WASTEWATER SOURCE CONTROL

A BEST PRACTICE BY THE NATIONAL GUIDE TO SUSTAINABLE MUNICIPAL INFRASTRUCTURE

National Guide to Sustainable Municipal Infrastructure

Guide national pour des infrastructures municipales durables

Canada

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Federation of Canadian Municipalities

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Wastewater Source Control
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FOREWORD

In spite of recent increases in public infrastructure investments, municipal infrastructure is decaying faster than it is being renewed. Factors such as low funding, population growth, tighter health and environmental requirements, poor quality control leading to inferior installation, inadequate inspection and maintenance, and lack of consistency and uniformity in design, construction, and operation practices have impacted on municipal infrastructure. At the same time, an increased burden on infrastructure due to significant growth in some sectors tends to quicken the ageing process while increasing the social and monetary cost of service disruptions due to maintenance, repairs, or replacement.

With the intention of facing these challenges and opportunities, the Federation of Canadian Municipalities (FCM) and the National Research Council (NRC) have joined forces to deliver the *National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices*. The Guide project, funded by the Infrastructure Canada program, NRC, and through in-kind contributions from public and private municipal infrastructure stakeholders, aims to provide a decision-making and investment planning tool as well as a compendium of technical best practices. It provides a road map to the best available knowledge and solutions for addressing infrastructure issues. It is also a focal point for the Canadian network of practitioners, researchers and municipal governments focused on infrastructure operations and maintenance.

The *National Guide to Sustainable Municipal Infrastructure* offers the opportunity to consolidate the vast body of existing knowledge and shape it into best practices that can be used by decision makers and technical personnel in the public and private sectors. It provides instruments to help municipalities identify needs, evaluate solutions, and plan long-term, sustainable strategies for improved infrastructure performance at the best available cost with the least environmental impact. The five initial target areas of the Guide are: potable water systems (production and distribution), storm and wastewater systems (collection, treatment, disposal), municipal roads and sidewalks, environmental protocols, and decision making and investment planning.

Part A of the *National Guide to Sustainable Municipal Infrastructure* focuses on decision-making and investment planning issues related to municipal infrastructure. Part B is a compendium of technical best practices and is qualitatively distinct from Part A. Among the most significant of its distinctions is the group of practitioners for which it is intended. Part A, or the decision making and investment planning component of the Guide, is intended to support the practices and efforts of elected officials and senior administrative and management staff in municipalities throughout Canada.

It is expected that the Guide will expand and evolve over time. To focus on the most urgent knowledge needs of infrastructure planners and practitioners, the committees solicited and received recommendations, comments and suggestions from various stakeholder groups, which shaped the enclosed document. Although the best practices are adapted, wherever possible, to reflect varying municipal needs, they remain guidelines based on the collective judgments of peer experts. Discretion must be exercised in applying these guidelines to account for specific local conditions (e.g., geographic location, municipality size, climatic condition).

For additional information or to provide comments and feedback, please visit the Guide at <www.infraguide.gc.ca> or contact the Guide team at infraguide@nrc.ca.

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This best practice was developed by stakeholders from Canadian municipalities and specialists from across Canada, based on information from a scan of municipal practices and an extensive literature review. The following members of the National Guide's Storm and Wastewater Technical Committee provided guidance and direction in the development of this best practice. They were assisted by the Guide Directorate staff and by SNC Lavalin Inc. in association with Aquapraxis Inc.

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EXECUTIVE SUMMARY

This best practice describes the implementation of a wastewater source control program. It is part of the *National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices*. This best practice, together with others developed in the Guide, will provide a road map to the best available methods for addressing municipal infrastructure issues.

Sewer systems have been used historically to collect liquid wastes and to convey them to receiving waters. Over the past 75 years, as receiving waters became noticeably polluted, municipalities started providing wastewater treatment to protect the health of the public and the aquatic environment. The level of treatment provided is linked to the effluent discharge criteria imposed by regulating authorities. The efficiency of the treatment and its costs are closely related to the quantity and quality of the wastewater to be treated. Source control is therefore recognized as an economical and sustainable means of managing wastewater treatment. More stringent effluent discharge criteria and management of biosolids generated by the treatment process are two elements that make source control an essential tool for sound infrastructure management.

The main objectives of a wastewater source control program are:

- to manage the demand for service through user rates and cost allocation, thereby delaying infrastructure expansions or upgrades;
- to protect sewer workers and the public from discharges to the sewers of materials that are toxic, flammable, or explosive;
- to protect the sewer infrastructure from corrosive materials, such as acids, or from materials, such as sand, rocks, and grease, that can clog the sewer system and lead to sewer backups;
- to protect wastewater treatment processes from substances or conditions which may upset the treatment processes and generate poor quality discharge and effluent permit violations;
- to protect the environment from substances such as toxic organics or toxic trace metals which cannot be removed technically or economically by the treatment processes; and
- to improve the quality of biosolids to enhance their recycling into fertilizers, soil improvement materials, and compost.

To meet these objectives, a wastewater source control program may include all or some of the following elements:

- a sewer-use by-law to regulate what can or cannot be discharged into sewers, and define monitoring and sampling, compliance, enforcement, fines for violation, and rates for additional services;

- clearly defined monitoring, enforcement and compliance programs;

- educational and awareness programs for the public and residential users to promote wastewater reduction through water conservation, replacement of hazardous products by more environmentally friendly substances, reduction of hazardous products used, and recycling of these materials; similar programs can also be developed for industrial, commercial, and institutional users;

- codes of practice or best management plans to address issues related to some trades or businesses that define specific requirements, such as the installation of pretreatment equipment (e.g., grease interceptors in restaurants and food processing facilities);

- wastewater rates to promote a user-pay approach and reduce hydraulic and pollutant loading to the wastewater treatment facilities; and

- pollution prevention plans to control or eliminate pollutants before they are discharged to the sewer system.

It is a good practice for all municipalities to have a wastewater source control program to meet these objectives. The sewer-use by-law is the basic element of a source control program. The by-law must be adapted within the context of the municipality and tailored to the type, size, and number of industrial and commercial activities. Review of the by-law should be done on a regular basis to integrate new parameters that might affect quality of effluent or biosolid at the treatment plant. In jurisdictions where a wastewater treatment plant serves more than one municipality, an all-encompassing sewer-use by-law should regulate discharges into the common system from all municipalities. Appropriate regulatory and enforcement powers must be given to the agency charged with enforcing the by-law requirements.

Other elements of a wastewater source control program should be developed and implemented based on specific conditions and the needs of each municipality. Source control activities, such as monitoring, can be costly and cumbersome for sewer users and the municipality. A proper adjustment of such activities according to the size and context of the municipality is very important.

Educational and awareness programs often produce results in the medium to long term. In the short term, pollutant reduction targets based on voluntary approaches should be realistic and not overly optimistic.

Complementary programs must accompany the wastewater source control program to ensure that problems associated with the pollutants of concern are not just moved from one medium to another. For instance, hazardous waste collection should be in place, to avoid shifting problems to the landfill site.

1. GENERAL

1.1 INTRODUCTION

Municipal storm and sanitary sewer systems have been used historically to collect liquid wastes from residences as well as from industrial, commercial, and institutional premises. Over the past 75 years, many municipalities have added various levels of treatment at end-of-the-pipe facilities to remove contaminants from the wastewater before releasing the effluent to the environment. It has been recognized that, for many water quality parameters, an approach based on prevention and optimization of costs and impacts at the source is better than removing diluted pollutants from combined discharges at a centralized facility. It is now widely accepted that a wastewater source control program can provide an economical and sustainable means of managing wastewater treatment systems. Municipal wastewater treatment plants are usually designed to remove contaminants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease but have limited capacity to treat or remove other contaminants such as metals. This type of a program can significantly reduce flows and pollutant loads to the centralized treatment facility and contribute to improved wastewater treatment plant effluent quality while ensuring more favourable reuse of biosolids generated by the treatment processes. Further, a reduction in demand for treatment capacity may increase the design life of existing facilities delaying costly capital expenditures that otherwise would be necessary.

1.2 SCOPE

This best practice is one of numerous best practices developed by the *National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices*. It is one aspect of more than 50 that have been identified by the Guide's Storm and Wastewater Technical Committee relating to linear infrastructure, wastewater treatment, customer interaction, and receiving water issues. The objective of this best practice is to define the content of a wastewater source control program.

1.3 GLOSSARY

Biochemical oxygen demand (BOD) — The quantity of oxygen consumed, expressed in milligrams per litre, during biochemical oxidation of matter over a specified period at a temperature of 20°C.

By-laws — The official rules and regulations which govern a municipality's or corporation's management derived from the powers of a primary document such as a constitution or a charter.

Chemical oxygen demand (COD) — The quantity of oxygen used in the chemical oxidation of organic matter under standard laboratory procedures, expressed in milligrams per litre.

Combined sewer — A sewer intended to function simultaneously as a storm sewer and a sanitary sewer.

Overstrength sewage — Wastewater with one or more constituent concentrations exceeding limits set out by the respective sewer use by-law.

Pollutant — An impurity (contaminant) that causes an undesirable change in the physical, chemical, or biological characteristics of the air, water, or land that may be harmful to or affect the health, survival, or activities of humans or other living organisms.

Sanitary sewer — A sewer receiving and carrying liquid and water-carried wastes, to which storm, surface, or groundwater are not intentionally admitted.

Sewage — See wastewater.

Sewer — A pipe or conduit for carrying sewage, groundwater, stormwater, or surface run-off. It includes sanitary sewers, sewer drains, storm sewers, clear water sewers, storm drains, and combined sewers.

Storm sewer — A sewer that carries stormwater and surface run-off water, excluding wastewater.

Stormwater — Water from precipitation of all kinds, including water from the melting of snow and ice, groundwater discharge, and surface water.

Suspended solids — The insoluble matter suspended in wastewater that is separable by laboratory filtration.

Wastewater — Liquid wastes from buildings, containing animal, vegetable, or mineral matter in suspension or solution, together with groundwater, surface water, or stormwater as might be present; also referred to as sewage.

Wastewater pond (lagoon) — Large basin, relatively shallow, built as a wastewater treatment facility with or without aeration systems.

2. OBJECTIVES AND PERCEIVED BENEFITS OF WASTEWATER SOURCE CONTROL

Wastewater collection systems have a long history of use by residential, institutional, commercial, and industrial users to dispose of liquid and some solid wastes. The perception was that once flushed down the drain, these wastes would disappear and would not have any effects downstream. However, this is not the case, and many of the products discharged into sewers can have detrimental effects on the sewer infrastructure, the wastewater treatment processes, biosolids, sewer operators, the public, and the environment. The best way to eliminate or reduce a number of pollutants from the wastewater stream, with minimum effort, is by establishing and implementing a wastewater source control program, managing discharges into the system at the source.

There can be several objectives when establishing a wastewater source control program. These are discussed in the following.

2.1 MANAGE THE DEMAND FOR SERVICE

The expansion of sewer infrastructure, including both collection and treatment facilities, might be required due to increases in flow or pollutant loadings. Wastewater source control can lead to the postponement of works and capital investments by limiting hydraulic and pollutant loadings to the treatment plant.

An equitable distribution of costs can encourage customers to manage their waste streams. In many cases, industrial users significantly affect the operation and maintenance costs of a wastewater treatment plant. For instance, biodegradable organic loads increase the power costs for aeration, and high suspended solid loads mean more biosolid production, which needs disposal. A pricing schedule reflecting these conditions can be a means of redistributing these additional treatment costs more equitably.

2.2 PROTECT SEWER WORKERS AND THE PUBLIC

Workers maintaining the sewer system must operate in a safe environment. The discharge of flammable, toxic, or oxygen-depleting substances can be harmful to these workers. Although the public does not enter the sewers, they live adjacent to them. Protection of their security and interests is also a service expectation.

2.3 PROTECT THE SEWER INFRASTRUCTURE

Sewer infrastructures in a municipality represent millions or even billions of dollars in investments. The discharge of corrosive materials, such as acids, into sewers can cause serious damage to pipes, pumps, and associated structures. Accumulations of grease, sand, or gravel may clog pipes and lead to overflows and sewage backups. Corrective measures and repairs can be disruptive and costly.

2.4 PROTECT WASTEWATER TREATMENT PROCESSES

Wastewater treatment plants rely on biological and physical-chemical processes to biodegrade or remove contaminants. Most of these processes are sensitive to one or more wastewater parameters such as pH, temperature, toxic materials, and organic and solids overload. The negative impacts range from higher operations and maintenance costs to the complete failure of the biological processes leading to discharge violations and major costs to reinstate biological processes.

2.5 PROTECT THE ENVIRONMENT

Technically or economically, some contaminants disposed of into a sewer system cannot be removed from a wastewater stream. These contaminants pass through the wastewater processes and can be harmful to the receiving environment.

2.6 PROTECT AND IMPROVE THE QUALITY OF BIOSOLIDS

Disposal costs for biosolids produced by wastewater treatment are increasing due to higher landfill rates and more stringent regulations. Once properly stabilized, biosolids can be applied to land for beneficial purposes or marketed as a fertilizer, compost, or a soil amendment. The safe use of biosolids requires meeting the quality objectives developed to protect the public and the environment. Biosolids concentrate some contaminants in the wastewater stream, such as heavy metals and toxic organic materials. In systems such as wastewater ponds, the accumulation of some of these contaminants may lead to their classification as a hazardous material, which then prevents more useful or economical ways of biosolid processing and disposal. The reduction or elimination of these contaminants through a wastewater source control program will protect and improve the quality of biosolids.

3. WASTEWATER SOURCE CONTROL PROGRAM DEVELOPMENT

3.1 USER CHARACTERISTICS

Users of the municipal sewer system can be divided into three main classes: residential, commercial/institutional, and industrial. To develop a successful wastewater source control program, discharge characteristics and patterns for each of these user classes must be well understood.

Residential users normally account for the most flow in a sewer system. Wastewater quality characteristics from the residential sector should be well documented in terms of general pollutant parameters (BOD, suspended solids, ammonia, etc.). The contribution of hazardous or toxic materials from residential users is often difficult to estimate or trace due to the large number of residential point sources they represent.

There are industrial, institutional, and commercial activities with wastewater discharge characteristics that present potential problems to the collection and treatment systems. These include (but are not limited to):

- restaurants (large source of oil and grease, mainly in the fast food sector, that can clog sewer pipes and accumulate in pumping stations);

- dentists offices (mercury from extracted amalgams);

- car repair shops (mineral oil and grease as well as solvents); and

- dry cleaners (solvents, such as perchloroethylene, and other similar products).

Businesses in the same field of commercial activity usually have similar sewer discharge characteristics. Specific control strategies, such as codes of practice, can be developed for these commercial activities.

Industrial users are the most complex dischargers. Hydraulic and pollutant loads can vary greatly from one type of industry to another and, even within one industry, hourly or seasonal variations are not uncommon. Furthermore, the large number of materials used by industry and the diverse types of industrial products increase significantly the number of pollutants going into the sewer system. Wastewater source control strategies for the industrial sector are normally covered in sewer-use by-laws that describe the prohibited and restricted pollutants, and the conditions for issuance of discharge authorizations and permits.

3.2 Program Content

A wastewater source control program includes a number of components: by-laws, monitoring and enforcement programs, educational and awareness programs, codes of practice, wastewater rates, and pollution prevention plans.

3.2.1 By-Laws

By-laws are the most essential element of a wastewater source control program. Depending on the size of municipality or the type of sewer, one or more by-laws can govern the use of the sewers. Typically, regulations are either sewer by-laws or sewer-use by-laws.

A sewer by-law regulates the way a building sewer connection can be made to the municipal sewer system. It normally includes a description of the procedure to be followed when connecting a new building (i.e., permits, fees) as well as specific construction requirements (i.e., flow monitoring points, oil and grease interceptors). The number and type of lateral connections (sanitary, storm, or combined) are also defined in this type of by-law.

A sewer-use by-law defines the regulations applicable to discharges to the wastewater system. It is divided into sections covering definitions, the release of waste to the wastewater system, permits, monitoring, and sampling, fines and penalties, and rates.

The release-of-waste section of the by-law should define the rules/conditions for disposal of wastewater, storm and sub-surface water to sanitary, storm, or combined sewers depending on the source and pollutant content of the disposed water. Pollutants are normally divided into two broad categories:

- prohibited wastes, which refer to matter or materials that cannot be released to the sewer or may be released only under strictly limited circumstances (see Appendix A); and

- restricted wastes, which may be discharged when the concentration of contaminants is below a certain limit. In some cases, wastewaters exceeding concentration limits may be released to the sewer but are subject to overstrength charges (see Appendix B).

Industrial and commercial entities that have the potential to release restricted wastes or discharge wastewater over a certain volume or loading often need authorization or a discharge permit. These specify the terms and conditions for the discharge, including the sampling, monitoring, and reporting required to ensure compliance with the by-law.

Fines and penalties are defined for violations of by-law requirements.

Wastewater rates are usually defined in by-laws. The objective is to recover all or part of the costs associated with the collection and treatment of wastewater (methods to establish a full cost recovery rate structure are discussed in section 3.2.5). Rate structures vary from municipality to municipality. They are most often proportional to either the volume of consumed water or the volume of discharged wastewater when the latter is known. Overstrength charges can be applied for discharges of certain contaminants, such as BOD and suspended solids, over some specified limits (see Appendix C).

Some of the above information can be contained in appendices to the sewer-use by-laws. Appendices may also include various standard forms, such as permit applications and pollution prevention plans. Some by-laws also include codes of practice that have been developed for specific commercial/institutional operations. Ontario Ministry of the Environment's document entitled *The Proposed 1998 Model Sewer Use By-Law*, MOE, 1998, (http://www.ene.gov.on.ca/envision/env_reg/documents/a/pa8e0029.pdf) has some of these elements.

3.2.2 MONITORING AND ENFORCEMENT

Each municipality that adopts a sewer-use by-law should have a clearly stated enforcement policy that is properly communicated to the general public and to all users. It is particularly important in areas where one wastewater treatment plant serves more than one municipality for the sewer-use by-law and enforcement policy to be consistently applied to all system users.

Pollutant limits on discharges to sewers are normally set either in the sewer-use by-law or in the permits/authorizations issued to specific users. To ensure compliance with these limits, monitoring of the discharge is required at a certain frequency, which may be daily, monthly, quarterly, or annually. Monitoring can also provide the basis for overstrength wastewater charges.

Most major municipalities use self-monitoring and reporting of discharge characteristics by the individual dischargers. In addition, municipalities carry out, with their personnel or third parties, audit sampling and site inspections.

Non-compliance to the requirements of by-laws can be dealt with through enforcement. By-laws can be written to give the municipality the authority to assess penalties for non-compliance with the practices or concentration limits indicated in the by-law. Most municipalities prefer to work with their customers on the basis of notification and education and utilize penalties only as a last resort.

Should it be determined that a discharge is persistently non-compliant, a discharger may make application for a permit to discharge subject to entering into a compliance program. The applicant provides information (concentrations, volumes, etc.) about the non-compliant matter and outlines a program of investigation, reporting and remediation to bring the discharge back into compliance. Depending on the nature of non-compliance (threat to the wastewater system and treatment process) and the magnitude of the remediation (e.g., process changes, construction of new pre-treatment processes, etc.). Compliance programs can have remediation plans (schedules) that last for several years.

3.2.3 EDUCATION AND AWARENESS PROGRAMS

Effective wastewater source control of residential, institutional, and commercial sources needs more than having a by-law in place, because of the high number of users involved and the amount of work required. Additionally, entering a residential property, for enforcement purposes, is extremely limited under the legal system. An education and awareness program needs to be implemented to reach these users and achieve program goals.

A source control educational program must include both the quantitative and qualitative aspects of wastewater generation. Wastewater flow or quantity control is generally linked with potable water conservation programs, which promote the use of water-efficient fixtures, such as faucet aerators, low-flush toilets, and water-efficient shower heads. Further flow reduction can be achieved through information about lot drainage, the proper connection of downspouts, foundation drains and sump pumps, and the use of rainwater or stormwater for landscape irrigation. This is particularly important in areas served by combined sewers.

The quality aspect of residential, institutional, and commercial wastewater source control is mostly related to the use of hazardous household products. Educational programs must deal with the three Rs of pollution reduction:

- replace the use of hazardous products with more environmentally friendly substances;
- reduce the quantity of hazardous products bought and used; and
- recycle hazardous wastes by returning them to the proper depots and locations, or by sharing leftovers with neighbours.

Examples of information on the three Rs of hazardous wastes can be found on the City of Toronto (http://www.city.toronto.on.ca/hhw/thehome.htm) and the Greater Vancouver Regional District (GVRD) (http://www.gvrd.bc.ca/services/sewers/ source/pdf/choice.pdf) Web sites.

Educational programs should also focus on changing household habits, such as discouraging the use of food waste grinders (which increases the load flowing to treatment plants) or the disposal of sizeable quantities of cooking oil to the sewer.

While these programs mainly target the public, similar content can also be presented to commercial, institutional, and industrial employees, to promote better practices related to wastewater source control in the workplace.

Education and awareness programs can be delivered through:

- the Internet, on dedicated Web sites;
- flyers included with utility bills;
- posters in shopping malls;
- newsletters;
- school visits;
- media; and
- environmental and community groups.

Special information programs have been implemented in several cities to remind customers of the consequences of disposing both household and industrial hazardous materials (e.g. paints, solvents, acids, heavy metals) into sewers.

3.2.4 Codes of Practice

Some municipalities develop codes of practice to address wastewater issues related to the sewerage system. For example, to reduce grease buildups in the sewer system, the Greater Vancouver Regional District (GVRD) enacted a code of practice for wastewater management at food sector establishments. This code complements the district's sewer-use by-law by specifying the size, operation, and maintenance of grease interceptors to ensure compliance with oil and grease discharge limits. In co-operation with representatives from municipalities and restaurant associations, the GVRD published a booklet describing the code's requirements, and a best management practice to improve the quality of wastewater discharge as well as the efficiency of the grease interceptor installation.

3.2.5 Wastewater Rates

Wastewater rates, as part of a wastewater source control program, can:

- ensure full or partial capital and/or operation and maintenance cost recovery;
- promote a user-pay approach;
- ensure the fair allocation of treatment costs;

- reduce hydraulic and pollutant loads to the sewer system and treatment plant(s) to optimize the use of existing facilities and defer expansions; and

- encourage water efficiency.

Depending on the chosen objectives and the availability of data, rates can range from a simple flat rate for residential users to more sophisticated formulas for industrial users that integrate charges for the volume of water consumed (or discharged) with overstrength charges for surchargeable contaminants, such as BOD, suspended solids, phosphorus, nitrogen, and phenols. For some industries, paying for centralized treatment at a municipal plant may be an economic choice.

The Canadian Water and Wastewater Association (CWWA) published two documents in 1994 and 1997 on rate setting: a municipal water and wastewater rate manual and a rate primer. The CWWA (1994) provides a Canadian perspective on rate setting and promotes a simplified approach to the process. It discusses the methods and theory, underlying logic, and the processes of rate setting, and provides a fully documented rate setting software model. The CWWA approach to rate setting establishes three principal goals: full cost recovery, the equitable distribution of costs among consumers, and the efficient use of both water resources and financial resources. The basic process of rate setting is as follows.

- Determine rate setting objectives, revenue recovery goals, and water efficiency goals.

- Collect financial and operating data, such as pumpage and sales, and user records.

- Analyze the demand for service. This includes looking at billable flow volumes and service connections. Evaluate peak demands and growth.

- Analyze the costs of service. Develop cost factors. Classify and allocate costs.

- Calculate rates. Determine the total and net revenue requirements, set rate levels and develop the rate schedule.

- Evaluate and refine rates. Assess the impact on revenues, reserves, and user bills. Evaluate risk and finalize the rates.

- Secure approval from the municipal authority for the new rates.

- Implement the new rates. Launch an information campaign for users.

The rate primer from the CWWA discusses water and wastewater rates policies, and information required to establish the rates. It explains and demonstrates rate setting calculations, reviews how rate setting fits into long-term financial and capital planning cycles, and presents a brief review of the implementation process for new rates.

3.2.6 POLLUTION PREVENTION PLANS

Pollution prevention planning is an alternative approach to environmental management that seeks to avoid the production of pollutants and waste in the first place. Pollution prevention planning is a systematic, comprehensive method of identifying options to minimize or avoid the creation of pollutants or waste. The goal of pollution prevention planning is to have a facility, company or organization select the measures that are most appropriate to its specific circumstances. The P2 approach, through elimination of the causes of pollution, reflects a shift in emphasis from control to prevention.

The most widely used definition of pollution prevention (P2) is that established by the Canadian Council of Ministers for the Environment (CCME). It states that P2 is the "use of processes, practices, materials, products, or energy that avoid or minimize the creation of pollutants and waste, at the source" (CCME, 1996). Pollution prevention planning is a cornerstone of the *Canadian Environmental Protection Act, 1999.* The declaration of the Act includes the following statement: *"It is hereby declared that the protection of the environment is essential to the well-being of Canadians and that the primary purposes of this Act is to contribute to sustainable development through pollution prevention."*.

Although some entities, like the Greater Vancouver Regional District, have considered promoting pollution prevention, the City of Toronto is an example of a major Canadian city that included P2 planning requirement in its sewer-use by-law. P2 plans are required from a large number of commercial and industrial sectors.

The development of a P2 plan is a comprehensive and continual evaluation of the materials, processes, and practices involved in commercial and industrial operations. The steps involved in preparing a P2 plan are shown in Figure 3–1 (Toronto, 2002). After implementation, P2 planning requires ongoing monitoring and reassessment to ensure program objectives are being met.

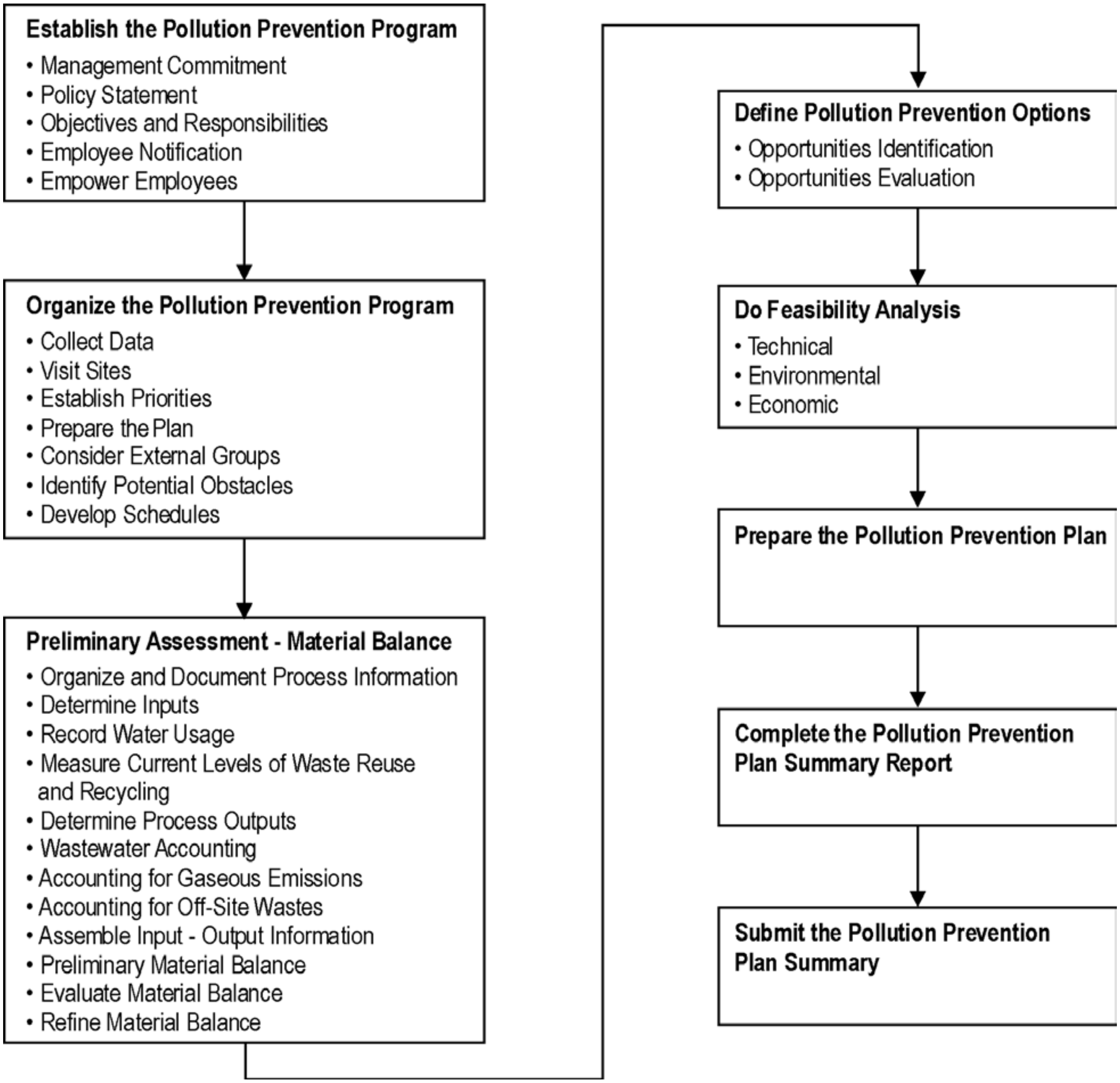

Figure 3–1: Pollution prevention (P2) plan development flow chart

4. APPLICATIONS AND LIMITATIONS

4.1 APPLICATIONS

The basic element of a source control program is the sewer-use by-law, which states what users may or may not discharge into the sewer system and gives the municipality the legal rights to enforce the by-law. Such a by-law is normally based on existing by-laws from other Canadian cities of similar size or on models proposed by provincial governments. The by-law can and should be adapted to the local context (i.e., the specific conditions of the collection and treatment infrastructure and processes, and the type and size of commercial and industrial facilities that are connected to the system). Further, the municipality must ensure it has proper jurisdiction to take enforcement actions against by-law violators. Regional harmonization should also be considered when preparing by-laws to avoid discrepancies between neighbouring municipalities and to increase effectiveness by providing consistent expectations.

The by-law should be reviewed regularly (i.e., every 10 years) to reflect new regulations on effluent and biosolids quality, and changes in technical and scientific information with respect to the various contaminants found in municipal effluents. The by-law preparation and revision process should involve the system users to facilitate a fair exchange of information and to balance views and perspectives on the new or revised requirements.

Monitoring discharges can be costly when dealing with all the toxic substances listed in sewer-use by-laws. To help wastewater managers narrow the range of parameters to monitor, the Canadian Water and Wastewater Association published the *Directory of Sources of Contaminants Entering Municipal Systems* (2001). This document can help focus pollution prevention and by-law enforcement efforts on identifying the sources of specific pollutants entering the sewer system.

4.2 RISKS AND LIMITATIONS

Due to its regulatory aspects, wastewater source control can become very costly and cumbersome for both the municipality and sewer system users. It is very important to adapt the content and the scope of the program to the size, context, and needs of each municipality while respecting regulatory requirements.

Education and awareness programs often have medium- to long-term effects, and their immediate goals are not always reached. Other voluntary programs, such as waste recycling, take a number of years before full results are realized. Projections of pollution reduction from the residential sector should be realistic and not overly optimistic.

Pollution prevention planning is a preferred approach to environmental management. Because current implementation of such plans on a large scale in

Canada is limited, the experience of the City of Toronto will be invaluable in assessing the results of such programs.

Wastewater source control must be supplemented by other programs to ensure that problems associated with pollutants are not just moved from one medium to another. For instance, hazardous waste collection and disposal should be in place to avoid shifting wastewater system problems to landfill sites.

Appendix A: Example of Prohibited Discharges into Sanitary Sewers

No person shall discharge, into wastewater facilities, sewage, or wastewater, which causes or may cause, or results or may result in:

(a) a health or safety hazard;

(b) obstructions or restrictions to the flow in the wastewater facilities;

(c) an offensive odour to emanate from wastewater facilities, and without limiting the generality of the foregoing, sewage containing hydrogen sulphide, mercaptans, carbon disulphide, other reduced sulphur compounds, amines, or ammonia in such quantity that may cause an offensive odour;

(d) damage to wastewater facilities;

(e) interference with the operation and maintenance of wastewater facilities;

(f) a restriction of the beneficial use of sludge from the municipality's wastewater facilities; or

(g) effluent from municipal wastewater facilities to be in violation of any provincial or federal acts or regulations.

No person shall discharge, into wastewater facilities, sewage, or wastewater with any one or more of the following characteristics:

(a) a pH less than 5.5 or greater than 9.5;

(b) two or more separate liquid layers; or

(c) a temperature greater than 65°C.

No person shall discharge, into wastewater facilities, sewage, or wastewater containing one or more of the following:

(a) combustible liquid;

(b) fuel;

(c) hauled sewage, hauled wastewater or leachate, except where written permission from the municipality has been obtained;

(d) ignitable waste including but not limited to, flammable liquids, solids, and/or gases, capable of causing or contributing to explosion or supporting combustion in wastewater facilities;

(e) detergents, surface-active agents or other substances that may cause excessive foaming in the wastewater facilities;

(f) sewage containing dyes or colouring materials which pass through wastewater facilities and discolour the wastewater facility or effluent;

(g) pathological waste in any quantity;

(h) material containing polychlorinated biphenyls (PCBs);

(i) pesticides;

(j) reactive materials;

(k) radioactive substances; or

(l) leachate, except where the discharger has written permission from the municipality.

APPENDIX B: EXAMPLE OF RESTRICTED DISCHARGES INTO SANITARY SEWERS

Substance	Milligrams Per Litre	Substance	Milligrams Per Litre
Aluminium, total	50	Mercury, total	0.01
Antimony, total	5	Methylene chloride	0.2
Arsenic, total	1	Molybdenum, total	5
Barium, total	5	Nickel, total	2
Benzene	0.01	Oil and grease - mineral or synthetic in origin	15
Beryllium, total	5	Oil and grease - animal or vegetable in origin	150
Biochemical oxygen demand	300	o-Xylene	0.5
Bismuth, total	5	Phenolic compounds (4AAP)	1
Cadmium, total	1	Phosphorus, total	10
Chemical oxygen demand	1000	Selenium, total	1
Chlorides	1500	Silver, total	2
Chloroform	0.05	Sulphates expressed as SO_4	1500
Chromium, total	2	Suspended solids, total	300
Cobalt, total	5	1,1,2,2 – Tetrachloroethane	1.0
Copper, total	1	Tetrachloroethylene	1.0
Cyanide, total	2	Tin, total	5
1,2 – Dichlorobenzene	0.1	Titanium, Total	5
1,4 – Dichlorobenzene	0.1	Toluene	0.01
cis - 1,2 – Dichloroethylene	4.0	Total Kjeldahl nitrogen	100
Trans - 1,3 – Dichloropropylene	0.15	Trichloroethylene	1.0
Ethylbenzene	0.15	Vanadium, total	5
Fluoride	10	Xylenes, total	1.5
Iron, total	50	Zinc, total	2
Lead, total	1		
Manganese, total	5		

Note: A reference to "total" in this table denotes total concentrations of all forms of the metal and ion including both particulate and dissolved species.

APPENDIX C: OVERSTRENGTH CHARGES OF SOME CANADIAN MUNICIPALITIES

Municipality	BOD	COD	Suspended Solids	Phosphorus	Oil and Grease	Total Kjeldahl Nitrogen	Remarks
Quebec (1)	None	$22/1000 kg over 204 mg/l	$170/1000 kg over 123 mg/l	$4,051/1000 kg over 2,0 mg/l			
Ontario (1)	$1.07/kg over 300 mg/l		$057/kg over 350 mg/l	$1.72/kg over 10 mg/l	$0.67/kg over 150 mg/l	$4.26/kg over 100 mg/l	Phenolic compounds $1.07/kg over 1.0 mg/l
Prairies (1) (1st Level)	$0.1727/kg over 300 mg/l	$0.1727/kg over 600 mg/l *	$0.1776/kg over 300 mg/l	$0.7939/kg over 10 mg/l	$0.1829/kg over 100 mg/l	$0.1777/kg over 50 mg/l	* or twice the BOD whichever is greater
Prairies (1) (2nd Level)	$0.1727/kg over 3000 mg/l	$0.1727/kg over 6000 mg/ *	$0.1776/kg over 3000 mg/l	$0.7939/kg over 75 mg/l	$0.1829/kg over 400 mg/l	$0.1777/kg over 200 mg/l	Rates apply in addition to first level
Prairies (2)	$0.526/kg over 300 mg/l		$0.499/kg over 300 mg/l		$0.747/kg over 100 mg/l		

Note: * In the case of Prairies (1), surcharge applies after the first level is reached and an additional surcharge applies if the second level is exceeded.

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