excavators for sediment removal.
- **Policy/By-laws:**
  - Related to sewer and stormwater management system design requirements;
  - Groundwater protection, especially around wellheads;
  - Easements will be required over infiltration facilities.

PUBLIC EDUCATION/ INVOLVEMENT

- Sample devices such as soak-away pits can be applied in residential areas. Residents should be informed about the devices and educated as to proper maintenance.
- Education program will assist in community acceptance of lot-level controls on private property or facilities located in areas of high public use.

LINKAGES

- **Related Practices:** Stormwater management; sediment control; roof leader disconnection; reasonable use guideline.

LIMITATIONS

- Effectiveness is highly dependent upon sediment control facilities since infiltration media can be easily plugged.
- Design life is lengthened significantly by accounting for horizontal infiltration only.
- Low permeability soil limits use of this practice.
- High groundwater levels and/or bedrock near the surface limits applicability.
- Protection of groundwater quality must be considered.

APPLICATION EXPERIENCE

- The City of Waterloo includes provisions in the design of entire subdivisions to require that the downspouts and foundation drains (connected to a sump pump) outlet to a “dry well” or “soak-away pit”.

REFERENCES

- J. F. Sabourin and Associates Inc. 1997, *An Evaluation of Roadside Ditches*, Toronto Region Conservation Authority.
- Ferguson, Bruce K. *Stormwater Infiltration*, CRC Press, 1994.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's*, Metropolitan Washington Council of Governments, 1987.

Vegetation Measures – Buffers

FR6

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

The practice of leaving areas next to environmentally significant areas, steep slopes, watercourses and previously manicured areas of parks in natural conditions, without mowing or treatment with pesticides or herbicides.

The purpose of this best management practice (BMP) is to provide several environmental benefits including decreased sediment and other pollutants in runoff, increased infiltration, improved habitat for wildlife and protection of watercourses from thermal impacts. In addition, since the areas receive no mowing, the measure minimizes transportation of clippings and cuttings into the stormwater conveyance system.

APPROACH

Vegetation control typically involves a combination of mechanical methods and careful application of chemicals (herbicides, pesticides and fertilizers). Mechanical vegetation control includes leaving existing vegetation, cutting less frequently, hand cutting, planting low-maintenance native vegetation, and educating employees and the public. The following are areas of concern:

- Steep slopes,
- Vegetated drainage channels,
- Creeks,
- Areas adjacent to catchbasins and,
- Detention/retention basins.

BENEFITS

- **General:** Clippings/cuttings carried into the stormwater system and receiving streams can degrade water quality in several ways. Suspended solids will increase causing turbidity problems. Since most of the constituents are organic, the biological oxygen demand will increase causing a lowering of the available oxygen to animal life. In areas where litter and other solid waste pollution exists, toxic materials may be released into receiving streams resulting in degradation of water quality. Runoff flow is reduced through infiltration and evapotranspiration.
- **Pollutants Reduced:** Sediment, Nutrients, Floatable Materials, Oxygen Demanding Substances.

Vegetation alongside a watercourse to provide environmental benefits

- **Beneficial Uses Improved:** Aesthetics, aquatic life.
- **Performance:** Woodward and Rock (1991) showed 60% or better removal of both phosphorus and sediment within a 50 ft grass strip.

REQUIREMENTS

- **Cost Implications:** Minor costs may be incurred to modify certain mowing equipment to pick-up clippings or mulch and leave in place. Clippings/cuttings on flat surfaces are generally not transported by stormwater run-off unless the event is particularly intense.
- **Program Support:** Maintenance activities should be co-ordinated to avoid cutting vegetation at drainage facilities when heavy rainfalls are anticipated.
- **Equipment:** Landscaping equipment for buffer maintenance.

FACTSHEET

Vegetation Measures – Buffers

- **Policy/By-laws:** Local municipal antidumping by-laws can be used to ensure that when vegetation is controlled by cutting or removal, the waste is disposed of properly. The "Topsoil Preservation Act" provides municipalities with the ability to pass by-laws to control the limits on exposure of soil after removal of vegetation. In an effort to meet solid waste reduction goals, many municipalities require or encourage composting yard waste instead of landfill disposal. For this purpose, some municipalities even offer a separate yard waste pick-up.

PUBLIC EDUCATION/ INVOLVEMENT

- Measures to improve the disposition of clippings/cuttings are simple and inexpensive. For the most part, the solution to this problem involves behaviour modification through education. Educate the public about careful use of or alternatives to herbicides, proper disposal of clippings and cuttings, and the effect of erosion from exposed soil. Residents should be encouraged to purchase mulching lawn mowers.

LINKAGES

- **Related practices:** Alternative landscaping. Grassed waterways.

LIMITATIONS

- The public may not find existing, natural or low-maintenance vegetation as attractive or desirable as ornamental or higher maintenance vegetation.

APPLICATION EXPERIENCE

The City of Waterloo West Side and Clair Creek developments use extensive buffering of natural areas including woodlots and wetlands and storm water drainage facilities. A booklet, Living With Nature in West Side Waterloo: A Good Neighbours Guide, is given to all new homeowners in the area. It is also available on request from the City of Waterloo, 100 Regina Street South, Waterloo, ON N2J 4A8. Website: www.oceta.on.ca/city.waterloo

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- S.E.Woodward and C.A.Rock, *The Role of Natural Buffer Strips in Controlling Phosphorus and Sediment Runoff*, #AC91-044-004, WPCF 1991 Conference Proceedings.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Urban Forests

FR7

FACTSHEET

DESCRIPTION

The practice of planting trees in urban areas to achieve a high level of tree canopy cover for multiple benefits, including stormwater flow reduction. Tree leaves intercept rainfall and release it slowly to the surface, while retaining a portion that evaporates later. The shade provided by trees cools the surface and produces a micro-climate that is attractive for residents. Wildlife is protected.

APPROACH

- Trees in our urban environment provide numerous benefits in maintaining the natural hydrologic cycle, such as capturing an initial portion of runoff, sheltering natural areas from erosion, and increased infiltration and evapo-transpiration (water given off to the atmosphere as the tree grows).
- Methods developed by American Forests can quantify the hydrologic benefit of existing trees and of enhanced tree cover in the urban ecosystem. The method called "urban ecological analysis" is carried out by a software package called CITYgreen, which utilizes computer maps of an area in a geographical information system (GIS). The analysis then can be used to justify additional investments in tree planting.
- American Forests recommends a goal for tree canopy cover in urban areas of 40%, broken down into 15% for business districts, 25% for urban residential, and 50% for suburban.
- Tree planting can be encouraged for individual residents and institutions, school boards, commercial and industrial sites.
- Public participation in tree planting programs for vacant public lands are a good way to raise awareness and achieve increased tree cover.

BENEFITS

- **General:** Trees provide benefits in energy conservation and reduction in the production of greenhouse gases. Aesthetics and wildlife habitat is improved. The goal of environmental sustainability of a community is enhanced.
- **Beneficial Uses Improved:** Flow reduction benefits include: reduced flooding and erosion; reduced overflows and treatment costs for combined sewer conditions; and reduced need for stormwater retention systems (storage ponds or tunnels).

An urban forest can enhance a communities environmental sustainability

REQUIREMENTS

- **Program Support:** Parks departments and conservation authorities often have tree experts on staff and can provide help in choosing hardy native trees for urban landscaping and specific applications.
- **Equipment:** The planning and analysis of urban forest programs is enhanced by use of a geographical information system (GIS) based software package. Advanced computer systems with graphic capabilities are required.
- **Policy/By-laws:** Policies to encourage tree planting by residents, and commercial and industrial facilities can be incorporated into the planning process of the municipality. Tree protection by-laws can reduce unnecessary tree removal during development and re-development.

PUBLIC EDUCATION/ INVOLVEMENT

- Programs to encourage public involvement in tree planting programs have usually been successful. Involvement of students, service clubs and scouting groups are encouraged.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Urban Forests

LINKAGES

- **Program:** Parks management, flow reduction, planning department, conservation authority valley and stream management.
- **Related practices:** Natural drainage systems.

APPLICATION EXPERIENCE

- American Forests applied the CITYgreen software to the City of Milwaukee. The current tree canopy of 18% was calculated to be worth $305 million, in terms of the equivalent storage required to capture the flow from a two-year storm. This water volume was estimated to be captured by the existing tree canopy. If Milwaukee increased its canopy cover to the goal of 40%, additional stormwater benefits of $202 million were estimated. In addition, an air pollution reduction benefit of $18 million was estimated for the increased canopy.
- Kitchener has a program to renew its urban forest by subsidizing purchase of trees for private properties – contact the City of Kitchener at 519-741-2557
- City of Mississauga has adopted a Tree Permit By-law to regulate the removal of trees from private property. Contact City of Mississauga at 905-615-4569.

REFERENCES

- Brochures – Project Green, 477 Pelissier Street, Suite 7, Windsor, Ontario, Canada N9A 4L2. Website: www.greencanada.agora.ca
- *The State of Our Urban Forest: Assessing Tree Cover and Developing Goals*, Sept. 1997. American Forests, PO Box 2000, Washington DC 20013. Website: www.amfor.org

Rooftop Treatments

FR8

FACTSHEET

DESCRIPTION

The use of flat rooftops for storage of rainwater and for rooftop vegetation including gardens.

APPROACH

Flat building roofs can be used to store the rain that falls on them and to reduce peak flow rates of runoff to storm sewer systems. Rooftop storage has been used for several decades as a peak flow control. There are few water quality, erosion control or water balance-type benefits achieved by utilizing this type of storage on building roofs. However, site servicing and storm drainage costs can be reduced through reduced downstream storm sewer sizes and such systems contribute to flood control objectives. Rooftop storage is economical when addressed at the building design stage and requires little extra cost during construction.

Traditional rooftop storage is applicable to large flat commercial and industrial rooftops, and in some cases, residential apartment/condominium development. Peaked roofs offer few opportunities for storage. Rooftop storage is widely applied for infill development scenarios to mitigate the need for downstream storm sewer size increases. This control storage is highly effective in reducing downstream peak flow rates. The volume of storm runoff to the sewer system is not reduced as discharge occurs over a much longer duration.

Rooftop gardens (an extension of the traditional storage techniques) are a relatively recent innovation in the field of stormwater management. They are typically designed to capture runoff from smaller storms than traditional rooftop storage systems. They are therefore more oriented towards providing water quality, erosion and water balance-type benefits. Rooftop gardens may be as simple as installing a layer of soil medium and establishing turf to create a sodded roof which retains water in the soil medium and provides filtration. They can also be more elaborate, involving a fully landscaped area with trees, shrubs, gardens, fountains, seating areas and other outdoor amenities. At both extremes of the range, rooftop garden stormwater management is an integral design objective. The range of plants suitable for use in rooftop landscapes in limited by the extremes of microclimate of the rooftop setting, including high wind, low winter

Rooftop gardening will provide water quality, erosion and water balance benefits

temperature due to lack of ambient heat which is retained in the ground in at-surface situations, and drought. As a result, alpine or sub-alpine species are well suited to rooftop applications. In more elaborate schemes, infrastructure such as irrigation systems, increased insulation and venting from interior heat sources can be employed to overcome limitations imposed by adverse microclimate conditions. Rooftop gardens have been used extensively and successfully in Europe and their performance is well documented.

"According to European studies, rooftop gardens retain 70 to 100% of precipitation that falls on them in summer and about half that in winter – storing it until it is taken up by plants and returned to the atmosphere through evapotranspiration. Studies have shown that plants act as a natural filter for runoff – removing up to 95% of heavy metals such as cadmium, copper and lead" (Environment Canada, 1999).

BENEFITS

- **General:** Storage of rainwater on rooftops will reduce flow to the storm or combined sewer system in wet weather. This may reduce the effects of excess flows, such as flooding, channel erosion, and combined sewer overflows. Rooftop gardens will also reduce pollutant loadings from rooftops.
- **Beneficial Uses Improved:** Flow reduction reduces: flooding and erosion; overflows and treatment costs for combined sewer conditions; and need for stormwater retention systems (storage ponds or tunnels).

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Rooftop Treatments

REQUIREMENTS

- **Cost Implications:** No additional cost associated with option when applied in new, infill and redevelopment situations (assumes extra costs are part of the normal stormwater requirements or are based on lifestyle/amenity considerations).
- **Other:** Local building requirements should be consulted since not all municipalities may allow these practices.

LINKAGES

- **Program:** Flow reduction, downspout disconnection.
- **Related practices:** Rain barrels, storm gardens, urban forest.

LIMITATIONS

- Rooftop storage primarily applies to new construction involving structures with flat roofs. Retrofit is difficult because of structural load requirements and potential building modification costs (e.g. piping, etc).
- Rooftop garden effectiveness is design-dependent.

APPLICATION EXPERIENCE

- Traditional rooftop storage is an effective peak flow control and is accepted by some conservation authorities (e.g. Toronto and Region Conservation Authority) as part of stormwater management strategies (for flood control).

REFERENCES

- City Farmer. www.cityfarmer.org/
- Environment Canada, Science and Environment Bulletin. “Green Skylines offer urban re-leaf”. www.ec.gc.ca/science/sandejuly99/article2_e.html
- Rooftop Gardens Resource Group, 14 Sackville Place, Toronto, ON M4X 1A4. www.interlog.com/~rooftop/

Municipal Operations Measures

These measures focus on the operations of municipalities in maintaining and rehabilitating infrastructure systems such as the sewer systems, roadways and public lands such as parks. The measures outlined include:

MO1 **Sewer Use By-law**
MO2 **Road De-icing/Salt Application**
MO3 **Leaf Cleaning/Removal**
MO4 **Street Cleaning**
MO5 **Catchbasin Cleaning**
MO6 **Storm Drain Flushing**
MO7 **Municipal Yard Operation**
MO8 **Municipal & Residential Housekeeping Practices**
MO9 **Tank Spill Prevention and Control**
MO10 **Illicit Connection to Storm Sewer – Prevention and Detection**
MO11 **Leaking Sanitary Sewer Control – Combined and Sanitary (exfiltration)**

Sewer Use By-laws

M01

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Ontario municipalities may pass by-laws for prohibiting, regulating and inspecting the discharge of any gaseous, liquid or solid matter into land drainage works, private branch drains and connections to any sewer, sewer system or sewage works for the carrying away of domestic sewage or industrial wastes or both, whether connected to a treatment works or not. This authority is provided under Section 210, paragraph 150 of the Municipal Act.

APPROACH

Sewer use by-law requirements vary by local municipality. The by-law can be an effective tool to encourage industries and commercial facilities to prevent pollution because it can:

- prohibit discharges of hazardous waste;
- specify numerical discharge limits e.g., metals, organics, suspended solids, and biological oxygen demand.

BENEFITS

- **General:** Control of discharges to storm, sanitary and combined sewers will reduce loading to sewage treatment plant and environment. Sewer use programs can encourage pollution prevention by increasing awareness of pollutants of concern as well as providing incentives to control discharges and avoid penalties.
- **Pollutants Reduced:** Metals, Organics, Suspended Solids, Biochemical Oxygen Demand (BOD),Toxic Materials, Floatable Materials, Oil and Grease, Bacteria, Nutrients.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments, aquatic life.
- **Performance:** Depends on the parameters, monitoring, enforcement, and education program of the municipality. Many municipalities are able to limit discharges of metal and organic chemicals so that biosolids can be applied to agricultural land.

REQUIREMENTS

- **Cost Implications:** Program costs for staff and equipment to monitor, enforce, and educate the public and commercial and industrial establishments.

Regular inspection and testing of sanitary sewers to ensure sewer use by-laws are followed

- **Program Support:**
  - Requires technical staff to establish local limits, detect and investigate violations, and co-ordinate public education.
  - Legal advice is required to establish by-laws and pursue prosecution of significant cases.
  - Administrative staff is required to maintain and update database of industrial sewer discharges and provide program support.
- **Equipment:**
  - Personal protective equipment;
  - Sampling containers and equipment;
  - Computers/database for records maintenance;
  - Laboratory facilities in house or under contract.
- **Policy/By-laws:**
  - Municipal Act;
  - Environmental Protection Act – Ontario Regulation 347;
  - Pesticides Act;
  - Ontario Water Resources Act.

FACT SHEET

Sewer Use By-laws

PUBLIC EDUCATION/ INVOLVEMENT

The general public should be made aware of the by-law and its enforcement by the municipality. This is an example of a positive program for which a municipality can take credit.

LINKAGES

- **Program:** Pollution Prevention / Environmental Management Systems.
- **Related practices:** Best Management Plans, Codes of Management Practice.

LIMITATIONS

Staff requirements to establish limits, monitor industry, and enforce limits. Costs of laboratory analysis.

APPLICATION EXPERIENCE

Over 250 municipalities in Ontario have sewer use by-laws. In Ontario, one of the most recent sewer use by-laws to be adopted was by the City of Toronto in 2000. By-law No. 457-2000 includes discharge limits for sanitary/combined sewers and storm sewers, and pollution prevention requirements (now Toronto Municpal Code Chapter 681).

REFERENCES

- Model Sewer Use By-law, MOE, 1988.
- Section 3.4 of this Handbook “Municipal Sewer Use By-law”.
- City of Toronto Sewer Use By-Law. No. 457-2000, adopted June 2000 – now Toronto Municipal Code Chapter 681 – SEWERS.

Road De-icing/Salt Application

M02

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Past practices for winter road maintenance on local residential streets included as common practice, waiting until 25mm or more of snow accumulated before beginning to plow and treat with chemicals which frequently led to the development of "pack". Removal of this compacted layer tightly bonded to the pavement is called de-icing. This technique usually requires a large quantity of chemical to work through the pack to reach the snow/pavement interface and break it up. Arterial and collector streets receive application of salt at an earlier stage of snowfall, often at the onset of snow, in order to maintain traffic safety.

Alternatively, application of anti-icing liquid chemicals on the dry pavement delays ice formation during a snowfall or temperature drop.

Regardless of the technique applied, the common goal of a winter operations program is to provide safe road conditions without losing sight of the cost implications and potential negative impacts to the environment due to misuse of chemicals.

A recent review of road salts by Environment Canada (Priority Substances List Assessment Report – Road Salts, Environment Canada, August 2000) has recommended that "road salts", primarily sodium chloride, be considered "toxic" under Section 64 of the Canadian Environmental Protection Act 1999. This will place road salting under increasing scrutiny and increase the need for close management of operational practices.

APPROACH

The Ministry of the Environment Guideline B-4 Snow Disposal and De-Icing Operations in Ontario is provided to minimize the environmental impact of snow collection and disposal practices and de-icing operations. De-icing operational guidelines are as follows:

"The Ministry encourages the sensible and conservative use of sodium chloride and other de-icing compounds and recommends the following operational guidelines to be used by the road maintenance agencies:

- reduce de-icing chemical application rates to the minimum amount necessary to successfully perform the job. Experience has shown that an application rate in the order of 100 to 130 kg per km of two-lane road is sufficient;
- employ rate-controlled distribution equipment which applies de-icing chemical at the proper rate regardless of vehicle speed;
- apply de-icing chemicals on main thoroughfares and critical sections of the roadways only;
- where salt/sand mixtures are applied, incorporate into the admixture only enough salt to achieve desired results; and
- consider special protective measures when de-icing chemicals are applied to places in proximity to very salt sensitive areas (e.g. orchards, parks).

Salt dome and salt truck

- Level of Service – The extent to which maintenance services will be provided to a road section must be determined and preferably approved by municipal council.
- Determine techniques to be included in anti-icing program:
  - Consider Automatic Spreaders vs. Manual Controls to eliminate over and under spreading especially when truck speed is variable. Manual systems can be monitored and adjusted by the operator based upon truck speed, but such adjustments become a full-time job.
  - There are some advantages to the use of liquids at pavement temperatures above -5°C.
  - Pre-wetting of solid salt has been proven to keep more material on the road surface as opposed to being blown away by passing vehicles. Prewetting salt quickens its melting

FACTSHEET

Road De-icing/Salt Application

Warning motorists of icy conditions

action and if prewetted with liquid calcium chloride, enhances its melting effect at lower temperatures. Reductions in dry salt usage, which could be attributed to the effectiveness of prewetting with 32% liquid calcium at a rate of 4 to 8% by weight, ranged from 10 to 40%.

BENEFITS

- **General:** Excess use of salt causes corrosion of vehicles and structures, damages terrestrial vegetation and can pollute groundwater and surface water supplies (excessive sodium increases hyper-tension).
- **Pollutants Reduced:** Sodium chloride.
- **Beneficial Uses Improved:** Aquatic life.

REQUIREMENTS

- **Cost Implications:** Costs are dependent on the weather conditions, area to be serviced and the staff and equipment used for the task. Suitable storage areas must be provided for the de-icing materials and also vehicles for delivery of the materials.
- **Equipment:** Equipment includes vehicles with automatic or manual control spreaders, and any other road clearing equipment considered necessary for the area under consideration.

PUBLIC EDUCATION/ INVOLVEMENT

Public education is necessary to obtain support for snow management changes.

LINKAGES

- **Program:** Road maintenance.
- **Related practices:** Street cleaning, catchbasin cleaning.

LIMITATIONS

Reducing level of service may lead to increased risk of accidents and related liability for municipalities. Budget limitations may limit use of more expensive alternatives.

APPLICATION EXPERIENCE

City of Waterloo Program. The City of Waterloo Salt Reduction Program resulted in less salt usage through use of more effective control of the salt dosage systems in the salt spreader trucks.

The City of Toronto reviewed practices and alternatives to road salt in the early 1990s. Changing the plowing practices to favour more plowing and less salt reduced overall salt usage.

REFERENCES

- *Priority Substances List Assessment Report – Road Salts*, Environment Canada, August 2000.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Leaf Cleaning/Removal

M03

FACTSHEET

Vacuum truck and equipment for leaf removal

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Some reduction in the discharge of nutrients and pollutants to stormwater from street surfaces can be accomplished by conducting leaf cleaning/removal during the fall season. The primary benefit of this activity is the removal of a high nutrient load from the storm sewer and ultimately the creek system, which enhances overall water quality.

APPROACH

The following approaches may be effective to implement and maintain a leaf pick-up program:

- Prioritize pick-up to use the most technically advanced sweepers or truck mounted vacuums designed especially for this activity, at the greatest possible frequency in areas with the greatest numbers of trees.
- Co-ordinate efforts to coincide with garbage pick-up, require that leaves be deposited loose at curb side or in bio-degradable paper bags suitable for composting.
- Keep accurate operation logs of tonnages collected to track program.

BENEFITS

- **General:** Improved water quality in local streams. Residents abutting channels will likely partake in a program as opposed to using the creek as a disposal site. Possible diversion of compostable materials from landfill sites.
- **Pollutants Reduced:** Sediment, Nutrients, Floatable Materials, Oxygen Demanding Substances.
- **Beneficial Uses Improved:** Aesthetics, aquatic life.

REQUIREMENTS

- **Cost Implications:** A leaf pick-up program requires a significant capital and Operating and Maintenance budget.
- **Program Support:** The following considerations may apply to the leaf pick-up best management practices (BMP):
  - Sweeper operators and maintenance staff, supervisory and administrative personnel are required.
  - Traffic control/by-law officers may be required to enforce parking restrictions.
  - Pick-up routes must be designed to optimize efficiencies.

FACTSHEET

Leaf Cleaning/Removal

- Collected materials must be properly disposed. Composting is encouraged.

- **Equipment:** Mechanical broom sweepers are more effective at picking up leaves and large debris and cleaning wet streets. Provisions must be made for dumping as the on board storage fills quickly with the bulky material. Areas with heavy leaf deposits may be most easily cleaned with loaders and dump trucks or a tuck mounted vacuum system that discharges into the back of the truck.

PUBLIC EDUCATION/ INVOLVEMENT

- The general public should see the negative impacts of dumping yard wastes into abutting watercourses.
- Residents should be encouraged to dispose of leaf and yard waste in their own composters or by mowing and leaving on the lawn.
- Residents should be informed of leaf collection arrangements, such as location of leaf collection centres; use of 2-ply kraft paper yard bags instead of plastic; curbside collection dates; restrictions and proper methods of accumulation.
- Residents can benefit later by picking up the finished compost for their gardens.

LINKAGES

- **Program:** Road maintenance, Garbage collection, Municipal composting.
- **Related practices:** Street sweeping.

LIMITATIONS

The following limitations may apply to this BMP.

- Parked cars are the primary obstacles to effective program if leaves are deposited at curbside.
- The effectiveness may also be limited by traffic congestion, construction projects, and climatic conditions.
- There is some potential for danger of children playing and hiding in curbside leaf piles.

APPLICATION EXPERIENCE

- City of Kitchener 2000 Leaf to Compost Program, Public Works Department.

REFERENCES

- City of Kitchener, Department of Public Works (519) 741-2514 or www.city.kitchener.on.ca.
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Street Cleaning

MO4

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Some reduction in the discharge of pollutants to stormwater from street surfaces can be accomplished by conducting street cleaning on a regular basis. The primary and historical role of street cleaning is for sediment and litter control.

APPROACH

The following approaches may be effective to implement and maintain the street cleaning program:

- Prioritize cleaning to use the most technically advanced sweepers, at the greatest possible frequency in areas with the highest pollutant loading.
- Optimize cleaning frequency based upon interevent times (the dry period between storms). To achieve 30% removal of street dirt, the sweeping interval must be no more than 2 times the average interval between storms. To reach 50% removal, sweeping must occur 1 or 2 times during the average interval between storms.
- Conventional street cleaning may not have a very positive effect on stormwater quality because conventional street cleaners preferentially remove the large particles from the street. Valiron (1992) confirmed many earlier U.S. studies by showing that street cleaners only remove about 15% of the finest particles (less than 40 µ), while close to 80% of the largest particles (>2,000 µ) are removed.
- Increase sweeping frequency just before the rainy season.
- Keep in mind that proper maintenance and operation of sweepers greatly increases their efficiency.
- Keep accurate operation logs of curb miles swept and amount of waste collected to track program.
- Sutherland and Jelen (1996) have conducted tests using a new style street cleaner that show promise in removing large fractions of most of the street dirt particulates, even the small particles that are most heavily contaminated. The combination vacuum and brush sweeper tested is capable of much improved removal of fine particles from the streets compared to any other street cleaner ever tested. This machine was also able to remove large fractions of the fine particles even in the presence of heavy loadings of large particles. This is a built-in tandem machine, incorporating rotating sweeper brooms within a powerful vacuum head. Model analyses for Portland, Oregon indicate that monthly cleaning in a residential area may reduce the suspended solids discharges in the stormwater by about 50%, compared to only about 15% when using the older mechanical street cleaners that were tested during the early 1980s.

Note the heavy sediments picked up by the sweeper. Parked cars cause street sweeping problems street cleaning

BENEFITS

- **General:** Aesthetics. The maintenance program can reduce the amount of solid loadings to surface water.

FACTSHEET

Street Cleaning

This sweeper does a good job removing heavy sediments at spring cleanup

- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Floatable Materials, Oxygen Demanding Substances.
- **Beneficial Uses Improved:** Aesthetics, contaminated sediments, aquatic life.

REQUIREMENTS

- **Cost Implications:** A street cleaning program requires a significant capital and Operating Maintenance budget. Sweeper capital costs range from $85,000 to $140,000 (US$), with a useful life of about 4 years (Pitt, 1998).
- **Program Support:** the following considerations may apply to the street cleaning BMP:
  - Sweeper operators and maintenance staff, supervisory and administrative personnel are required.
  - Traffic control / by-law officers may be required to enforce parking restrictions.
  - Cleaning routes must be designed to optimize efficiencies.
  - Collected wastes must be properly disposed.
  - Operators require training in proper sweeper operation and technique.
- **Equipment:** Mechanical broom sweepers (more effective at picking up large debris and cleaning wet streets, less costly to purchase but generate more dust), vacuum sweepers (more effective at removing fine particles and associated heavy metals but ineffective at cleaning wet streets), combination sweepers and street flushers. Speeds of 10-15 km per hour are optimal. In addition, brush adjustment, rotation rate and sweeping pattern also affect removal efficiencies.
- **Policy/By-laws:** Densely populated areas or heavily used streets may require parking regulations to clear the street to accommodate street cleaning operation.

PUBLIC EDUCATION/ INVOLVEMENT

- The general public should be educated about the need to obey parking restrictions, to clean up after pets, and to reduce litter by using litter receptacles.

LINKAGES

- **Program:** Road Maintenance.
- **Related practices:** Catchbasin cleaning. Sewer flushing. Pet litter control.

LIMITATIONS

The following limitations may apply:

- There is currently no available conventional sweeper effective at removing oil and grease.
- Mechanical sweepers are not effective at removing fine sediment.
- Parked cars are the primary obstacles to effective street sweeping.

- Effectiveness may also be limited by street condition, traffic congestion, construction projects, climatic conditions and condition of curbs.

APPLICATION EXPERIENCE

- Normal street cleaning operations for aesthetics and traffic safety purposes are not very satisfactory from a stormwater quality perspective. These objectives are different and the removal efficiency for fine and highly polluted particles is very low. Unless the street cleaning operations can remove the fine particles, they will always be limited in their pollutant removal effectiveness. Some efficient machines are now available to clean porous pavements and infiltration structures, and new tandem machines that incorporate both brooms and vacuums have recently been shown to be very efficient, even for the smaller particles. Conventional street cleaning operations preferentially remove the largest particles, while rain preferentially removes the smallest particles. In addition, street cleaners are very inefficient when the street dirt loadings are low, when the street texture is coarse, and when parked cars interfere. However, it should also be noted that streets are not the major source of stormwater pollutants for all rains in all areas. Streets are the major source of pollutants for the smallest rains, but other areas contribute significant pollutants for moderate and large rains. Therefore, the ability of street cleaning to improve runoff quality is dependent on many issues, including the local rain patterns and other sources of runoff pollutants. More research is needed to investigate newer pavement cleaning technologies in areas such as industrial storage areas and commercial parking areas, which are critical pollutant sources.
- A study in Severn Sound found that some technologies are an efficient and cost effective stormwater management practice. Potential phosphorus reductions from stormwater of approximately 5% are achievable at less cost than most other traditional stormwater management practices.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- *Public Works Practices*, Robert Pitt, University of Alabama at Birmingham, March 30, 1998.
- Aaron Mattson, Severn Sound Remedial Action Plan, Urban Stormwater Management Strategy: Phase II – October, 1998.
- Sutherland, R.C. and S.L. Jelen. *Sophisticated stormwater quality modeling is worth the effort. In: Advances in Modeling the Management of Stormwater Impacts*. Edited by W. James. Computational Hydraulics International. Guelph, Ontario. 1996.
- Sutherland, R.C. *Studies show sweeping has beneficial impact on stormwater quality*. APWA Reporter. pp. 8 – 23. 1996.
- Valiron, 1992. *Usual techniques for stormwater pollutant removal in urban areas*. (In French), provisory report for the Seine-Normandie Water Agency.

Catchbasin Cleaning

M05

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

Vacuum truck for catchbasin cleaning

DESCRIPTION

Catchbasin and stormwater inlet maintenance should be done on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system and restore the catchbasin's sediment-trapping capacity.

APPROACH

Municipal staff should inspect public and private facilities on an annual basis to ensure compliance with the following:

- Catchbasins should be cleaned regularly enough to reduce the possibility of sediment and pollutant loading from the flushing effect of stormwater inflow. Cleaning should occur before the sump is 40% full.
- Prioritize maintenance to clean catchbasins and inlets in areas with the highest pollutant loading and in areas near sensitive water bodies. Ideally works should be scheduled just prior to the wet fall season to remove sediments and debris accumulated during the summer.
- Keep accurate operation logs of which catchbasins were cleaned and how much waste was removed to track program.
- Catchbasins with "goss traps" also capture oil and other floatable materials.

BENEFITS

- **General:** The maintenance program can reduce solid loadings to surface water and associated pollutants.
- **Pollutants Reduced:** Sediment, Heavy Metals, Floatable Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Aesthetics, contaminated sediments, aquatic life.
- **Performance:** Basically, catchbasins remove the largest particulates that are washed from the watershed during rains, preventing them from being deposited in downstream sewerage and in the receiving water. If the catchbasins are full, they cannot remove any additional particulates from the runoff. Catchbasin sump particulates can be conveniently removed to restore the trapping of these particulates, and some of the runoff pollutants. Cleaning catchbasins twice a year was found to allow the catchbasins to capture particulates for most rains. This cleaning schedule was found to reduce the annual discharges of total solids and lead by between

FACTSHEET

Catchbasin Cleaning

10 and 25 percent, and chemical oxygen demand (COD), total Kjeldahl nitrogen, total phosphorus, and zinc by between 5 and 10 percent (Pitt and Shawley 1982).

Butler and Karunaratne (1995) gives the reported particle sizes trapped in gully pot sumps. The median particle size of the sump particles is shown to be between about 300 and 3000 µm, with less than 10% of the particles smaller than 100 µm, the typical upper limit of particles found in stormwater. Catchbasin sumps trap the largest particles that are flowing in the water, and allow the finer particles to flow through the inlet structure. Relatively few pollutants are associated with these coarser solids found in the sumps, compared to the finer particles.

REQUIREMENTS

- **Cost Implications:** An aggressive catchbasin cleaning program could require a significant capital and operating and maintenance budget because of the typically large number of catchbasins in any given area and the high cost of labour and equipment required to do the work.
- **Program Support:** The following administrative and staffing considerations may apply.
  - Two-person teams are required to clean catchbasins with vacuum trucks.
  - Arrangements must be made for the proper disposal of the collected wastes.
  - Crews must be trained in proper maintenance, including record keeping, disposal and safety precautions.
- **Equipment:** Truck mounted vacuum excavators are normally used for this activity. Smaller municipalities may elect to contract this work out as an annual contract.
- **Policy/By-laws:** There are no regulatory requirements for this best management practice (BMP). Municipal by-laws should prohibit the disposal of soil, debris, refuse, hazardous waste and other pollutants in the storm sewer system.

PUBLIC EDUCATION/ INVOLVEMENT

- Educate contractors (cement, masonry, painting) and utility employees (telephone, cable, gas and hydro) about proper waste (solid and liquid) disposal.

LINKAGES

- **Program:** Sewer system maintenance.
- **Related practices:** Street sweeping. Sewer flushing.

LIMITATIONS

- The metal content of decanted liquids and solids cleaned from catchbasins should be periodically tested to determine if the liquid violates limits for disposal to the wastewater treatment plant or if the solids would be classified as a hazardous waste.

REFERENCES

- *Public Works Practices*, Robert Pitt, University of Alabama at Birmingham, March 30, 1998
- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- Butler, D. and S.H.P.G. Karunaratne. "The suspended solids trap efficiency of the roadside gully pot." *Wat. Res.* Vol. 29, No. 2. pp. 719-729. 1995.
- Pitt, R. and G. Shawley. *A Demonstration of Non-Point Source Pollution Management on Castro Valley Creek*. Alameda County Flood Control and Water Conservation District (Hayward, CA) for the Nationwide Urban Runoff Program, U.S. Environmental Protection Agency, Water Planning Division, Washington, D.C., June 1982.

Storm Drain Flushing

M06

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

A storm drain is "flushed" with water to suspend and remove deposited materials.

APPROACH

Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive build-up. In some instances, it may be necessary to acquire the existing conditions data with "closed circuit television" (CCTV) inspection.

- Whenever possible, flushed effluent should be collected and pumped to the sanitary sewer for treatment.

BENEFITS

- **General:** Flushing is particularly beneficial for storm drains with grades too flat to be self-cleansing. Flushing helps ensure pipes convey design flow and removes pollutants from the storm drain.
- **Pollutants Reduced:** Sediment, Nutrients, Heavy Metals, Oxygen Demanding Substances, Bacteria
- **Beneficial Uses Improved:** Swimming, aquatic life.
- **Performance:** The practice is a regular maintenance activity primarily directed at build-up of sediment in sewers that would cause conveyance performance to drop. Sediment removed from the sewer represents a decrease in loading to the environment.

REQUIREMENTS

- **Cost Implications:** Unless flushing to a dry/wet detention area, the collection of liquid and sediments may be costly in terms of pollutant removal benefits.
- **Program Support:**
  - Minimum two-person teams needed for routine sediment removal and flush water collection.
  - Equipment operators also required.
- **Equipment:**
  - Water source (water truck, fire hydrant).

Sewer cleaning crew with a hydraulic jetter trailer

- Sediment collector (vacuum truck, dredge).
- Inflatable devices to block flow.
- Sediment/turbidity containment/treatment equipment required if flushing to an open channel.
- **Policy/By-laws:** Municipal by-laws should include sections prohibiting the discharge of soil, debris, refuse, hazardous waste and other pollutants that may hinder the designed conveyance capacity of the storm drain system.

PUBLIC EDUCATION/ INVOLVEMENT

- If large scale flushing activities are undertaken, local residents should be informed in advance.
- The public should be educated about the purpose of storm drains and the problems created by illegal dumping.

FACTSHEET

Storm Drain Flushing

LINKAGES

- **Program:** Sewer system maintenance.
- **Related practices:** Catchbasin cleaning, Street sweeping.

LIMITATIONS

These limitations may apply:

- Flushing is most effective in small diameter pipes.
- The availability of sufficient water and pressure to do the job must be ensured. A truck-mounted sewer flusher may be required to move the sediments.
- Personnel may have difficulty finding a downstream collection area for the sediments. A vacuum excavator may be required to pump the flows out of a downstream manhole.
- The flushed liquids and sediments must be properly disposed.
- Disposal of flushed effluent to the sanitary sewer may be prohibited in some areas because of inflow capacity and water quality concerns of the local wastewater treatment plant.

APPLICATION EXPERIENCE

XCG Consultants (1999) recommended a program of sewer flushing to reduce bacterial pollution loads to the Bay of Quinte in a recent pollution control planning study.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- XCG Consultants. 1999. City of Trenton Pollution Control Planning Study – Phase 2 – Final Report. Report prepared for Quinte Conservation, the City of Trenton and Environment Canada Great Lakes 2000 Cleanup Fund.

Municipal Yard Operation

M07

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Municipal works yard operations can include the storage of soil, cold mix asphalt, sand, salt and construction rubble. Other yard activities include vehicle repair and the washing of equipment. This best management practice (BMP) covers prevention and cleanup of spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials and training employees.

APPROACH

Vehicles and equipment will leak and spill fluids. The key is to reduce the frequency and severity of leaks and spills and, when they do occur, prevent or reduce the environmental effects. The following considerations may be effective:

- Perform fluid removal and changes inside or under cover on paved surfaces.
- Keep equipment clean; don't allow excessive build-up of oil and grease. Wash water to be properly filtered and disposed.
- Inspect equipment and storage yard on a regular basis. Carry out corrective measures immediately.
- Properly store hazardous materials and waste.
- Recycle greases, used oil and filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluid.
- Have spill cleanup supplies readily available.
- Use dry cleanup methods.
- Prepare a written contingency plan between local agencies that outlines responsibilities for major spills from tanker trucks.
- Drainage from stored materials should be treated to remove sediments.
- Salt/pickled sand storage areas should be covered.
- Drainage from the entire site should be directed to a stormwater management facility to remove sediment and oils and grease.

Municipal works yard material storage

Municipal vehicle maintenance and repair

BENEFITS

- **General:** A preventative program will reduce discharge of contaminants, improve public image and reduce liability (due diligence). Active stormwater management controls further guarantee benefits.
- **Pollutants Reduced:** Heavy Metals, Toxic Materials, Oil and Grease, Suspended Solids.
- **Beneficial Uses Improved:** Contaminated sediments, aesthetics, and aquatic life.

REQUIREMENTS

- **Cost Implications:** Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be very expensive.
- **Program Support:** This BMP has no significant administrative or staffing requirements. Training is crucial to reduce the frequency, severity and effects of leaks and spills.

FACTSHEET

Municipal Yard Operation

- **Equipment:** No major equipment needed.
- **Policy/By-laws:** Waste generators, including municipalities, must be registered with the Ministry of the Environment under Ontario Regulations 347, for each location that would store hazardous waste produced on the site. Each generator must also register each subject waste that is produced at the site. This information is required in order to properly dispose of each waste.
- Technical Standards and Safety Act & Codes.
- Environmental Protection Act, Part X – Spills Notification, e.g. Spills Action Centre (SAC).

PUBLIC EDUCATION/ INVOLVEMENT

- Inform the public of the program – be a good corporate example for the private sector.

LINKAGES

- **Program:** Pollution Prevention and Control. Environmental Management System.
- **Related practices:** Municipal housekeeping practices.

LIMITATIONS

- Space and time limitations for vehicle repairs may preclude all work being conducted indoors.
- Identification of engine leaks may require some use of solvents.
- Dry floor cleaning methods may not be sufficient for some spills. Special clean-up methods may be required depending on contaminant leaked or spilled.
- Site limitations may make it difficult to install a stormwater management pond.

REFERENCES

California Storm Water Best Management Practice Handbooks; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Municipal & Residential Housekeeping MO8

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

The promotion of efficient and safe housekeeping practices (storage, use, cleanup and disposal) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products and swimming pool chemicals. Good housekeeping practices include storing hazardous products securely, safely and in original containers; reading and following product instructions; working in well-ventilated areas; and properly disposing of products.

APPROACH

- Pattern a new program after the many established programs from municipalities across the country. Integrate this best management practice (BMP) as much as possible with existing programs in the municipality.
- This measure involves three key audiences: municipal employees, the general public and small businesses.
- Implement this measure in conjunction with the safer alternative products measure.

BENEFITS

- **General:** Prevention programs reduce spills and decrease liability (due diligence).
- **Pollutants Reduced:** Sediment, Nutrients, Toxic Materials, Oxygen Demanding Substances, Oil and Grease.
- **Beneficial Uses Improved:** Potential spills are reduced along with resulting damage to aquatic life.

REQUIREMENTS

- **Cost Implications:** The primary cost for good, housekeeping practices is for staff time.
- **Program Support:** Staff is needed to train municipal employees and coordinate public education efforts. Municipal employees who handle potentially harmful materials should be trained in good housekeeping practices. Personnel who use pesticides must be trained in their use. Commercial pesticide application within the Province of Ontario requires certification.

Safe storage of flammable materials

- **Equipment:** There are no major equipment requirements for this BMP.
- **Policy/By-laws:** There are no additional regulatory requirements that apply to this BMP. Existing regulations require municipalities to properly store, use and dispose of hazardous materials and waste. This source control also focuses on materials and waste that may not be hazardous in a regulatory sense but deleterious to water quality and organisms. Housekeeping practices of the general public are addressed through education rather than regulation.

PUBLIC EDUCATION/ INVOLVEMENT

- Public awareness is a key to this BMP. The continued use or switch to good housekeeping practices is a behaviour and behaviour is based upon awareness.
- Public education programs should be promoted which provide information on such items as: storm water pollution and beneficial effects of proper disposal on water quality; reading product labels; safer alternative products; safe storage, handling and disposal of hazardous products; list of local agencies and emergency phone numbers. The following are examples of topics to be covered under a public education program.

FACTSHEET

Municipal and Residential Housekeeping

- Do not dispose of household hazardous waste:
  - in trash;
  - down storm drains or into creeks;
  - down sink or toilet;
  - onto the ground; or
  - by burning.
- Dispose hazardous wastes at household hazardous waste collection events or facilities.
- Written materials on safe use and disposal of hazardous materials should be included in public information packages.

LINKAGES

- **Program:** Pollution Prevention and Control. Environmental Management System.
- **Related practices:** Prevention and detection of illicit connections to storm sewers.

LIMITATIONS

There are no major limitations to this best management practice.

REFERENCES

California Storm Water Best Management Practice Handbooks; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Tank Spill Prevention and Control

M09

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Prevention or reduction of discharge of pollutants to stormwater from aboveground storage tanks can be done by installing safeguards against accidental releases, installing secondary containment, conducting regular inspections and training employees in standard operating procedures and spill cleanup techniques.

APPROACH

- Integrate efforts with existing, aboveground petroleum storage tank programs through the local fire and health departments, and with the local emergency response plan coordinated by the municipality.
- Use engineering safeguards to reduce the chance for spills.
- Perform regular maintenance.
- Keep ample supplies of spill cleanup materials at all facilities.
- Update spill cleanup materials as changes occur in the types of chemicals stored on site.

BENEFITS

- **General:** Public health and safety, workplace safety.
- **Pollutants Reduced:** Toxic Materials, Oil and Grease.
- **Beneficial Uses Improved:** Contaminated sediments, aquatic life, and aesthetics.

REQUIREMENTS

- **Cost Implications:** Costs will vary depending on the size of the facility and the necessary controls.
- **Program Support:** This best management practice (BMP) has no significant administrative or staffing requirements. Well-trained employees can reduce human errors that lead to accidental releases or spills.

Containment dike to contain accidental spills from above ground tanks

- **Equipment:** Containment systems (either purchased or custom manufactured).
- **Policy/By-laws:** Ministry of the Environment Environmental Protection Act; CCME Code of Practice; National Fire Code; Technical Standards and Safety Act & Codes.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Illicit Connection to Storm Sewer MO10

Prevention and Detection

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Preventing unwarranted physical connections to the storm drain system from sanitary sewers and floor drains through regulation, regular inspection, testing and education can remove a significant source of stormwater pollution.

APPROACH

The following steps are components of this best management practice (BMP):

- Ensure that existing provincial municipal building and plumbing codes prohibit physical connection of non-stormwater discharges to the storm drain system.
- Require visual inspection of new developments or redevelopments during development phase.
- Develop documentation and record keeping protocols to track inspections and catalogue the storm drain system.
- Use techniques such as zinc chloride smoke testing, fluorometric dye testing and television camera inspection to verify physical connections.
- Carry out routine monitoring of storm sewers to detect contamination from sanitary sewage, and follow up with location and disconnection of illicit connections.

BENEFITS

- **General:** An active program will reduce pollution and reduce liability (shows due diligence) for pollution from storm sewers.
- **Pollutants Reduced:** Nutrients, Oxygen Demanding Substances, Bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments, aquatic life.

REQUIREMENTS

- **Cost Implications:** Zinc chloride smoke testing, fluorometric dye testing and television camera inspection can be costly. Labour and equipment cost for verification of plumbing connections is also a factor.
- **Program Support:** Building and plumbing inspectors must verify and document inappropriate discharges into the storm drain system. Additional follow-up time is required to verify that corrective measures have been carried out.
- **Equipment:**
  - Personal protective equipment (hard hats, boots, plastic gloves, coveralls);
  - Sampling containers and storm water test kits;
  - Self-contained breathing apparatus;
  - Oxygen/combustible and hydrogen sulfide gas meters;
  - Closed circuit television (CCTV) pipeline camera;
  - Smoke and dye testing equipment.
- **Policy/By-laws:** Ontario Plumbing and Building Codes; Municipal Sewer Use by-laws.

Regular inspection and testing of storm sewers can prevent unwarranted pollution

PUBLIC EDUCATION/ INVOLVEMENT

- Consider a community awareness program (using various media), targeting appropriate audiences (homeowners, businesses and contractors) to warn against improper connections to the storm drain system and encourage public reporting of illegal connections through a community hotline telephone number. Notify community and local fire departments before testing with zinc chloride smoke testing and fluorometric dye testing in targeted areas.

FACTSHEET

Illicit Connection to Storm Sewer

LINKAGES

- **Program:** Sewer system operations.
- **Related practices:** Downspout disconnection by-law, sewer rehabilitation, and leaking sanitary sewer control.

LIMITATIONS

The following limitations may be applicable:

- Proper connections may be verified on date of inspection but could be altered afterwards by illicit connections.
- The cost for inspection equipment can be high.
- Improper physical connections to the storm drain system can occur in a number of ways, such as the overflow of cross-connections from sanitary sewers and floor drains from businesses such as auto shops and restaurants.

APPLICATION EXPERIENCE

- During dry weather surveys of outfalls to the Don River in Toronto, approximately 16% were exceeding by-law limits for bacteria, 31% for suspended solids, and 25% for iron. In follow-up surveys in the storm sewer system to locate sources of contamination, mostly cross connections of sanitary services to storm sewers, were recommended.
- St. Catharines Dry Weather Survey, 1986 to 2001 (Toth, 1993). This annual program involves sewer flow monitoring in dry weather, and sewer connectivity investigations. Remedial works can be in order of $1,000s, or $50,000 plus. The investigation work is time consuming and labour intensive.

REFERENCES

- *California Storm Water Best Management Practice Handbooks*; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.
- *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems – A Users Guide*, EPA600/R-92/238, January, 1993.
- Canviro Consultants, 1987, Don River Dry Weather Survey, *TAWMS Technical Report* #11, MOE.
- Toth, C., 1993. *Realities of Pollution Control Planning and Implementation: St. Catharines Strategy Proceedings, Stormwater Management and Combined Sewer Control Technology Transfer Conference*, Toronto 1993, Environment Canada.

Leaking Sanitary Sewer Control

MO11

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

Control procedures should be implemented for identifying, repairing and remediating infiltration, inflow and wet weather overflows from sanitary sewers to the storm drain conveyance system. Procedures include field screening, follow-up testing and compliance investigation.

APPROACH

The approaches listed below may be useful for sanitary sewer control:

- Identify dry weather infiltration and inflow first. Sewer flow monitoring is needed. Wet weather overflow connections are difficult to locate.
- Locate wet weather overflows and leaking sanitary sewers using conventional source identification techniques, including:
  - Field screening program (including field analytical testing);
  - Fluorometric dye testing;
  - Zinc chloride smoke testing;
  - Closed circuit television (CCTV) video camera inspection;
  - Nessler reagent test kits for ammonia detection; and
  - Citizens' hot line for reporting of wet weather sanitary overflows.

BENEFITS

- **General:** An active program reduces pollution and shows due diligence.
- **Pollutants Reduced:** Nutrients, Oxygen Demanding Substances, Bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, contaminated sediments.

REQUIREMENTS

- **Cost Implications:** Cost implications include the following:
  - There may be program costs for procuring necessary equipment and training.
  - Departmental cooperation is recommended for sharing or borrowing staff resources and equipment from municipal wastewater treatment departments. Infiltration, inflow and wet weather overflows from sanitary sewers can be labour and equipment intensive to locate.

Closed circuit television (CCTV) used to inspect sewers

- **Program Support:**
  - Two-person teams are needed to perform field screening and associated sampling.
  - Larger teams are required for fluorometric dye testing, zinc chloride smoke testing, CCTV inspection and physical inspection with confined space entry.
  - Program coordination is required for handling emergencies and record keeping.
- **Equipment:** The following equipment may be needed:
  - Personal protective equipment (such as hard-hats, boots, plastic gloves and coveralls);
  - Self-contained breathing apparatus;
  - Oxygen/toxic/combustible gas detection meters;
  - Sampling containers/equipment;
  - Stormwater test kits;
  - Zinc chloride smoke and dispersal fans;

FACTSHEET

Leaking Sanitary Sewer Control

Overflowing sewer manhole

- Flurometric dye and fluorometer (optional);
- Closed circuit television (CCTV) with videocassette recorder;
- Vehicle(s) and communication equipment.

- **Policy/By-laws:** Sewer use by-law.

PUBLIC EDUCATION/ INVOLVEMENT

- Consider a public awareness program through local media to identify the problem of sanitary infiltration and wet weather overflows to the storm sewer system.
- Establish a community response hotline for reporting observed sanitary leaks (in dry weather) and wet weather sanitary overflows to the storm sewer system.
- Public notification, including notifying the local fire department is required for fluorometric dye or zinc chloride smoke testing in targeted areas.

LINKAGES

- **Program:** Sewer system operation.
- **Related practices:** Illicit connection to storm sewers. Inflow and infiltration control.

LIMITATIONS

- Private property access rights needed to perform field screening/testing along storm drain right-of-ways.
- Some local ordinances require suspicion of illicit connection for guaranteed right of entry to conduct verification testing.

REFERENCES

- California Storm Water Best Management Practice Handbooks; prepared by Camp Dresser & McKee, Larry Walker Associates, Uribe and Associates, Resources Planning Associates, for Stormwater Quality Task Force, March 1993.

Local Drainage and Inlets

Local drainage and inlet measures and practices relate to controls that are applied to urban drainage systems including both surface drainage and local sewer systems. These are generally not "at-source" measures, but relate to the control of how stormwater is conveyed in the upper or early stages of the sewer system, often before entry into the piped storm or combined sewer system. The measures outlined include:

Grassed Waterways

LD1

FACTSHEET

DESCRIPTION

Use of grassed waterways for stormwater conveyance, particularly for overland flow systems in urban development areas to replace conventional storm sewers. This can include roadside ditches as well as swales between lots, and through open space areas. Generally refers to headwater systems that only convey flows on an intermittent basis.

APPROACH

Design a conveyance system that provides for grassed waterways where possible. Can have a grassed waterway parallel to a storm sewer (i.e. back of lot drainage system) or as a receiving channel for storm sewers.

BENEFITS

- **General:** Provides for slower conveyance of stormwater and storage to reduce peaks. Provides an opportunity for infiltration to reduce runoff volumes. Vegetation filters pollutants from runoffs. Provides habitat for wildlife and food source for downstream aquatic habitat.
- **Pollutants Reduced:** Sediment, nutrients, heavy metals, toxic materials, oxygen demanding substances, and bacteria.
- **Beneficial Uses Improved:** Aesthetics, downstream water quality, and reduced potential for instream erosion.
- **Performance:** Drainage areas up to 2 ha can be serviced by grassed swales (at 35% imperviousness), assuming a channel slope of 0.5%, 0.75m bottom width, and maximum allowable flow of 0.15 m3/s and maximum allowable velocity of 0.5 m/s. Check dams can be added at intervals to enhance infiltration and sedimentation. If space is available, the addition of a vegetated filter strip can further enhance infiltration and sediment removal.

REQUIREMENTS

- **Cost Implications:**
  - Additional land for conveyance system
  - Cost of channel $36.00/m

Grassed swales reduce peak flow and trap sediments and nutrients

- **Program Support:**
  - Maintenance of vegetation
  - Removal of sediment may be necessary
  - Removal of litter and posting of signs for litter control
- **Equipment:**
  - Parkland maintenance equipment
  - Soil excavation and removal
- **Policy/By-laws:**
  - Greenspace management
  - Litter control

PUBLIC EDUCATION/ INVOLVEMENT

- Education programs will generally be necessary to gain acceptance of roadside ditches and grassed swales between lots. Should be directed at the environmental benefits provided.
- Proper treatment of greenways.
- Litter control.

LINKAGES

- **Program:** Flow control, pollution control.
- **Related practices:** Infiltration, natural drainage systems.

LIMITATIONS

- Require excess depth to provide outlet for storm sewers (if storm sewers are upstream of the application).

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Grassed Waterways

- Drainage area limitations to prevent excess flow volumes and velocity that would erode the channel.

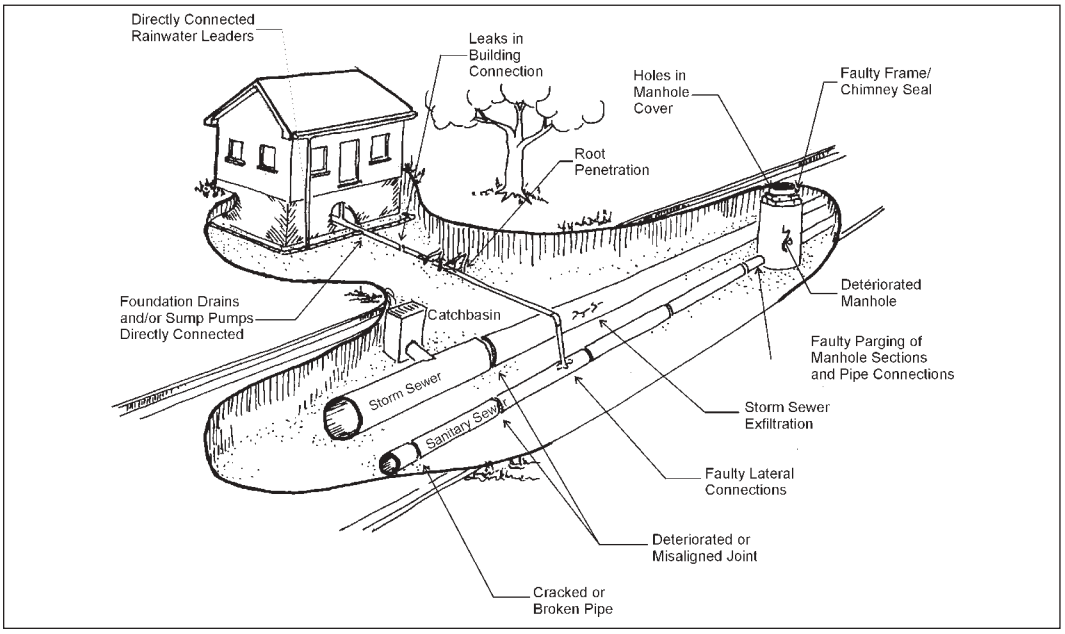
REFERENCES

- J.F. Sabournin and Associates, *Evaluation of Roadside Ditches and Other Related Stormwater Management Practices*, April 1997, published by Toronto Region Conservation Authority.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Inflow and Infiltration Control

LD2

FACTSHEET



Typical inflow and infiltration problems

DESCRIPTION

Control of extraneous flow to sanitary sewers (and combined) is closely related to sewer rehabilitation. The types of inflow and infiltration (I/I) are defined as follows:

- Inflow is the water (other than wastewater from sanitary sources) entering the sanitary or combined sewer system from the surface through downspouts, catchbasins maintenance hole covers, and cross connections to storm sewers.
- Infiltration is the water entering the sanitary or combined sewer system from the ground through defects in the piping system (broken pipes, leaking joints) or through foundation drains. Infiltration may occur in dry weather from an elevated ground water table, or may increase following rain events (rainfall induced infiltration).

The effects of the I/I flows are to:

- cause sanitary sewer overflows, increase combined sewer overflows, and treatment plant bypasses;
- use up capacity in sewers, pumping stations and treatment plants, requiring earlier expansions to accommodate growth;
- increase pumping and treatment costs; and
- increase load of contaminants to the environment.

APPROACH

The approach to reducing flows depends on the source, which can be determined by an investigation of the sewer system. The type of sewer and source of the inflow or infiltration affect the control approach and cost significantly. In particular, clean rooftop drainage from downspouts does not need treatment and is a good candidate for draining to the surface or to an infiltration measure.

The methods of investigation include:

- flow measurement at various locations in the sewer system to identify areas of high I/I and with examination of the flow response to rain, give an indication of the sources;
- visual inspection of maintenance hole lids and structures for leaks, visual inspection of downspout connections;
- television inspection of sewers for cross connections, broken pipes and leaky joints;
- smoke studies to indicate downspouts connected to sanitary sewers and dye studies to locate cross connections.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Inflow and Infiltration Control

CONTROL OR REHABILITATION CAN CONSIST OF THE FOLLOWING:

Problem	Method	Implications
Downspout connected to sanitary/combined sewer	Downspout disconnection program (see separate fact sheet).	See separate fact sheet.
Foundation drain connected to sanitary/ combined sewer	Install sump pumps and connect to surface or storm sewer. Redirect connection to storm sewer.	Relatively high cost. Difficulty examining private property connections. Many connections made legally when constructed.
Leaking joints in sewer or with private connection	Sewer rehabilitation, including reconstruction of sewer, or relining of sewer.	Sewer reconstruction is high cost and disruptive to traffic and the surrounding uses. This may be an opportunity to install alternate drainage features such as infiltration devices in the road right of way.
Broken sewer	Relining, spot reconstruction, major reconstruction if extensive and linked to other problems.	
Maintenance hole leaks	Spot repair. Replace maintenance hole covers.	Low cost.
Connection of surface drains to combined sewer system	Reroute to storm drains. Source flow reductions or infiltration measures at the inlet.	Moderate costs depending on the area drained and opportunities presented by the land use and density.

BENEFITS

- **General:** Reduced costs for sewage treatment and pumping, increased capacity in sewer system and sewage treatment can defer capital expenses for expansion to accommodate new growth.
- **Pollutants Reduced:** Pollutants in combined sewer overflows reduced include: sediment, nutrients, heavy metals, toxic materials, floatable materials, oxygen demanding substances, oil and grease, and bacteria.
- **Beneficial Uses Improved:** Swimming, aesthetics, and aquatic life.

REQUIREMENTS

- **Cost Implications:** Sewer investigation studies (in Ontario often called infrastructure needs studies) may require engineering consulting firms or specialized service companies to investigate and analyse the system. Capital costs for rehabilitation can be high with benefits largely in reduced operation costs. An economic analysis should be carried out to establish locations and measures that are cost effective. If capital costs to expand sewage treatment or control overflows are expected, then I/I control programs can be more attractive, i.e. economically justified.
- **Program Support:** Ongoing inspection services in the municipality can identify many of the problems and carry out repairs as part of the ongoing maintenance program. A program to support disconnection of downspouts and foundation drain connections may be needed, to enforce legal requirements to disconnect, or to assist in voluntary disconnection measures.
- **Equipment:** Specialized equipment is needed for inspection. Different rehabilitation measures may require specialized equipment for installation, e.g. sewer relining.
- **Policy/By-laws:** By-laws specific to downspout and foundation connections are usually in-place. Specific programs or by-laws may be required for connections made prior to the by-law enactment.

Inflow and Infiltration Control

FACTSHEET

PUBLIC EDUCATION/ INVOLVEMENT

- Programs to encourage voluntary disconnection of downspouts and foundation drain connections should be put in place, in conjunction with technical support.

LINKAGES

- **Program:** Flow reduction program, downspout disconnection program, sewer use by-law, and water conservation program.

APPLICATION EXPERIENCE

- In San Antonio, Texas, a maintenance hole rehabilitation program was carried out over two years for 30,000 maintenance holes. Rehabilitation costs, including investigative studies, design and construction totaled $11.6 million ($US in 1991). Dry weather I/I was reduced 47% and wet weather I/I was reduced 14%. The 20-year total cost savings for the flow eliminated was estimated at $104 million for transportation (sewers and pumping) and treatment (Infiltration/Inflow Performance Evaluation, San Antonio, Texas, WEF Conference Proceedings, 1992).

REFERENCES

- *ASCE Manual of Practice No. 62* and *WEF Manual of Practice FD-6*, 1983.Existing Sewer Evaluation & Rehabilitation.
- EPA/625/6-91/030, 1991. Handbook-Sewer System Infrastructure Analysis and Rehabilitation.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Detention and Infiltration Device Maintenance LD3

FACTSHEET

Type of Measure
FLOW REDUCTION
SOURCE CONTROL
DRAINAGE SYSTEM CONTROL

Program Element
RESIDENTIAL
COMMERCIAL ACTIVITY
INDUSTRIAL ACTIVITY
MUNICIPAL ACTIVITY

DESCRIPTION

Detention ponds and infiltration devices collect litter and sediment deposits. Proper maintenance and silt removal is required on both a routine and corrective basis to promote effective pollutant removal efficiencies.

APPROACH

These approaches may be beneficial for detention and infiltration device maintenance best management practice (BMP):

- Remove silt after sufficient accumulation.
- Periodically clean accumulated sediment and silt from pretreatment inlets.
- Infiltration device silt removal should occur when the infiltration rate drops below 13 mm (0.5 in.) per hour.
- Removal of accumulated paper, trash and debris should occur at least every 6 months or as needed to prevent clogging of control devices.
- Mow the slopes periodically and check for clogging and erosion.
- Corrective maintenance may require more frequent attention.

BENEFITS

- **General:** Stormwater retention/recharge basins dispose of surface water and recharge groundwater aquifers. Monitoring has confirmed that a variety of organic and inorganic contaminants generated in the catchments are removed by sorption within the top 4 cm of sediment in the recharge basin, making these contaminants available for removal and disposal through routine maintenance. Monitoring results also established that contaminants have not degraded groundwater quality beneath the basins.
- **Pollutants Reduced:** Sediment, heavy metals, oxygen demanding substances, and bacteria.
- **Beneficial Uses Improved:** Aesthetics, contaminated sediments, and aquatic life.
- **Performance:** Removal of sediments improves performance. Infiltration devices can be completely clogged, with substantial improvements in efficiency after maintenance. MOE (1994 and updates) suggests that sediments be removed when suspended solids removal efficiency drops by 5%.

Maintenance and silt removal to promote effective pollutant removal efficiencies

REQUIREMENTS

- **Cost Implications:** Frequent sediment removal is labour intensive and costly. Transport and disposal costs for waste material will vary proportionately with the volume of material. Disposal costs can be high if sediments have high levels of toxins.
- **Program Support:** Staff complement will vary depending upon the size of the program. A staff team is required to respond to corrective maintenance measures. Training of staff in appropriate excavation and maintenance procedures and proper disposal methods is required.
- **Equipment:** Equipment considerations include vehicles, dump trucks, bulldozers, backhoes, excavators, mowers, weed trimmers, sickles, shovels, rakes and personal protective equipment (goggles, dust masks, coveralls, boots and gloves).
- **Policy/By-laws:** Certificates of Approval for stormwater facilities issued under the Ontario Water Resources Act often have standard conditions requiring maintenance of the facility and specifically for removal of sediment. Sediment disposal is covered by guidelines (MOE 1996). Municipalities often require the developer to remove sediment from facilities before assuming ownership.

FACTSHEET

Detention and Infiltration Device

PUBLIC EDUCATION/ INVOLVEMENT

- It may be useful to create a public education campaign to explain the function of wet and dry detention ponds and infiltration devices and their operational requirements for proper effectiveness. Also, encourage the public to report facilities needing maintenance – where possible, publish a municipal contact and phone number.

LINKAGES

- **Program:** Stormwater management facility maintenance. Sewer system maintenance.
- **Related practices:** Erosion control.

LIMITATIONS

- Dredging sediments in wet detention ponds produces slurried waste that often exceeds the limits for acceptability used by many landfills.

APPLICATION EXPERIENCE

- Greenland (1999) presents several case studies.

REFERENCES

- Greenland International Consulting Inc, August 1999, *Stormwater Management Facility Sediment Maintenance Guide*, published by Toronto Region Conservation Authority.
- Ministry of the Environment, June, 1996, *Guideline for Use at Contaminated Sites in Ontario.*
- Ministry of the Environment, 1994 and updates. *Stormwater Management Practices Planning and Design Manual.*

Natural Drainage Elements

LD4

FACTSHEET

DESCRIPTION

The use of natural drainage elements in the design and implementation of conveyance facilities. This can include the preservation of existing streams particularly "headwater" streams (i.e. located near the top of a watershed) and channels when developing lands or the construction of new "natural" watercourses. Vegetation is used to enhance the uptake of nutrients and pollutants and to provide aquatic and terrestrial habitat.

Grassed swales will provide similar benefits, however, more effective vegetation including shrubs, trees and wetland plants (in appropriate areas) should be applied where possible.

APPROACH

The development layout, lot sizes and conveyance system will influence the feasibility and/or application of this approach.

Specific Approach:

- The width of easement required is dependent on the design of the channel system.
- Channel design is dependent upon:
  - conveyance needs (capacity);
  - outlet requirements (depth);
  - channel requirements for stability (i.e. side slopes for stability, meander belt width for natural streams).
- Stream setbacks (buffer widths) are dependent upon protection requirements generally:
  - coldwater streams – 30 m;
  - warmwater and degraded systems – 15 m.
- Riparian vegetation along streams will be required to mitigate impact to water temperature, filtration for water quality and wildlife habitat linkages wherever possible.

BENEFITS

- **General:**
  - Provision of natural drainage will reduce flows.
  - Reduced pollutant loadings to streams.
- **Pollutants Reduced:** Sediment, nutrients, toxic compounds, pesticides, bacteria and temperature.

Vegetation is used to enhance the uptake of nutrients and pollutants

- **Beneficial Uses Improved:** Aesthetics, and aquatic life.
- **Performance:**
  - Vegetative buffers can provide over 75% removal of sediment in sheet runoff to streams.
  - Stream temperature can be reduced to coldwater levels if ground water inflow occurs. Stream temperature increases will not occur with effective stream cover (high canopy bushes or trees).

REQUIREMENTS

- **Cost Implications:**
  - Costs for operation and maintenance.
  - Research has indicated that life cycle costs are less than those for open systems with hard linings. Patterson (1999) indicates a threefold saving for using natural channel designs over large concrete channels based on several case studies.
- **Program Support:** Maintenance, may require some trimming and removal of dead falls, depending upon application.
- **Equipment:** Landscaping equipment.
- **Policy/By-laws:**
  - Regulations for open drainage systems;
  - Easements, fill lines;
  - Protection of buffer systems, avoiding intrusion;
  - Parks, pathway design and application.

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

FACTSHEET

Natural Drainage Elements

PUBLIC EDUCATION/ INVOLVEMENT

- Many stream rehabilitation/enhancement and clean-up projects carried out with community involvement can provide a significant cost reduction, and instill community ownership and commitment to protecting and maintaining the natural system.

LINKAGES

- **Program:** Stream rehabilitation, channel erosion control.
- **Related practices:** Grassed waterways, and bioengineering.

LIMITATIONS

- Requiries additional land for stream corridor system and buffers.
- Policies are required for protection of stream corridor in headwater systems beyond most current floodplain and natural environment policies.

APPLICATION EXPERIENCE

- The approach is encouraged in a number of planning jurisdictions and Ontario Conservation Authorities, (particularly Toronto and Region Conservation Authority, Credit Valley Conservation, Grand River Conservation Authority). Extensive case studies are given in Patterson (1999).

REFERENCES

- Ministry of Natural Resources, June 1994, *Natural Channel Guidelines for Design and Management*.
- Timothy S. Patterson, January, 1999, *Comparison of Soil Bioengineering and Hard Structures for Riverine and shoreline Erosion Control in Ontario – Costs and Effectiveness*, Environment Canada.
- The Federal Interagency Stream Restoration working Group 1998, *Restoration, Principles Processes and Practices*.
- MOE, 1994, *Stormwater Management Practices Planning and Design Manual*, and updates.

Inlet Controls – Flow Reducers

LD5

FACTSHEET

Type of Measure

FLOW REDUCTION

SOURCE CONTROL

DRAINAGE SYSTEM CONTROL

Program Element

RESIDENTIAL

COMMERCIAL ACTIVITY

INDUSTRIAL ACTIVITY

MUNICIPAL ACTIVITY

DESCRIPTION

The provision of inlet control devices to limit the flow of stormwater to storm or combined sewers. Can be used with or without storage at the control device. Excess water will be stored or continue to flow overland.

APPROACH

The facility can be used to limit the flow of stormwater when the capacity of the downstream facility is limited (or to avoid overflow of a combined system). The feasibility will depend upon the potential for flooding when flows are limited at the inlet.

The sizing of an inlet control will depend upon:

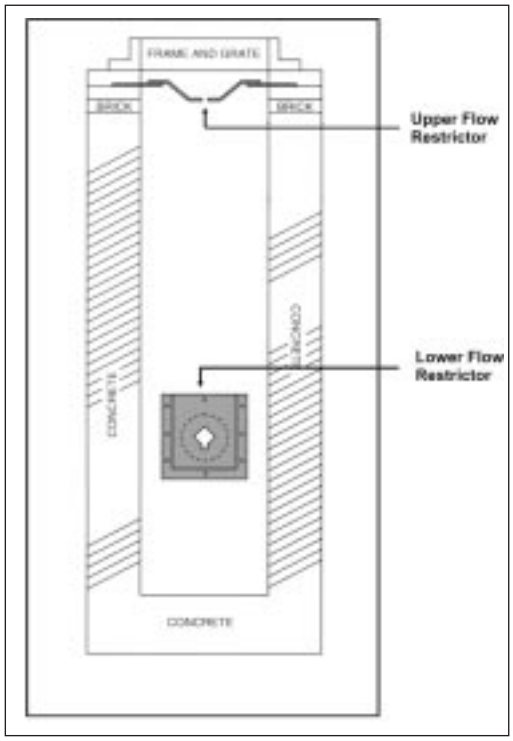
- design criteria for conveyance (major overland and minor piped system),
- the available downstream capacity,
- available storage or major overland conveyance system to carry the excess flows,
- types of inlet control including: orifice plates and vortex valves,
- acceptability of street ponding for longer periods during and after storm events.

BENEFITS

- **General:** Reduces flows in the sewer system (combined or otherwise) and reduces the potential for overflow or treatment requirements, and prevents flooding of properties connected to sewers.
- **Pollutants Reduced:** Pollutants associated with combined sewer overflows (CSOs), no impact if flow reduced to storm sewers.
- **Beneficial Uses Improved:** Reduced CSOs, improved swimming, bacteria, and aesthetics.
- **Performance:** Quantified overflow reduction. Vortex valves, while more expensive, are less likely to clog, since the cross sectional flow area is 4 to 6 times larger than an equivalent orifice.

REQUIREMENTS

- **Cost Implications:** Installation cost; maintenance if blocked.
- **Program Support:** Maintenance staff.



Inlet control device to limit the flow of stormwater to storm or combined sewers

- **Equipment:** Sewer maintenance equipment.
- **Policy/By-laws:** Level of ponding on street systems needs to be considered, and engineering standards.

PUBLIC EDUCATION/ INVOLVEMENT

This measure may result in surface ponding. Public information may be necessary to educate.

LINKAGES

- **Program:** Flow reduction. Flood Prevention.
- **Related practices:** Downspout disconnection.

LIMITATIONS

- Limited to areas with available storage or overland flow path. Can result in surface ponding.

APPLICATION EXPERIENCE

- These are in limited use in the Toronto area.

FACTSHEET

Inlet Controls – Flow Reducers

REFERENCES

- W.C. Pisano. *Inlet Control Concepts on Catchbasins – U.S. Experience in Urban Stormwater Quality Enhancement*, ed. H.C. Iowa, ASCE, 1989.